



**SENGUNTHAR ENGINEERING COLLEGE
(AUTONOMOUS)**

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
Recognized Under Section 2(F) & 3(BB) of the UGC Act, 1956
NAAC Accredited with 'A' Grade

TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU



&

**RESEARCH AND DEVELOPMENT CELL
SENGUNTHAR ENGINEERING COLLEGE**

**A PROJECT REPORT
FLOOD-GEOMORPHOLOGICAL SURVEY AND MAPPING OF
SURFACE WATER POTENTIAL & DEGRADATION STUDY FOR
TAMERABARANI RIVER STRETCH USING REMOTE SENSING AND
GIS TECHNIQUES**

**Submitted by
Dr.M.Seenirajan
Associate Professor
Department of Civil Engineering
Sengunthar Engineering College
Tiruchengode**

Ref: SEC/CIVIL/SEED/2020-21/ 1

To
The Chairman
Research and Development Cell
Sengunthar Engineering College
Tiruchengode-637211

Respected Sir,

Sub: Submission of Research Project Scheme (2020-2021) proposal – Reg.

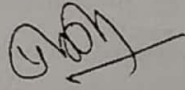
Greetings from Civil Department, Sengunthar Engineering College!

We are happy to submit our Research Project Scheme (2020-2021) proposal "Flood Geo-Morphological Survey And Mapping of Surface Water Potential & Degradation Study For Tamerabarani River Stretch Using Remote Sensing And GIS Techniques" under the guidance of Dr.M.Seenirajan, HoD, Department of Civil Engineering. Here with we have enclosed with Research Project Scheme (2020-2021) proposal form for your kind perusal.

We are expecting your kind consideration towards this proposal.

Thanking You

Your's faithfully,


(HoD CIVIL)

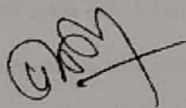
Encl:

1. Research Project Scheme (2020-2021) proposal.

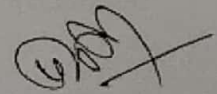
| RESEARCH PROJECTS SCHEME (2020-2021) - PROPOSAL | | |
|--|---|---|
| 1 | Name of the Principle Investigator | : Dr.M.Seenirajan |
| | Department / Designation | : Civil Engineering / HoD |
| | Institutional Address | : Sengunthar engineering college (Autonomous), Tiruchengode-637205, Namakkal (Dt) |
| | Phone No. & Mobile No. | : 04288-255716 (College) , 9952562199(Guide) |
| 2 | Project Title | : Flood Geo-Morphological Survey And Mapping of Surface Water Potential & Degradation Study For Tamerabarani River Stretch Using Remote Sensing And GIS Techniques |
| 3 | Sector in which your Project proposal is to be Considered | : Engineering and Technology |
| 4 | Project Details | : Separate sheet to be attached |
| 5 | Has a similar project been carried out in your college / elsewhere? If so furnish details of the previous project and highlight the improvements suggested in the present one | : No, We are implementing new innovative project. |

CERTIFICATE

This is to certify that Dr.M.Seenirajan, HoD, Department of Civil Engineering, is a bonafide of our college and it is also certified that utilization certificate and final report will be sent to the Research and Development Council after completion of the project by the end of December 2021.



Signature of the Principle Investigator



Signature of the HOD

PROJECT DETAILS

FLOOD GEO-MORPHOLOGICAL SURVEY AND MAPPING OF SURFACE WATER POTENTIAL & DEGRADATION STUDY FOR TAMERABARANI RIVER STRETCH USING REMOTE SENSING AND GIS TECHNIQUES

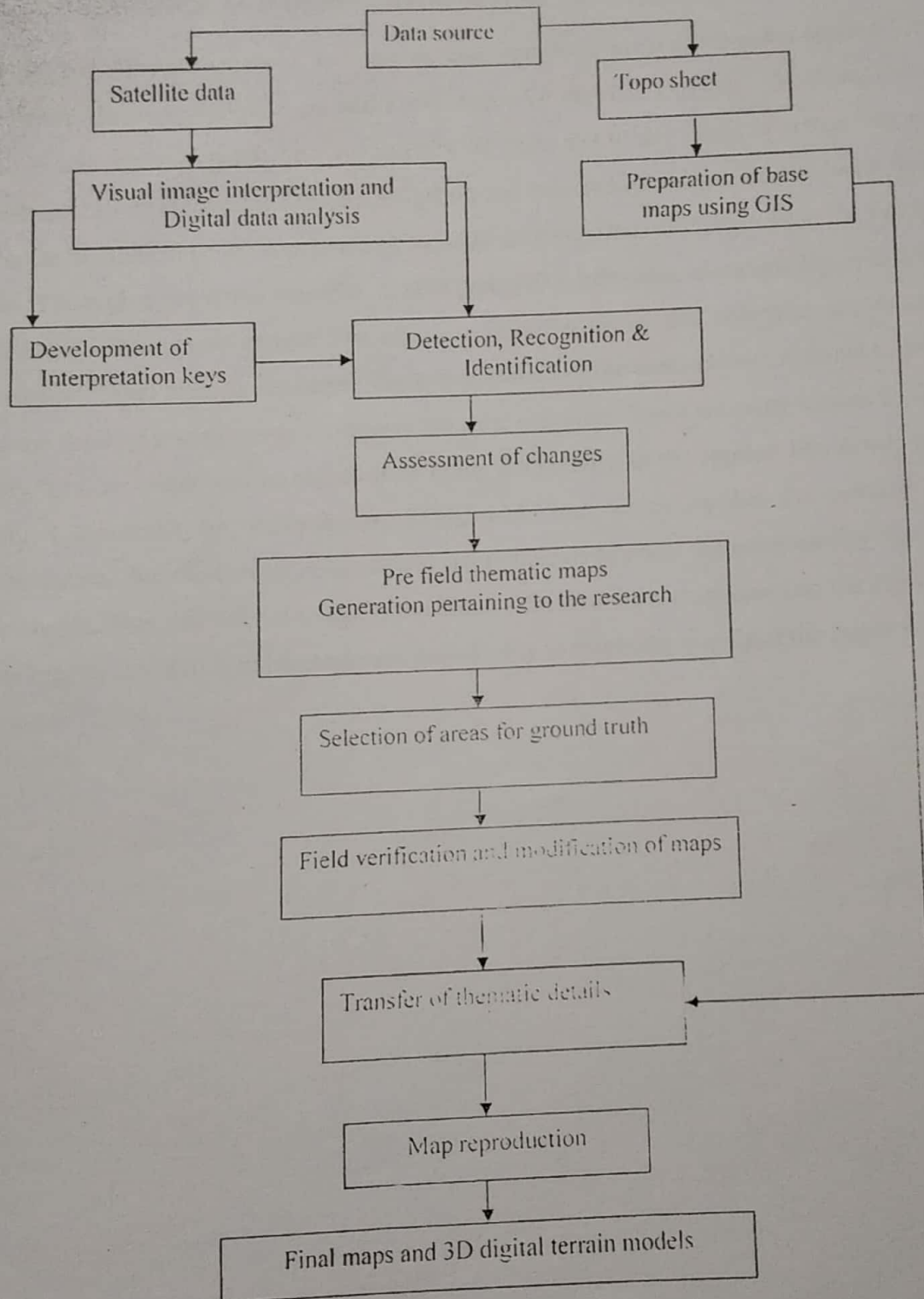
INTRODUCTION

Water pollution is one the crucial ecological problems in India. It is estimated that about 70% of all available water sources in India are polluted. Untreated industrial waste disposal in large quantity pollutes the river water. Every day about 1700 liters of industrial waste is discharged in to Tamerabarani River alone. Rapid urbanization and industrialization has contaminated the river water quality. Discharge of sewage to river or the sea is a common practice in towns and cities located along rivers or on the coast. Out of 103 municipalities in the state of Tamilnadu 45 of them discharge the domestic waste water into rivers and streams. Only five municipalities are provided with sewerage facilities and 14 partially. This covers only 12.35% of the municipal population. On an average the total waste water discharged by the 103 municipalities is 216.9 MLD. As per a study conducted in 1988 by the Central Pollution Control Board, the sewerage system in six of the nine cities/towns studied by it, shows that only three have an underground drainage system-Chennai, Tirunelveli. The waste water is discharged into the Tamerabarani River in Thoothukudi and Tamerabarani River (a tributary of Tamerabarani) in Tirunelveli, where as Thoothukudi discharges into the sea.

OBJECTIVE

- To create geo-spatial digital database related to drainage, topography, lithology and slope with the help of satellite imageries and ground data using GIS
- To create the digital elevation model of the study area
- To assess the magnitude of pollution in the surface water for the study region.
- To incorporate water quality data generation by collection and analysis of samples in the Tamerabarani River in Tirunelveli region
- To identify, locate and quantify the impacts of industrial waste disposal into the river stretch.
- To identify the problem areas and to suggest water management action plans.

METHODOLOGY

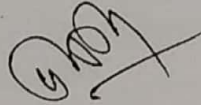


SOCIAL RELEVANCE AND USEFULNESS OF THE PROJECT

This project will surely make us to know the contamination levels of the major surface water source of the Erode, Bhavani, Pallipalayam and Karur region i.e the river Cauvery. The living community in the above said region depends on river cauvery for their day to day needs of water. The water from Tamerabarani River is used for drinking, irrigation and industrial processes. So, the water quality in the river has to be studied, which is polluted by the untreated industrial discharges from the Erode, Bhavani regions. The region has many tanneries, textile processing industries, electroplating industries, dyeing industries which are wide spread. The effluents from the above said industries are found to reach Tamerabarani River after its discharge. The concentration of the contaminants is found to be very high during the summer season, when the flow in the river is limited. There are many intakes in the banks of Cauvery to draw water and to supply it to living community in the regions like Erode city, Karur, Bhavani, Kumarapalayam, Pallipalayam, Modakurichi etc., which supplies the contaminated water from the source. So, the current research will surely help us to know the water quality that is supplied for the people. This will help us to assess the health effects of the contaminants on the drinking people. So, this type of research is to be conducted periodically to assess the quality of the major water sources in the state.

BUDGET

| PROJECT BUDGET | | | |
|--|------------------------------|------------------|-------------------------------|
| S.NO | NAME OF THE COMPONENT | Rate (Rs) | PRICE OF THE COMPONENT |
| 1 | Components | L.S | 6500.00 |
| 2 | Fabrication / Service | L.S | 2500.00 |
| 3 | Testing | L.S | 1000.00 |
| 4 | Conveyance | L.S | 2000.00 |
| TOTAL PROJECT BUDGET (A) | | | 12000.00 |
| In kind Donation(B) By our college | | | - |
| Battery | | 1 | - |
| In kind Donation Subtotal (B) | | | - |
| Required Amount for the project(A-B) | | | Rs.12,000.00 |



Signature of the Principle Investigator



Signature of the HOD

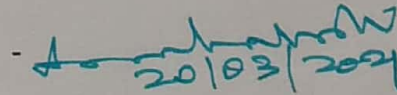
PROJECT EVALUATION REPORT

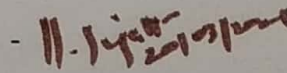
| | |
|---|--|
| Name of the Investigator | Dr.M.SEENIRAJAN |
| Name of the Co-Investigator | Mr.S.Prabu |
| Name of the Department | Civil Engineering |
| Title of project | Flood- Geomorphological survey and mapping of surface water potential & degradation study for tamerabarani river stretch using remote sensing and GIS techniques |
| Recommendation of the evaluation committee (Recommended/Revision/Not Recommended) | Recommended |
| Financial allocation recommended | Rs. 12,000.00 |

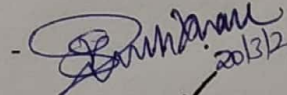
| Sl. No. | Head | Amount in INR |
|---------|--|---------------|
| 1 | Testing the water in field | 6500.00 |
| 2 | Testing the water sample in private laboratory | 2500.00 |
| 3 | Testing of river stretch using remote sensing and GIS techniques | 1000.00 |
| 4 | Travel Expenses | 2000.00 |
| | Total | 12,000.00 |

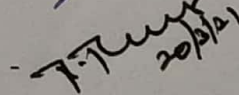
Evaluation Committee Members

1. Dr.C.Venkatesh - Principal
2. Dr. B.Sujatha - Dean(Academics)
3. Dr.P.Rameshkumar - Dean (R&D)
4. Dr.P.Ponmurugan - Head (R&D)

- 
20/03/2021

- 
20/03/2021

- 
20/3/21

- 
20/3/21

Flood- Geomorphologic survey and mapping of surface water potential & degradation study for Tamerabarani river stretch using remote sensing and GIS techniques

| Sl. No. | Head | Components /Description |
|----------------|--|---|
| 1 | Testing the water in field | Water testing kit: PH paper, Chlorine liquid, Calcium powder, Sodium liquid, Potassium liquid, Chromium liquid. |
| 2 | Testing the water sample in private laboratory | Iron Analysis, Sodium Analysis, Potassium Analysis, Chromium Analysis and Turbidity Analysis. |
| 3 | Testing of river stretch using remote sensing and GIS techniques | Collecting the Satellite data and River map data |
| 4 | Travel Expenses | 1. To get water samples 2. For testing of water samples in laboratory. |



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NAAC Accredited with 'A' Grade

TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU



RESEARCH & DEVELOPEMENT CELL

Submitted to Correspondent sir Approval

Ref: SEC/R&D/2020-2021/R/001

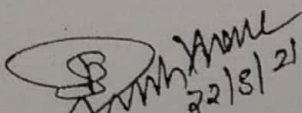
Date: 22.03.2021

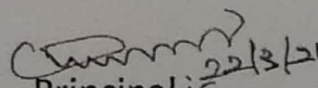
Sir,

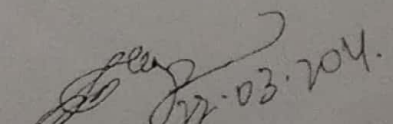
Sub: Requisition for permission to grant SEED money -Reg

The Research & Development cell of our college had selected the following projects to grant SEED money to implement the proposals submitted. The principal investigator has asked to carry out their work as mentioned in their report.

| Sl.No | Title of the Project | Name of the Principal Investigator | Amount |
|--------------|--|------------------------------------|------------------|
| 1 | Flood geo-morphological survey and mapping of surface water potential and degradation - study for tameradarani river stretch using remote sensing and gif techniques | DR.M.SEENIRAJAN | 12000.00 |
| 2 | LICENSE ELIGIBILITY MEASUREMENT SYSTEM | Mr.K.ASHOK KUMAR | 12000.00 |
| 3 | RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IOT | Dr.P. RAMESH KUMAR | 12000.00 |
| 4 | DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM | Dr.K.UMADEVI | 13000.00 |
| 5 | DESIGN AND DEVELOPMENT OF SMARK THREAD MILL BIKE | Mr. P.JAGADEESWARAN | 12000.00 |
| Total | | | 61,000.00 |


22/3/21
Dean(R&D)


22/3/21
Principal


22.03.2021
Correspondent

VOUCHER

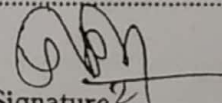
Date : 28.3.21

Dr. M. SEENI RAJAN.

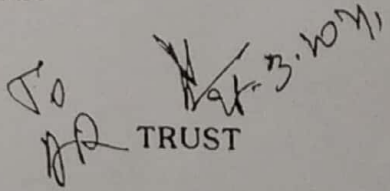
| Particulars | Rate | | Nos. | Amount | |
|-------------------------------|------|----|------|--------|----|
| | Rs. | P. | | Rs. | P. |
| Implementing seed money | | | | 12,000 | 00 |
| Total Expenditure | | | | | |
| (-) Advance Paid on..... | | | | | |
| Balance to be refunded / paid | | | | - | |

Received / Refunded Rs. : Twelve thousand only.

| | | |
|-----------|------------|--------|
| PREPARED | CERTIFIED | PASSED |
| Staff I/C | Supervisor | A.O. |


 Signature

PRINCIPAL

To

 TRUST

Sengunthar Engineering College
(Autonomous)
Tiruchengode

UTILISATION CERTIFICATE - (2020-2021)

Name of the Scheme under which the amount was sanctioned under the Research promotion scheme of Sengunthar Charitable Trust

| Sl. No | SCT Sanction Order/Letter No. & Date under which the amount was sanctioned | Amount (Rs.) | Remarks |
|--------|---|--|---|
| 1. | SEC/R&D/2020-21/003 dated 10.12.2021 | Rs 12,000 (Rupees Twelve Thousand Only) | Certified that out of Grant-in-Aid of Rs 12,000 (Rupees Twelve Thousand Only) sanctioned by the SCT during the financial year Rs. 12,000 has been utilized for the purpose for which it was sanctioned and the balance of Rs. 0 remained unutilized at the end of the year. |

Certified that I have satisfied myself that the conditions on which the amount was sanctioned have been duly fulfilled and that I have exercised that the money was actually utilized for the purpose for which it was sanctioned.



Signature of the Principal Investigator



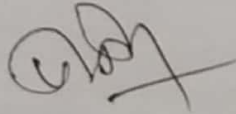
Signature of Head of the Institute

Place: Tiruchengode

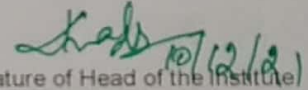
Date: 10.12.21

FORMAT FOR RECEIPT AND PAYMENT ACCOUNT

| Sl. No. | Receipt | Amount (Rs.) | Sl. No. | Payments | Amount (Rs.) |
|---------|--------------------|--------------|---------|-----------------|--------------|
| 1 | To Opening Balance | 12000 | 1 | Components | 8100 |
| | | | 2 | Implementations | 2000 |
| | | | 3 | Testing | 1000 |
| | | | 4 | Conveyance | 900 |
| | | | | Closing Balance | 0 |
| | Grand Total | 12000 | | Grant Total | 12000 |



Signature of the Principal Investigator



Signature of Head of the Institute

Place: Tiruchengode

Date: 10.12.21

SENGUNTHAR ENGINEERING COLLEGE

DEPARTMENT OF CIVIL ENGINEERING

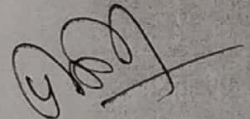
STATEMENT OF ACCOUNT

Flood- Geomorphological survey and mapping of surface water potential & degradation study for tamerabarani river stretch using remote sensing and GIS techniques

| S.NO | NAME OF THE COMPONENT | CREDIT (Rs) | DEBIT(Rs) |
|---------------------------------------|--|---------------------|--------------|
| 1 | Testing the water in field | | 6500.00 |
| 2 | Testing the water sample in private laboratory | | 2500.00 |
| 3 | Testing of river stretch using remote sensing and GIS techniques | | 1000.00 |
| 4 | Travel Expenses | | 2000.00 |
| Total | | | Rs.12,000.00 |
| SCT- Seed Money/Grand Received | | Rs.12,000.00 | |
| Balance | | | Nil |



Signature of the Guide



Signature of the HOD



ASIKHA VISHWAS ASSOCIATES
Er.C.R.Sriprasannarajh., M.E (struct)

Consulting Civil & Structural Engineers
279a, Kongumangur 4th street, Annar Road,
Karamnathampatti, Coimbatore - 641 659

Cell: +919865842375, Email: crs@prasannarajh@gmail.com

Reg No: PE/00095/18

Coimbatore/LPA/SE/GR-I/19/06/014

To
Senguthar Engineering College,
Tiruchengode-637 205.

23.04.2021

INVOICE BILL-1

Sub: Flood Geo -Morphological Survey and Mapping of Surface Water Potential and related Studies -reg

| S.No | Description of work | Rate (Rs) | Amount (Rs) |
|------|-----------------------|-----------|------------------|
| 1. | Components | LS | 6500.00 |
| 2. | Fabrication / Service | LS | 2500.00 |
| 3. | Testing | LS | 1000.00 |
| 4. | Conveyance | LS | 2000.00 |
| | Total | | 12,000.00 |

(Rupees Twelve Thousand only)

With reference to the above subject, I here by sending an invoice for payment. Kindly
Make the Payment to my SBI Account at the earliest.

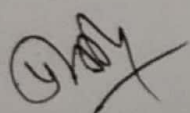
SBI Bank - A/c Name C.R.Sriprasannarajh, A/c No: 31176748738, Saravanampatti
branch, IFSC Code SBIN0011061, Coimbatore -641035.

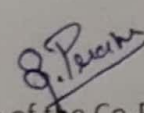
Thanking You,
With kind regards

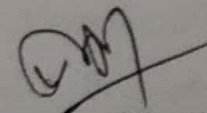
C.R.Sriprasannarajh

PROJECT COMPLETION REPORT

| | | |
|-----|---|---|
| 1 | SMS Reference No | SEC/R&D/2020-2021/R/001 |
| 2 | Title of research project | Flood Geomorphological survey and mapping of surface water potential & degradation study for Tamerabarani river stretch using remote sensing and GIS techniques |
| 3 | Name of the Principal Investigator | Dr.M.Seenirajan |
| 4 | Name of the Co-Investigator | Mr.S.Prabu |
| 5 | Name the Department | Civil Engineering |
| 6 | Effective date of starting of the project | 22.03.2021 |
| 7 | Grant approved and expenditure incurred during the period of the report | |
| 7.1 | Total amount approved | Rs.12,000.00 |
| 7.2 | Total expenditure | Rs.12,000.00 |
| 8 | Report of the work done: (Please attach a Brief objective of the project: i. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication or communicated) ii. Has the progress been according to original plan of work and towards achieving the objective if not, state reasons iii. Has the project been submitted for external funding, if so give details | i. Attached Report ii. Yes iii. No |
| 9 | Please indicate the difficulties, if any, experienced in implementing the project during SMS. | No |
| 10 | Outcome of the project | Not yet publish |


Signature of the Principal Investigator


Signature of the Co-Principal Investigator


Signature of the Head

ABSTRACT

Anthropogenic influences as well as natural processes degrade surface water quality, and impair their use for drinking, industrial, agricultural, recreation or other purposes. Due to spatial and temporal variations in water chemistry a monitoring programme that will provide a representative and reliable estimation is necessary. Solid and liquid wastes emanating from the industrial activities are the inevitable by-products of manufacturing process. These wastes contain toxic chemicals such as chromium salts, sul-fides and other substances including heavy toxic trace metals. A number of natural and anthropogenic sources produce heavy metals. People are becoming more aware of the complexity of the nature and the delicate balance that exist within the global ecosystem. The discharge of effluents and associated toxic compounds into aquatic systems represents an ongoing environmental problem due to their possible impact on communities in the receiving aquatic water and a potential effect on human health. Urbanization increases in population density and the intensification of agricultural activities in certain area is among the main causes of water pollution.

Tamerabarani River is one of the significant sources of water supply for domestic, agricultural and industrial usage in Tamilnadu. In spite of large scale utilization of the river water, poor water management has resulted in large scale degradation of the quality of water. The study area lies between N 8°42' and E 77°28' along the river course.

The present work aims to study the surface water quality in the region, thereby to assess the suitability of water for drinking and the extent of deterioration. Spatial variation of various surface water quality parameters will be studied using Geographical Information System (GIS). The application of GIS techniques will offer a better understanding of water quality and ecological status of studied systems, allowing

identification of possible factors/sources that influence water systems, and provides a variable tool for reliable management of water resources as well as rapid solutions on pollution problems. The data obtained could be subjected to identify possible sources of contamination and to estimate the contributions of possible sources of concentration of determined parameters.

DETAILS OF THE PROJECT

(i) Introduction

Water pollution is one the crucial ecological problems in India. It is estimated that about 70% of all available water sources in India are polluted. Untreated industrial waste disposal in large quantity pollutes the river water. Every day about 1700 liters of industrial waste is discharged in to Tamerabarani River alone. Rapid urbanization and industrialization has contaminated the river water quality. Discharge of sewage to river or the sea is a common practice in towns and cities located along rivers or on the coast. Out of 103 municipalities in the state of Tamilnadu 45 of them discharge the domestic waste water into rivers and streams. Only five municipalities are provided with sewerage facilities and 14 partially. This covers only 12.35% of the municipal population. On an average the total waste water discharged by the 103 municipalities is 216.9 MLD. As per a study conducted in 1988 by the Central Pollution Control Board, the sewerage system in six of the nine cities/towns studied by it, shows that only three have an underground drainage system-Chennai, Tirunelveli. The waste water is discharged into the Tamerabarani River in Thoothukudi and Tamerabarani River (a tributary of Tamerabarani) in Tirunelveli, where as Thoothukudi discharges into the sea.

The Central Pollution Control Board has classified industries which could cause a high degree of pollution as "Red" industries. The study report by Stanley Associates shows that there are altogether 3,226 industries in the state but waste water

data is available only for 2,115 industries. An estimated 6,03,890 m³ of effluents are generated by all the 2,115 industries. The foregoing overview of the Indian environment unmistakably reveals that the degradation and water contamination is clearly visible, which fails to provide clean water for livelihood. Several attempts have been made to regulate/control the quality of effluents that are discharged from waste generating industries into our water systems. This study is an interdisciplinary research designed to investigate all possible anthropogenic impacts on the water quality of the Tamerabarani River in the study area.

(ii) Origin of the Problem

Papanasham has a cluster of about 70 textile units. The small units generate 300 m³ of effluent per day which is discharged into the Gadanathi River, Tamerabarani River and Marudur canal. In the long run, this may result in reduction of dissolved oxygen and affect aquatic life in the main stream rivers. The biota in the local streams is seriously affected by the coloured effluent. Also, more than 60 tannery units are located in the western part of Tirunelveli town. A majority of them carry out processing of hides which requires a considerable amount of water. Over 90% of the water is discharged as waste water, which amounts to 2,800m³/d. Future expansions of the cluster will likely generate waste water in the range of 7,500 m³/d. Of the 60 units, 40 adopt vegetable tanning, 10 chrome tanning and other operations. The effluents from various Paper mills are discharged to nearby drains which finally join water quality downstream on the Tamerabarani. The chromium bearing effluents are toxic to the aquatic biota including fish. The organic constituents and sulphides are likely to affect aquatic ecosystems, through toxic effects and oxygen depletion. The TDS and the chromium in the effluent may affect the top soil quality when disposed of on the land. The tanneries have caused immense damage to the ground and surface water in the town.

Monitoring these small scale units and providing treatment plants becomes very

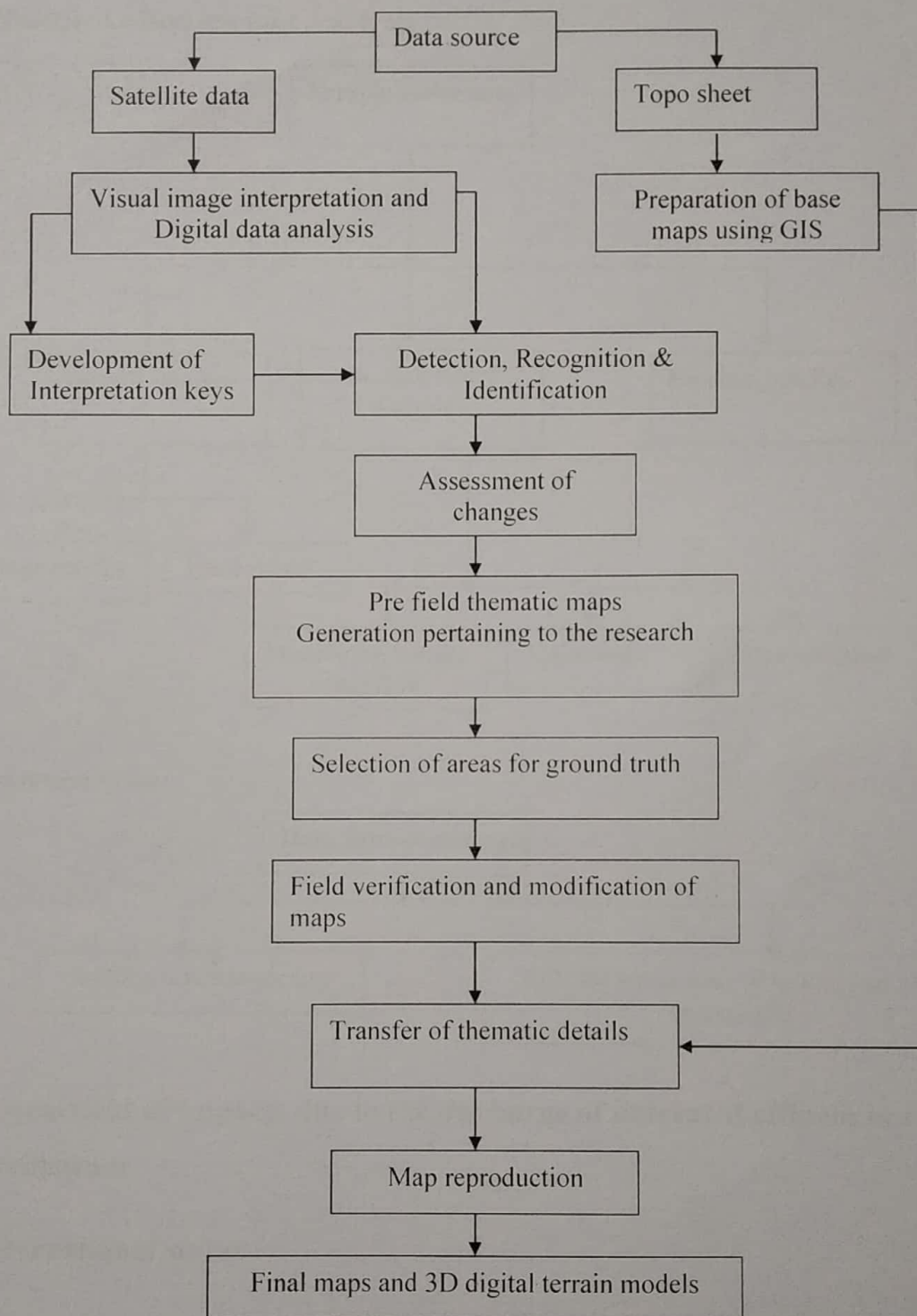
difficult. Several industrial units are located in clusters. In such area, effluent treatment facilities are either installed or under various stages of construction. These industries are mostly tannery and textile units. Hence, there is a need to monitor the surface water quality in the Tamerabarani River which is being used as the domestic water source in Erode region.

(iii) Objectives

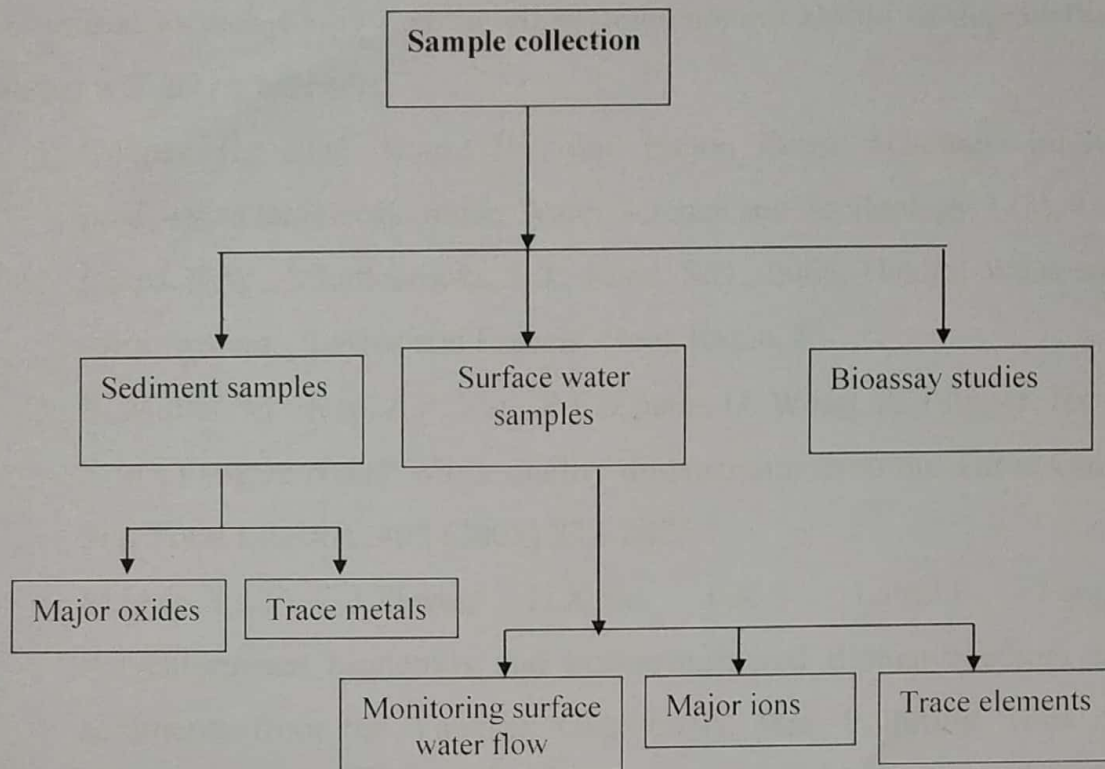
- To create geo-spatial digital database related to drainage, topography, lithology and slope with the help of satellite imageries and ground data using GIS
- To create the digital elevation model of the study area
- To assess the magnitude of pollution in the surface water for the study region.
- To incorporate water quality data generation by collection and analysis of samples in the Tamerabarani River in Tirunelveli region
- To identify, locate and quantify the impacts of industrial waste disposal into the river stretch.
- To identify the problem areas and to suggest water management action plans.

(iv) Methodology

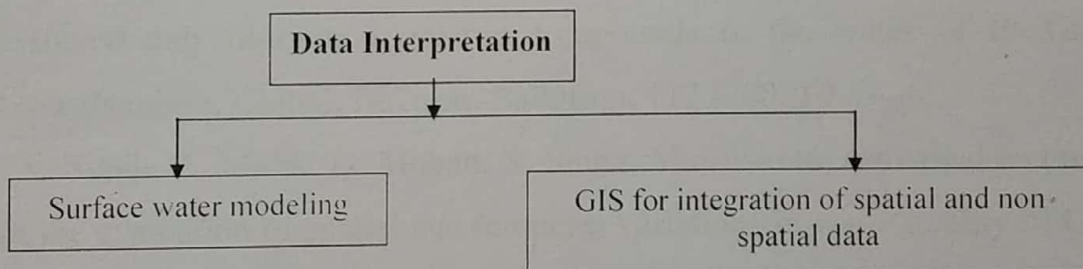
(a) Preparation of Thematic Maps



(b) Sample Collection and Analysis



(c) Data Interpretation



(d) Assessment of Impacts due to the discharge of untreated effluent in river Tamerabarani.

(v) International status

Researchers have studied the surface water quality changes and have concluded that the use of all types of satellite and decentralized systems will become critical in the future. They have reported that sustainable practices have to be

followed in water usage discharge of effluents into natural water courses have to be minimized in such a way that the ecosystems natural ability of degradation of these wastes will not be exceeded.

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(vi) National Status

Many researches have reported that the use of remote sensing data is critical to evaluate the spatial and temporal variations in water quality and quantity of surface water.

8. P. Kunwar Singh, M. Amrita, M. Dinesh, S. Sarita, Multivariate statistical techniques for the evaluation of spatial and temporal variations in water quality of Gomti river (India): a case study. *Water Research*, available online from 8th September 2004.
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11. K. Shivkumar, A.K. Pande, G. Biksham, Toxic trace element pollution in ground-waters around Patancheru and Bolaram industrial areas, Andhra Pradesh, India: a graphical approach, *Environmental Monitoring and Assessment* 45 (1997) 57-80.
12. NEERI, A report on Patancheru industrial area. National Environmental Engineering Research Institute, Nagpur, India, 1989. 85 pp.
13. A.K. Krishna, et al., Assessment of heavy metal pollution in water using multivariate statistical techniques in an industrial area: A case study from Patancheru, Medak District, Andhra Pradesh, India, *Journal of Hazardous Materials*. (2009).

(vii) Year wise plan of work and targets to be achieved.

First Year Work Plan:

- (i) Collection of Literature - 3 months
- (ii) Identifying the sources and collection of materials - 1 month
- (iii) Preparation of various thematic maps from collected data
& satellite imageries using GIS. - 2 months
- (iv) Field work including Surface water sample collection during
March (post monsoon) & June (pre monsoon) period and
testing for identification of trace metals, major ions etc., - 6 months

Second Year Work Plan:

- (v) Analysis of collected samples for Major ions
& Heavy metals. - 3 months
- (vi) Preparation of charts, diagrams, correlation matrices, spatial
and seasonal variation contour maps. - 3 months
- (vii) Developing Models - 6 months

Study area

The study area was located in the steep slope terrain surface of the Western Ghats with the geographical extent from $77^{\circ} 5039.0300E$ to $77^{\circ} 31020.90800E$ longitude and from $8^{\circ} 13042.01900N$ to $8^{\circ} 34011.97400N$ latitude. The length of the sub-basin from the high end point to the river mouth was 42.78 km with an areal extent of 745 km². The range of elevation is from 1,816 m to 1.2 m within the short length is produce the sub-basin system as steep slope terrain in nature (Fig. 1). This area consists of River Tamiraparani as the main drainage system, which originates from the peak of the Pothigai Hills on the southwestern slopes of Western Ghats from elevation of 1,725 m above mean sea level (MSL). However, the major tributaries, namely Kodayar, Kalikesanar, Kallar and Chittar, flow from the different parts of Western Ghats and join the main channel. Three major reservoirs, namely Kodayar,

Pechiparai and Perunchani, are located at elevations of 1,816, 131 and 100 m, respectively. This sub-basin area consists of three different types of landforms such as highland dense forest, middle gentle slope agriculture and plantation and lowland coast and estuary at the mouth of the river. The general climatic pattern of this area is sub-tropical. The temperature annual optimum level ranges from 23 to 27 °C and two types of monsoons such as south-west monsoon during June to September and north-east monsoon during October to December prevail over the area. The monsoon rainfall is the main source of water for the surface and sub-surface storage sectors and ranges between 80 and 241 mm. The maximum rainfall occurs during the north-east monsoon (October and December) periods.

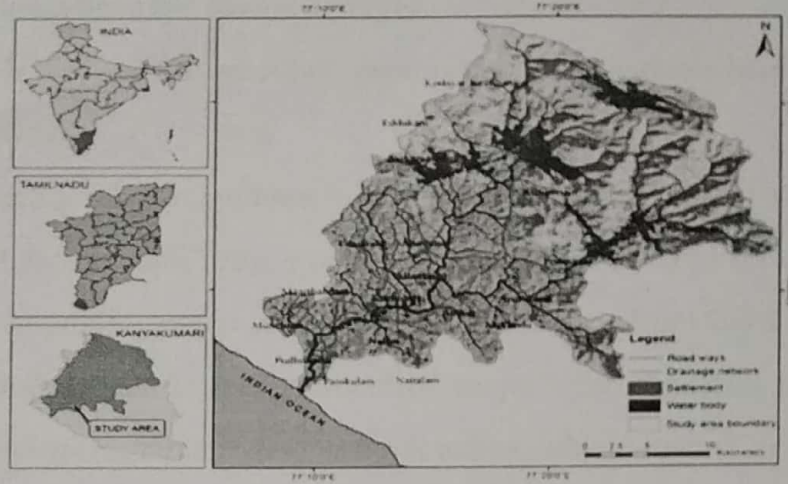
Materials and methods

The morphometric parameters of drainage basin such as number of stream segments, stream order, drainage pattern, sub-basin length, perimeter and area were delineated from the ASTER DEM (30 m) data and verified with Survey of India topographical map (1:25,000). These parameters are involved in computing the morphometric characteristics such as bifurcation ratio, drainage density, stream frequency, form factor, circulation ratio, relief ratio, overland flow and hypsometric behavior using various mathematical equations in the GIS environment. Moreover, the slope and relief of the area were extracted from the same data source using spatial analyst tool in ArcGIS 10.2 software. The thematic layers, namely land use/land cover and geomorphology, were prepared from Landsat ETM ? geo-coded data (30 m) based on digital interpretation technique using ERDAS Imagine 9.1 software. The regional geological settings were interpreted with their lithological characteristics from the district resource map published by the Geological Survey of India using the GIS software.

Extraction of drainage network

Delineation of drainage networks within the catchment can be achieved using traditional methods such as topographical maps or field observations. The major drawback in the traditional approach is the tedious effort needed to examine all stream networks from field observations, due to their extent over a vast area (Rinaldo et al. 1998; Ozdemir and Bird 2009; Bhagwat et al. 2011). In some cases, the extent and shape of stream segments, mainly in the inaccessible area, involve subjective judgment by the cartographer (Tarboton et al. 1991; Gurnell and Montgomery 1999; Maidment 2002). In recent years, the automatic extraction of drainage networks from DEM data sources is quite easy using the GIS software program made on the concept of the D8 (multi-direction method) method (Martz and Garbrecht 1992; Maidment 2002; Ozdemir and Bird 2009; Ahmed et al. 2010; Muralikrishnan et al. 2013). In this study, the hierarchical orders of the drainage networks were derived from the ASTER DEM (30 m) based on the D8 (multidirection method) method using Hydrology Tool in ArcGIS software (Band 1986; Morris and Heerdegen 1988; Tarboton et al. 1991; Ahmed et al. 2010). The precision of the DEM was enhanced by removing the pixel-based errors such as sinks and peaks; this is also used to eliminate discontinuities in the drainage network. The stream segments were extracted from the filled DEM based on Strahler (1964) stream ordering system. Mapping of relatively high accurate drainage network from the DEM follows sequences of systematic GIS functions such as filling pixels, computing flow direction and flow accumulation and then computing the contributing area from where water drains into an outlet grid cell (Wilson and Gallant 2000; Tarboton and Baker 2008). In this analysis, the threshold value of 0.5 was applied to the grid for extracting the drainage network from DEM and then it was verified with the Survey of India topographical map to check the reliability of the drainage pattern.

Fig. 1 Location of the study area



Analysis of DEM provides the flow direction of streams using eight-direction (D8) pour point model in which surface water drains out from the surrounding eight pixels into one (Tarboton et al. 1991; Fairfield and Leymarie 1991; Maidment 2002; Muralikrishnan et al. 2013). The D8 model algorithm determines the flow direction based on water flow from a given cell into only one adjacent cell. Flow accumulation is the next step in the drainage network extraction modeling. Here, the flow accumulation was calculated from the flow direction raster by assigning a threshold of 100 pixels to determine the stream network using raster calculator tool in ArcGIS software. In which, the pixels of flow direction raster were assigned with the value equal to the number of pixels drain the water through a given pixel which involved in the flow accumulation (Ahmed et al. 2010). Furthermore, the flow accumulation raster was used to generate a drainage network based on the flow direction of each cell. The drainage layer was extracted from the accumulated pixels, which have more than or equal to a threshold of 100 pixels using raster to feature conversion tool. Similarly, the sub-basin boundary was delineated by fixing the pour point in the outlet.

Preparation of geo-database for thematic layer

The thematic layers such as geology, geomorphology, land use/land cover and drainage network were obtained from various mapsources. At first, the digital source of maps were georeferenced with UTM-WGS 84 projection and coordinate system using ground control points (GCPs) observed from the Survey of India topographical map (scale 1:25,000) and also from the benchmarks located along the study area. These georectified maps were digitized to produce thematic layers with the attribute database including object name, area extent, perimeter, etc., using ArcGIS software.

Computation of morphometry parameters

In the present study, morphometric measurement was performed in three aspects: (1) linear (2) areal and (3) relief, using defined mathematical equations (Table 1). In the linear aspect of quantitative analysis, the linear structures such as length of the main channel, elongated length of sub-basin, stream hierarchical orders, bifurcation ratio, length of overland flow, stream length ratio and mean length of streams were measured to evaluate the linear morphometric characteristics of the sub-basin. In the areal aspect of analysis, sub-basin area, drainage density, stream frequency, circulatory ratio, elongation ratio and form factor were measured. Relief ratio, relative relief and slope range were estimated under the relief aspect. Primary measurements such as stream number and its length, subbasin area, sub-basin width, sub-basin elongated distance and sub-basin perimeter were derived from the thematic layers to evaluate the complex morphometric characteristics of the sub-basin.

Hypsometric analysis

In the present study, hypsometric analysis was performed using ASTER DEM data (30 m) obtained from GLCF (Global Land Cover Facility), USA, for the year 2010. The georeferenced DEM was analyzed to extract the basin area and relief or elevation range using the spatial analyst module of ArcGIS software. The DEM was

sliced into ten classes of horizontal cross-sectional area based on the elevation breakpoints using add-on tool to Arc GIS software, namely Hypsometric Toolbox, scripted and customized by Jerry Davis (2010), to calculate the proportional area of the basin with respect to elevation for each class in the attribute table. This tool facilitates determining the values of cumulative distribution of area and normalized elevation from the above-calculated values for hypsometric curve preparation (Sarangi et al. 2001). The cumulative area is derived from the ratio between the total area of the sum of the individual basin (A) and the segment of basin area (a) above a particular contour elevation (h), whereas normalized elevation is the ratio between total elevation of the basin (H) and the elevation on either side of a particular contour line. In this analysis, the hypsometric curve is obtained by plotting the value of normalized cumulative area (a/A) in x axis and normalized elevation (h/H) in y axis with the scale ranging from 0 to 1. Furthermore, the ratio of a/A and h/H always ranges from 0 to 1, in which the value 0 of the normalized cumulative area is denoted at the highest point (where h/H is equal to 1) and the value 1 at a lower point of the basin. The hypsometric integral of the basin is derived from the hypsometric curve using the mathematical equation proved by Pike and Wilson (1971). It is described as the ratio of integral value equal to the range of mean elevation and minimum elevation ($E_{\text{mean}} - E_{\text{min}}$) divided by the range of maximum and minimum elevation ($E_{\text{max}} - E_{\text{min}}$) of the basin. Thus, the value of HI (Hypsometric Integral) is denoted as the number of classes that coarsely summarizes the relief of the basin.

Denudation rate estimation

The geomorphic quantitative analysis of the denudation process addresses the tectonic erosional activities in the catchment area by climatic and terrestrial processes (Ciccacci et al. 1980). In this analysis, the estimation of denudation rate is performed using morphometric parameters such as basin area, length and number of stream segments and drainage density obtained from the Survey of India topographical maps

(1:25,000) and ASTER DEM (30 m) data source by integrated GIS-aided topographic calculation techniques. In recent studies of denudation rate estimation, many researchers have used these parameters to calculate the hierarchical anomaly density (G_a) and hierarchical anomaly index (D_a) for estimation of denudation (T_u) rate (Tokunaga 2000; Del Monte et al. 2002; Della Seta et al. 2007; Gioia et al. 2011; Bahrami 2013). The density parameter (D) was derived from the ratio of stream length and basin area (Horton 1945). Hence, the density value exhibits the characters of the drainage network, such as length of the stream segments and its areal extension, which strongly affect denudation intensity. Furthermore, the values of hierarchical anomaly density (G_a) were selected on the basis of the minimum number of streams in each order ($u \geq 1$) involved to make a drainage network perfectly ordered in a tree-shaped structure (Melton 1958). Then, the hierarchical anomaly index (D_a) is obtained from the ratio (G_a/N_1) of hierarchical anomaly density and the number of first-order streams actually occurring in the drainage basin (Avena et al. 1967). Finally, the denudation rate (T_u) of the drainage basin is calculated using the empirical equation (Table 1) that was previously determined (Ciccacci et al. 1980, 1986, 2003). The denudation rate index (T_u) relates values of drainage density and hierarchical anomaly index to evaluate denudation power within the drainage basins and suspended sediment yield ($t/km^2/year$) transported in suspension per unit area of the catchment.

Results and discussion

The drainage basin is a fundamental hydrologic and geomorphic unit of the river system through which precise description of the geometry of landforms could be harnessed, as data can be collected, organized and analyzed. Unlike the morphometry of the normal drainage basin, the landforms and topographical structures of this study area vary in hydrological processes, because of the short length of drainage network flow over the steep slope terrain surface. The stream segments and their morphometry

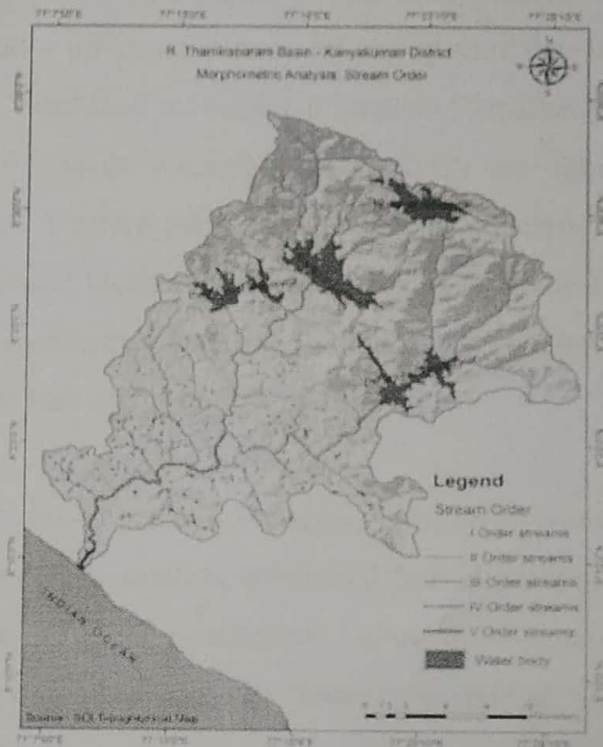
are considered as major hydrological entities to determine the hydrodynamic processes of this area, such as stream flow intensity, overland flow and surface runoff into the outlet. The quantitative analysis of the morphometry of this subbasin was performed in linear, areal and relief aspects to evaluate the characteristics of the drainage system using remote sensing and GIS.

Drainage network

The drainage pattern of the R. Thamirabarani sub-basin area is dendritic. The streams originate at different parts of the Western Ghats off the southwestern slope. The study area has five hierarchical orders based on the Strahler's ordering system (Strahler 1957). The main drainage network of R. Thamirabarani is formed by the confluence of seven major tributaries, namely Kodayar, Kallar, Kalikesanar, Chittar, Pambar, Chattar and Masipatti Ar., which flow from different parts of the Western Ghats. These major tributaries discharge into four reservoirs, namely Kodayar reservoir, Kodayar Lake, Pechiparai reservoir and Perunchani reservoir. The length of the sub-basin is 42.78 km and the elevation is 1,816 m from mean sea level. The study area is generally a steep slope along the northern part except the coastal area. This causes variation in the number of stream segments in the first-order and second-order streams. The total number of stream segments in first order is 238; however, the number of stream segments in second order is only 56. This reveals that the study area is dominated by firstorder streams. The shape, size and distribution of the stream segments in the drainage network can affect the drainage basin morphologic characteristics (Obi Reddy et al. 2004). The interrelations of these factors with the land use and land cover control the discharge of water and surface runoff in the gentle slope surface in the mid-region and plain surface in the southern part. However, the rate of infiltration of groundwater into the sub-surface is mainly determined by the drainage network and geological composition of the area. In some cases, the lineaments, fault

and fracture-like morphological structures can increase the infiltration rate along the north-eastern valley region (Fig. 2).

Fig. 2 Drainage network and stream order of the study area



Geological settings

The sub-basin area has underlain different geological structures such as garnet–biotite gneiss, sillimanite– graphite gneiss, charnockite, clay sand, gabbro (intrusive igneous rocks) rock type, granite, sand, silt with clay intercalation and fissile hornblende biotite gneiss (Fig. 3). The sequences of horizontal to nearly horizontal bedded complex structures of garnet–biotite gneiss are distributed predominantly over all part of the study area, and the areal extent of this setting is about 334.12 km² and is equal to 44.85 % of the total study area. Garnet–biotite-sillimanite– graphite gneiss mixture is a second dominant feature (286.88 km²) of the sub-basin which was found associated with garnet–biotite gneiss in the western parts and the northern hilly

terrain. Isolated batches of charnockite formation have been found in south-east and north-western portion of the study area with the total areal extent of 91.16 km² (12.24 %). In the southern parts, about 15.64 km² of the area consists of sedimentary formations such as sand, silt with clay mixture and clayey sand that lay down in the estuary of the river mouth. Furthermore, intrusive igneous formation (4.71 km²) and impermissible consolidated granite formation (6.62 km²) are found as discrete structures in the eastern and western parts of the study area, respectively. A batch formation of fissile hornblende biotite gneiss was found with the composition of primary lateritic capping, basement crystalline complex and conglomerate near the river channel in the southern part of the study area (Table 2).

Geomorphology

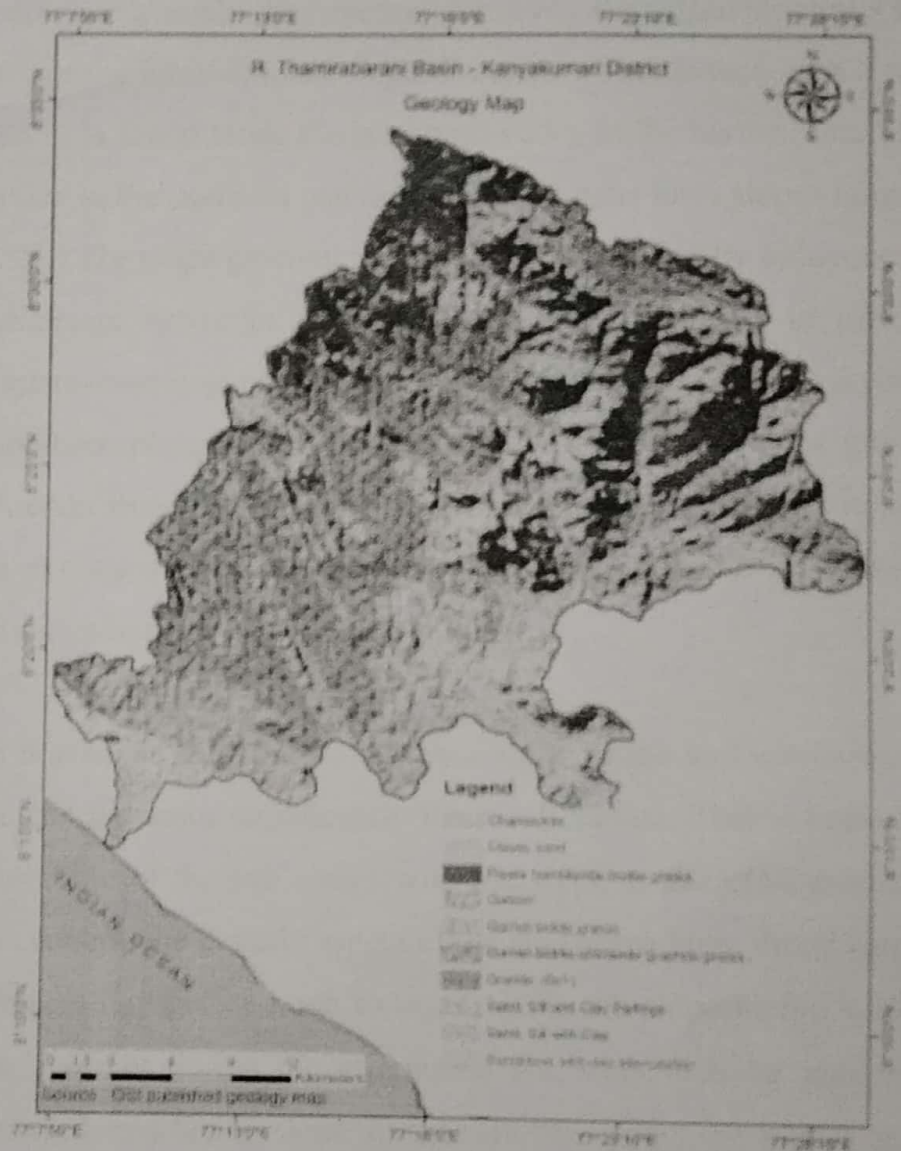
Morphologically, the sub-basin area consists of different types of landforms such as ridge-type structural hill, shallow weathered buried pediplain, moderately weathered buried pediplain, inselberg, structural valley, inter-mountain structural valley, valley fill, dome type denudational hill, dome type residual hill, dyke (linear ridge), pediment valley floor, meander scar, young coastal plain and brackish water creek. Along the northern hilly terrain, the ridged type of structural hills are predominantly spread over with the association of inter-mountain valley or structural valley and valley-filled vegetative cover. The major parts of these landforms cover dense forest with an areal extent of 448.72 km² and is equal to 60.23 % of the total sub-basin area (Table 2). The discrete dome-shaped denudation hill is found in the eastern side of the study area (3.54 km²). The hill is surrounded by shallow weathered buried pediplain with steep slope faces to the northerly side and has strong influences on the river flow path. Shallow weathered buried pediplain (197.92 km²) has been noticed in major parts of the southern plain region with the association of linearly stretched pediment, moderately weathered buried pediment along the riverbed, linear ridges and dykes, valley-filled vegetation, inselberg and dome-shaped isolated

residual hills. Depositional wet landforms such as brackish water creek (0.37 km²), meander scar and young coastal plain (0.45 km²) have been recorded along the river mouth in the southern region (Fig. 4).

Land use and land cover

The land use and land cover distribution of the study area has been derived from Landsat ETM+ image with the help of consequent image processing and classification techniques carried out using ERDAS Imagine software. Thus, the results reveal that the study area mainly consists of five types of land use and land covers such as deciduous forest cover, tree plantation, agriculture, water bodies and settlements (Fig. 5). The areal distribution of various land use and land cover feature classes is given in Table 2. About 44.91 % (334.55 km²) of the study area was found to have dense forest cover that comprised evergreen deciduous wood plants, semi-deciduous broad-leaved trees and shrub vegetation in the northern hilly surface and its associated regions of structural valley in the north-west and valley fill in the north-eastern parts. Moreover, the northern and north-western slope regions have been used for rubber and tea plantation. Agriculture is the second predominant land use in the study area (269.59 km²), which includes crop-cultivable lands and fallow and barren land along both sides of river banks in the middle parts and in the southern plain surface. Water bodies such as rivers, streams, channels and reservoirs are spread mostly on the plain surface and the total areal extent is 46.72 km², equal to 6.27 % of the total study area. Moreover, the southern plain and adjacent parts of the river have noticed abundantly distributed settlements and built-ups including urban, semiurban and rural settlements and the extension of this from west to east in middle part along the river bank and southern south to north along the estuary.

Fig. 3 Geological settings of the study area



Slope (Sa)

Slope is an important parameter to determine the morphometric characteristics of the catchment. This represents the topographical structures with its degree of inclination with respect to a horizontal plain surface. The slope of the study area was derived from ASTER DEM data (30 m) using surface analyst tool of ArcGIS 9.3 software. The slope range of this sub-basin is estimated from 0.5 to 59.85 . The spatial distribution of various slope gradient classes is given in Table 2. It is observed

that the slope faces down in a southerly direction; however, the ridged structural hills in the northern parts consist multi-faceted slope directions. The surface with a steep slope (38.72 – 59.85 °) is found along the structural valley in the northeastern parts, whereas the hilly terrain in the northern and north-western parts have slopes ranging from 32.15 ° to 38.72 °. The slope gradient of this hilly surface directly influences the flow direction of drainage networks. Moreover, the slope elements in turn are controlled by the climato-morphogenic processes along the rocky surface, varying in its resistance. The southern plain surface is characterized by a gentle slope gradient (0.5 – 7.5 °) and extends from the estuary to agricultural area in the middle parts. The spatial variation of consequent slope gradients has direct influences on the runoff and denudational activities in the sub-basin area (Fig. 6).

Aspect

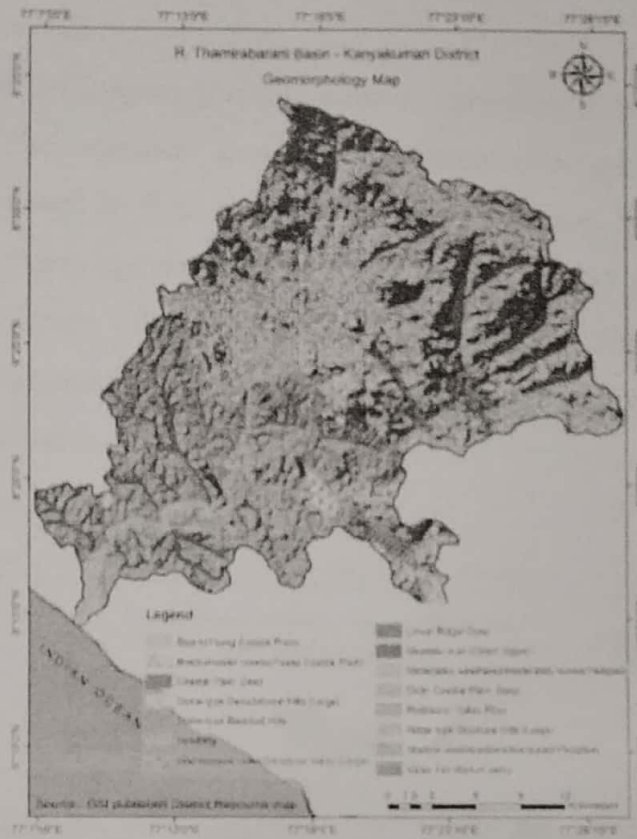
Aspect refers to the horizontal direction to which a slope of the surface faces. The aspect of the surface can influence significantly the local climate. This is because of the interaction of the angle of the sun's rays with the slope surface (Magesh et al. 2011). Based on this concept, the easterly aspect of the study area faces direct sunlight during the hottest time of day before noon to noon, while the slope facing westerly aspect is exposed to sunlight during the afternoon. The slope will be moderately warmer than the sheltered east-facing slope surface. In this study, the aspect map is derived from the ASTER DEM (30 m) using Spatial Analyst tool in ArcGIS software. The output raster map shows the compass direction of the aspect with ranges from 0 to 360 °, in which the value 0 ° is for true north and a 90 ° aspect is to the east, whereas 180 ° is to the south and so on. In this study area, the aspect values range from 0 ° to 22.5 ° representing the northerly aspect, and the range of values 22.5 – 67.5 ° indicates the slope that faces the north-eastern direction. The easterly aspect is represented as the ranges from 67.5 ° to 112.5 °, while the southerly aspect ranges from 157.5 ° to 202.5 ° (Fig. 7). The visual interpretation of the aspect map reveals

that the western parts have noticed with easterly and north-easterly aspect. This east-facing slope experiences more insolation of sunlight which causes a much hotter and drier climate in the middle and southern parts (Bennie et al. 2006). Moreover, the northern hilly terrain and eastern parts have found with westerly and south-westerly aspect, this west facing slope surface has strong effect on weathering, drainage network flow and distribution of natural vegetation.

Average annual rainfall

The morphometry of the sub-basin is highly influenced by the rainfall which induces surface runoff and overland flow depending on the slope condition. The area has available rainfall during both south-west monsoon (June–September) and north-east monsoon (October–December). The monsoon rainfall is the main source of water for surface and sub-surface storage sectors and the average annual rainfall is recorded with the ranges between 80.06 and 241.56 mm. The maximum rainfall occurs during the north-east monsoon (October and December) periods. A high amount of rainfall (200–240 mm) has been noticed in the valley region and in the deciduous forest of the north and northwestern hills. The central slope area and plain surface in the southern part of the study area are found with an average rainfall level between 140 mm and 180 mm. Minimum rainfall amount has been noticed along the shrub vegetative cover in middle-eastern and north-eastern parts of the sub-basin (Fig. 8).

Fig. 4 Geomorphology



Morphometric evaluation of the sub-basin

The morphometric parameters were measured quantitatively in three aspects, such as linear, areal and relief, to evaluate their characteristics. The relationships among the stream networks have been understood from the stream number, stream length, stream overland flow, bifurcation ratio and stream length ratio. The sub-basin area influence on the drainage was found by the measurement of drainage density, circulatory ratio, elongation ratio and form factor. The behavior of stream flow and stream flow intensity are determined by the slope and relief ratio.

Stream number (Nu) and stream order (U)

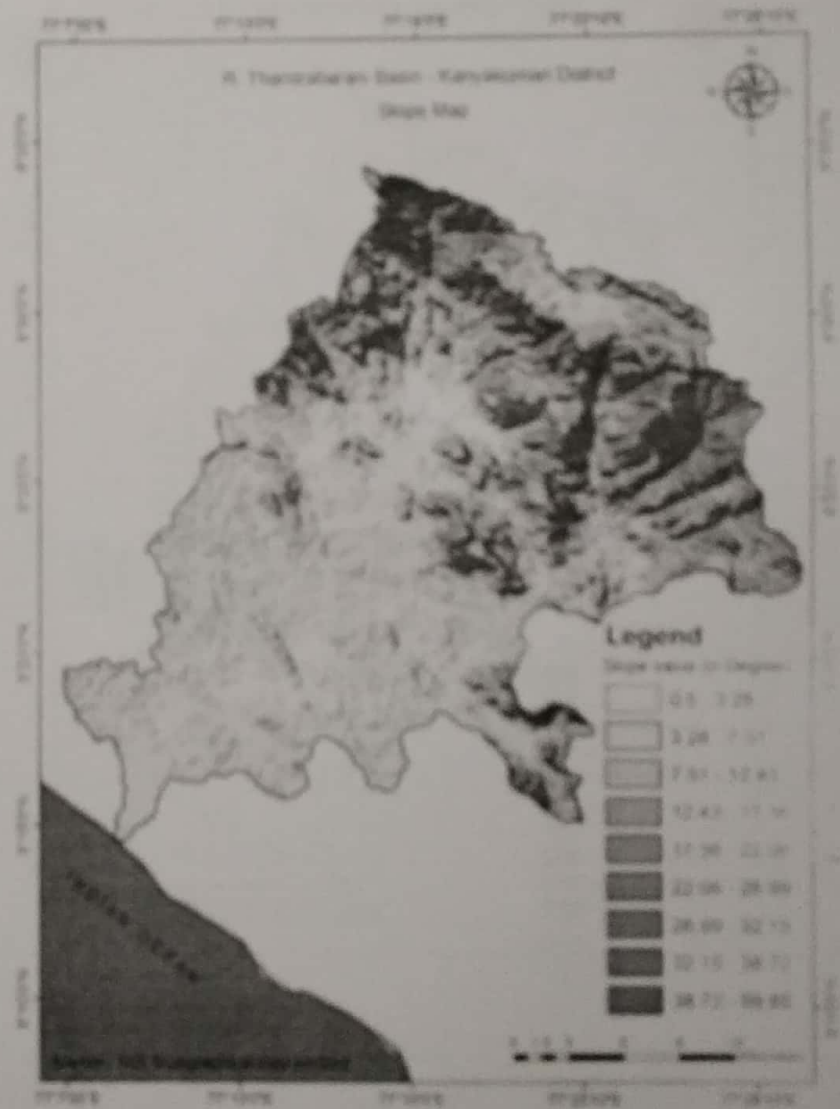
The stream order is defined as the origin of streams and the interconnections among them. This has proven to be useful to understand the stream shape, size, length, width and discharge amount of the streams. The first step in morphometric analysis is designation of stream orders. In this study, the stream order was classified according to Strahler's ordering system (Strahler 1964). Assuming this ordering system, the sub-basin area had five orders of streams, such as small, narrow streams originating from high elevated hilly terrains and designated as first-order stream, the total number of which was 238. The second order streams are formed from where the two first-order streams join and form as a single outlet. Here, in this subbasin, the total number of these streams is 56. The total number of stream segments in appropriate order has been summarized in Table 3. This shows that the sub-basin consists of five orders of streams with a total of 308 stream segments in all orders. Out of these, the first stream order was found in larger numbers than the next hierarchical orders, revealing that the terrain obviously had steep slope and short flow length in nature. The logarithm value of stream number against stream order shows nearly a straight line (Fig. 9). This reveals that the drainage network has semi-linear relationship among the stream segments.

Stream length (Lu)

The length of the stream in the sub-basin area was measured from the attribute database of the drainage layer using ArcGIS software. Stream length is a direct indicative factor to measure the drainage density and the contributing area of runoff in the sub-basin. The total length of streams in all hierarchical order is 561.98 km. Among them, stream segments in the first order occupied a length of 286.43 km and the second order about 136.35 km. The stream lengths of all orders are given in Table 3. According to Horton's law of stream length (Horton 1945), the logarithm values of stream length have been plotted against stream order in Fig. 10. This shows the

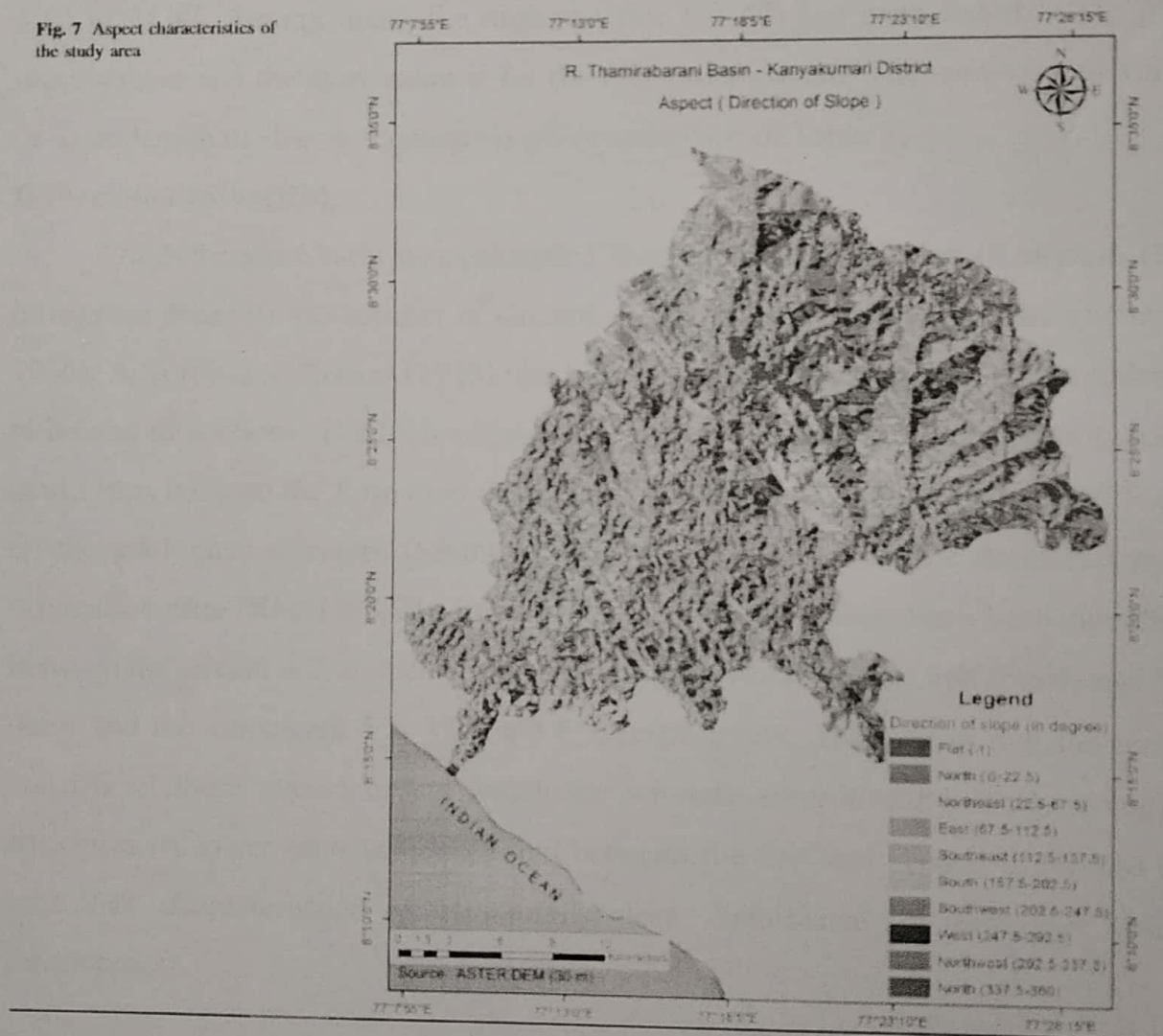
relationship between stream length and stream order. The stream segments in the first-order stream have short length, but the value is high because of the huge number of streams distributed more predominately than that of remaining orders. If the hierarchical stream order of the drainage basin is not controlled by climate, then their structure is mainly determined by external forces related to climate and geological

Fig. 8 Slope of the study area



settings (Ongley 1974). Here, the sub-basin area consists of five hierarchical orders of streams, which are not functionally related to contemporary climate, but composed of external forces such as surface rainfall runoff on local topography. The continuous interactive processes of these factors for long geologic time are manifested in the determination of stream numbers, lengths, slopes and basin areas.

Fig. 7 Aspect characteristics of the study area



Mean stream length (Lsm)

Mean stream length is a characteristic of the drainage network components and its associated sub-basin surface (Strahler 1964). The mean stream length is calculated by dividing the total length of the stream in an order by the number of stream segments of the same order. The mean length values of this study area ranges from 1.20 to 21.47. Among them, the highest value (21.47) has been found in the fifth-order stream and the least value is for the first-order stream. The summarized values of mean length of stream segments is given orderwise in Table 3.

Bifurcation ratio (Rb)

The bifurcation ratio was calculated from the ratio of number of streams (N_u) in a given order to the number of streams (N_{u+1}) in the next higher order (Schumm 1956). According to Horton (1945), the bifurcation ratio is considered as an index of relief and dissections. The high variations of bifurcation ratio in the different types of land forms indicate the formation of stream segments by the continuous runoff forces on the geological structure (Strahler 1957). In the study area, the measured mean bifurcation ratio (R_{bm}) is 4.21 (Table3). The higher ratio values have been calculated between the stream orders such as third and fourth; two and three; and fourth and fifth order and the values are 5.5, 5.09 and 5.0, respectively. This shows that the terrain consists of these stream orders which are strongly controlled by local geological structures. A lower ratio value is found between the first and second order and this area has characteristics of structurally less disturbance in drainage system development.

(a) BRIEF BIODATA OF THE INVESTIGATOR

1. Name of the Faculty: **Dr.M.Seenirajan** M.E.(Environmental Engg.) Ph.D

2. Educational Qualification

a) School Level:

| Sl. No | Class | Name and location of the school | School Board such as HSC, CBSC etc. | Medium of Instruction | Month & Year of Passing | % of Marks |
|--------|---------|---|-------------------------------------|-----------------------|-------------------------|------------|
| 1 | S.S.L.C | WPA Soundra Pandiya Nadar School-Chennai | State Board | Tamil | April 1989 | 78 % |
| 2 | H.S.C | Corporation Higher Secondary School-Chennai | State Board | Tamil | April 1991 | 83 % |

b) College Level (from Diploma / UG Degree onwards)

| Sl. No | Diploma / Degree / etc | Name of the Institution | Name of the University | Month & Year of Passing | Class |
|--------|------------------------------------|---|-----------------------------------|-------------------------|-------------|
| 1 | B.E (Civil) | IRTT-Erode | Bharathiyar University-Coimbatore | April 2000 | First class |
| 2 | M.E. (Environmental Engineering) | Karpagam Academic and Higher Education-Coimbatore | Karpagam University-Coimbatore | June 2013 | First class |
| 3 | Ph.D., (Environmental Engineering) | Karpagam Academic and Higher Education-Coimbatore | Karpagam University-Coimbatore | 2020 | |

3. Experience details:

| Experience | Name of the Organization | Duration | Nature of Work |
|--------------|--|-----------|----------------------------------|
| i). Teaching | Sengunthar Engineering College, Perundurai | 1 year | Teaching, Research & Consultancy |
| | Park Collage of Tehnology | 1.5 years | Teaching, Research & Consultancy |
| | Excel Engineering College | 3.5 years | Teaching, Research & Consultancy |
| | Kathir College of Engineering | 2 year | Teaching, Research & Consultancy |
| | RVS Technical Campus | 1 year | Teaching, Research & Consultancy |

| | | | |
|--------------|---|---------|----------------------------------|
| | CMS College of Engineering and Technology | 2 year | Teaching, Research & Consultancy |
| ii) Industry | IDEB Construction Project | 10 year | Estimation & Quantity Surveying |

4. Research publications:

| Sl. No | Title | Journal / Conference Name | International / National | Month and Year |
|--------|--|---|--------------------------|----------------|
| 1 | Importance of morphometry studies, Land for processes using remote sensing And GIS for Tamiraparani subbasin | Computational and Theoretical Nano Science | National | 2019 |
| 2 | Quality Characterization of Ground water in Tirupur Region | International Conference on Cleaner Technologies & Environmental Management | International Conference | January 2007 |
| 3 | Vermicomposting of Vegetable Waste with Dairy and Distillery Effluent | International Conference on Resource Utilization and Intelligent Systems | International Conference | January 2008 |
| 4 | Application of FAL-G for Rigid Pavements | National Conference on Technology Applications for Sustainable Development | National Conference | January 2009 |
| 5 | Identification of sulfide oxidizing Bacteria from Sewage – Thiobacillus species | National Conference on Technology Applications for Sustainable Development | National Conference | January 2009 |

5. Seminars / Conferences / Symposia / STTP / SDP / Workshops organized

| Sl. No | Date | | Seminars / Conferences / | Topic / Title | Name of the funding agency |
|--------|----------|----------|--------------------------|--|---|
| | From | To | | | |
| 1 | 10.04.08 | 11.04.08 | National Conference | Innovative Materials and Methodologies for Disaster Resistant Structures | Coir Board |
| 2 | 27.01.09 | | National Seminar | Nanotechnology for Site Remediation and Wastewater Treatment | Department of Science and Technology, New Delhi |

(a) BRIEF BIODATA OF THE CO-INVESTIGATOR

1. Name and Age : S.PRABU, 33
2. Designation : Assistant Professor
3. Degrees conferred

(Begin with Bachelor's Degree) :

| Degree | Institution Conferring the degree | Field (s) | Year |
|--------|---|------------------------|------|
| B.E. | Sengunthar Engineering College-Tiruchengode (Anna University) | Civil Engineering | 2011 |
| ME | KSR College of Engineering | Structural Engineering | 2013 |

5. Major Scientific Fields of Interest:

- (i) Ground Water Quality Analysis
- (ii) Advanced Wastewater Treatment

6. List of Publications:

| Sl No | Title | Journal / Conference Name | International / National | Month and Year |
|-------|--|---|-------------------------------|----------------|
| 1. | Optimization of Dosage of Fly ash as an Adsorbent for the Colour Removal of Textile Factory Effluent | International Journal of Ecology Environment and Conservation | Vol:14(2-3); 2008; Pp 475-480 | September 2008 |
| 2. | Ground Water Quality Analysis in Schools of Erode District of TamilNadu | National Journal of Nature Environment and Pollution Technology | Vol:4, No:3, Pp 467-468, 2005 | September 2005 |
| 3. | Identification of Sulfide Oxidizing Bacteria from Sewage- Beggiatoa species | National Journal of Nature Environment and Pollution Technology | Vol:5, No:1, Pp 163-164, 2006 | March 2006 |
| 4. | Treatment of Textile Factory Effluent using Flyash as Adsorbent – A case Study for Tirupur Region | National Journal of Nature Environment and Pollution Technology | Vol:4, Dec 2007 | December 2007 |
| 5. | Application of FAL-G for Rigid Pavements | National Conference on Technology Applications for Sustainable Development | National Conference | January 2009 |
| 6. | Identification of sulfide oxidizing Bacteria from Sewage – Thiobacillus species | National Conference on Technology Applications for Sustainable Development | National Conference | January 2009 |
| 7. | Biological Sulfide oxidation of Anaerobically Treated Effluents for Sulfide Inhibition Control | GREEN TECH 2005 | International Conference | January 2005 |
| 8. | Behaviour of Plastic Mixed Concrete in RC Structures | International Conference on Cleaner Technologies and Environmental Management | International Conference | January 2007 |
| 9. | Performance of Bacterial Species in Sulfide Oxidation | International Conference on Cleaner Technologies and Environmental Management | International Conference | January 2007 |
| 10. | Advanced Oxidation technology – Biological Sulfide Oxidation | International Conference on Infrastructure Development on Expansive Soils | International Conference | February 2006 |
| 11. | Vermicomposting of Vegetable Waste with Dairy and Distillery Effluent | International Conference on Resource Utilization and Intelligent Systems | International Conference | January 2008 |
| 12. | Application of FAL-G for Rigid Pavements | National Conference on Technology Applications for Sustainable Development | National Conference | January 2009 |
| 13. | Identification of sulfide oxidizing Bacteria from Sewage – Thiobacillus species | National Conference on Technology Applications for Sustainable Development | National Conference | January 2009 |

| | | | | |
|-----|--|---|---------------------|---------------|
| 14. | Retrofitting of RC beams Using Glass Fibres – An Experimental Investigation | National Conference on Concrete Composites for Structural Systems | National Conference | March 2007 |
| 15. | Prevention of Corrosion of RCC Structural Elements by Cathodic Protection Method | National Conference on Recent Trends in Structural Engineering | National Conference | May 2005 |
| 16. | Lateral Load Analysis of Multi-Storey Multi-Bay RC Frame | ISTE Staff Chapter | ISTE Staff Chapter | November 2004 |
| 17. | Experimental Study on Corrosion Control Method | ISTE Staff Chapter | ISTE Staff Chapter | November 2005 |

BRIEF BIODATA OF THE CO- INVESTIGATOR

1. Name of the Faculty: Mr.Anand Kumar S

2.Educational Qualification

a) School Level:

| Sl. No | Class | Name and location of the school | School Board such as HSC, CBSC etc. | Month & Year of Passing | % of Marks |
|--------|-------|--|-------------------------------------|-------------------------|------------|
| 1 | SSLC | Mahajana High School, Erode-638002 | State Board | April 2010 | 95.2% |
| 2 | HSC | Reliance Matriculation Higher Secondary school | State Board | April 2012 | 83% |

b) College Level (from Diploma / UG Degree onwards)

| Sl. No | Diploma / Degree / etc | Name of the Institution | Name of the University | Month & Year of | Class |
|--------|------------------------|---------------------------|------------------------|-----------------|-------|
| 2 | B.E. Civil | Excel Engineering College | Anna University | April 2016 | I |
| 3 | M.E | Excel Engineering College | Anna University | April 2020 | I |

4. Employment Data

Teaching:

| Sl. No | Name of the College | Designation | Period | | Experience | |
|--------|---|---------------------|------------|-----------|------------|--------|
| | | | From | To | Year | Months |
| 1 | Arulmurugan Polytechnic College, Karai. | Lecturer | 01.10.2006 | Till Date | 2 | 0 |
| 2 | Sengunthar Engineering College, Tiruchengode. | Assistant Professor | 28.09.2020 | Till Date | 0 | 11 |

6. No. of Research papers published

| Sl. No | Title | Journal / Conference | International / National | Month and Year |
|--------|---|---|----------------------------------|----------------|
| 1 | Performance of Geosynthetics in controlling Swell potential of expansive Clay | International Journal of Engineering & Industrial Research | Vol. 1, No. 6, Pp. 245-261, 2008 | Aug-2008 |
| 2 | Utilization of Flyash in Expansive Soils for manufacturing of Bricks | Department of Civil Engineering, University Malaysia at Kuala Lumpur. | International | March, 2003 |
| 3 | Performance of Geosynthetics in Controlling Swell Potential of Expansive Clay | IGC -2005 conducted by Nirma University, Ahmedabad. | National | Dec, 2005 |
| 4 | Experimental Investigation Geosynthetics Materials on Expansive Soils | International Conference on Resource Utilization & Intelligent Systems-2006 | International | Jan 2006 |
| 5 | Utilization of Flyash in Expansive Soils for manufacturing of Bricks | International Conference on Resource Utilization & Intelligent Systems-2006 | International | Jan 2006 |
| 6 | Performance of Geosynthetics in controlling Swell potential of expansive Clay | Recent Advances in Civil-2006 | National | Dec 2006 |
| 7 | Modeling of compressive strength of SFRC using statical methods | Recent Trends in Concrete Composites for Structural Systems | National | Mar 2007 |

| | | | | |
|---|---|-------------------------------|----------|----------|
| 8 | Strength and Compressibility Behaviour of Swollen Clays | Recent Advances in Civil-2008 | National | Dec 2008 |
|---|---|-------------------------------|----------|----------|

FACILITIES AVAILABLE AT THE INSTITUTION

- (a) Atomic Absorption Spectrophotometer
- (b) UV Spectrophotometer
- (c) Physico-Chemical Analysis Facilities
- (d) Global Positioning System (GPS)
- (e) Flame Photometer
- (f) COD digester
- (g) pH Meter
- (h) Electrical Conductivity Meter
- (i) BOD Incubator
- (j) Turbidity Meter
- (k) Hot Air Oven
- (l) Softwares related to the Study

SOCIAL RELEVANCE AND USEFULNESS OF THE PROJECT

This project will surely make us to know the contamination levels of the major surface water source of the Erode, Bhavani, Pallipalayam and Karur region i.e the river Cauvery. The living community in the above said region depends on river cauvery for their day to day needs of water. The water from Tamerabarani River is used for drinking, irrigation and industrial processes. So, the water quality in the river has to be studied, which is polluted by the untreated industrial discharges from the Erode, Bhavani regions. The region has many tanneries, textile processing industries, electroplating industries, dyeing industries which are wide spread. The effluents from the above said industries are found to reach Tamerabarani River after its discharge. The concentration of the contaminants is found to be very high during the summer season, when the flow in the river is limited. There are many intakes in the banks of Cauvery to draw water and to supply it to living community in the

regions like Erode city, Karur, Bhavani, Kumarapalayam, Pallipalayam, Modakurichi etc., which supplies the contaminated water from the source. So, the current research will surely help us to know the water quality that is supplied for the people. This will help us to assess the health effects of the contaminants on the drinking people. So, this type of research is to be conducted periodically to assess the quality of the major water sources in the state.



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TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU



&

**RESEARCH AND DEVELOPMENT CELL
SENGUNTHAR ENGINEERING COLLEGE**

A PROJECT REPORT

LICENSE ELIGIBILITY MEASUREMENT SYSTEM

Submitted by
Mr.KASHOKKUMAR
Associate Professor
Department of Computer Science and Engineering
Sengunthar Engineering College
Tiruchengode

Ref: SEC/CSE/SEED/2020-21/ 1

25.11.2020

To
The Chairman
Research and Development Cell
Sengunthar Engineering College
Tiruchengode-637211

Respected Sir,

Sub: Submission of Research Project Scheme (2020-2021) proposal – Reg.

Greetings from Computer Science and Engineering Department, Sengunthar Engineering College!

We are happy to submit our Research Project Scheme (2020-2021) proposal "**License Eligibility Measurement System**" under the guidance of Mr.K.Ashokkumar, Associate Professor, Department of computer Science and Engineering. Here with we have enclosed with Research Project Scheme (2020-2021) proposal form for your kind perusal.

We are expecting your kind consideration towards this proposal.

Thanking You

Your's faithfully,


(HoD/CSE)

Encl:

1. Research Project Scheme (2020-2021) proposal.

| RESEARCH PROJECTS SCHEME (2020-2021) - PROPOSAL | | |
|---|---|---|
| 1 | Name of the Principle Investigator | : K.Ashokkumar, M.E., |
| | Department / Designation | : Computer Science and Engineering / Associate Professor |
| | Institutional Address | : Sengunthar engineering college (Autonomous), Tiruchengode-637205, Namakkal (Dt) |
| | Phone No. & Mobile No. | : 04288-255716 (College) , 99420-47775 (Guide) |
| 2 | Project Title | : LICENSE ELIGIBILITY MEASUREMENT SYSTEM |
| 3 | Sector in which your Project proposal is to be Considered | : Engineering and Technology |
| 4 | Project Details | : Separate sheet to be attached |
| 5 | Has a similar project been carried out in your college / elsewhere? If so furnish details of the previous project and highlight the improvements suggested in the present one | : No, We are implementing new innovative project. |

CERTIFICATE

This is to certify that Mr./Miss. Mr.K.Ashokkumar, Associate Professor, Department of Computer Science and Engineering, is a bonafide of our college and it is also certified that utilization certificate and final report along with seminar paper will be sent to the Research and Development Council after completion of the project by the end of December 2021.


Signature of the Principle Investigator


Signature of the HOD

PROJECT DETAILS

LICENSE ELIGIBILITY MEASUREMENT SYSTEM

INTRODUCTION

Now-a-days in our country most of the existing RTO offices didnt have systematic driving license verification system. If we want to get the driving license from RTO office, it is not a difficult task now a days but maintaining the original driving license is major task to the vehicle users . On the other side vehicle users are cheating the police by maintaining fake license which was crime. Currently driving license card having details like driving license identification number and address Details of the authorized vehicle Drivers are being morphed. So now-a-days the persons who are maintaining fake driving license, they are removing the authorized vehicle driver license photo and the details and using same license identification number . This is the major disadvantage for the authorized driving license persons and it is advantage for the persons who are maintaining fake driving license. In order to overcome these problems an authenticating driving license system is proposed and provided to RTOs. By making use of RFID reader we can maintain authenticated driving license system. The existing method at the road transport officers was we need to fill the online driving license application form and next step is the written exam, that exam issuing a driving license by taking photo and the details of the eligible person .So in that driving license as we already know there existing a license. This is the major drawback of the existing driving license issuing system.

But we face new issues while getting a new driving license test for driving license is not done before the RTO officer. it is done by the driving school, they provide certificate for driving. After the driving school given certificate they applied for driving license it was easily getting from the RTO office. During this, certification from the Driving School. some of them have a chance for fraud work, that is without drive a car or bike they will provide certificate for money ,then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident, in this paper we discuss about the driver performance measuring by a eligibility test kit. A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

OBJECTIVE

In this project we measure the driver performance, and analyze how he drives a car full complete report will be automatically generate and send final report via GSM technology

METHODOLOGY

The problem identification in this project is, During certification process from the Driving School, some of them have a chance for fraud work, that is without drive a car they will provide certificate for money,then the person will easily get a driving license. These type of a person have a 90% chance of accident on the road. By avoid these type of accident, so the major problem issues is to solve the money bribery and accident met on the road.

A main aim of the project helps to measure the performance of a driver. in this project driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit. Finally the collecting data will be send to the RTO office Via GSM Technology ,after completing a driving course eligible candidate only getting the driving license from the RTO office.

WORKING PRINCIPLE

In this project the driver performance measuring kit is fitting in the vehicle. Ultrasonic sensor is fitting in the four sides of the car, when the car is moving on a road the sensor will start sense . if wrong direction will moved, the sensor gives the wrong message in the LCD Display. Then the switch present in the Accelerator will give full race pressure switch will sense the data send to the microcontroller .after that the microcontroller will analyses the data input given. when two are more times the sensor will sense the microcontroller will collect the message will be automatically send to the information via GSM to the RTO Office.

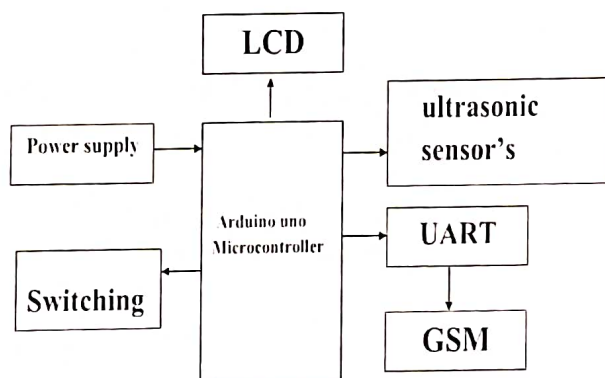



Fig 1.1 HARDWARE DESIGN

By using this driver eligibility measuring kit certification from the Driving School doesn't have a chance for fraud work. In this paper A driver eligibility measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit , the message will sent to the candidate

By using this driver performance measuring kit certification from the Driving School doesn't have a chance for fraud work, that is without drive a car they will not provide certificate for money ,then the person will not easily get a driving license. So we avoid chance of accident on the road. in this paper A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

BUDGET

| PROJECT BUDGET | | | |
|--|-----------------------|----------|------------------------|
| S.NO | NAME OF THE COMPONENT | QUANTITY | PRICE OF THE COMPONENT |
| 1 | ALTRASONIC SENSOR | 4 | 2000.00 |
| 2 | ARDIUNO UNO BOARD | 1 | 700.00 |
| 3 | PROTOTYPE CAR | 1 | 2500.00 |
| 4 | GSM MODULES | 1 | 670.00 |
| 5 | Implementation | | 3000.00 |
| 6 | Testing | | 1000.00 |
| 7 | Conveyance | | 2000.00 |
| TOTAL PROJECT BUDGET (A) | | | Rs.12670.00 |
| In kind Donation(B) By our college | | | |
| GSM MODULES | | | 670 |
| In kind Donation Subtotal (B) | | | |
| Required Amount for the project(A-B) | | | Rs.12,000.00 |


Signature of the Principle Investigator


Signature of the HOD

PROJECT EVALUATION REPORT

| | |
|--|--|
| Name of the Investigator | Mr.K.ASHOK KUMAR |
| Name of the Co-Investigator | - |
| Name of the Department | Computer Science and Engineering |
| Title of project | License Eligibility Measurement System |
| Recommendation of the evaluation committee (Recommended/Revision/Not Recommended) | Recommended |
| Financial allocation recommended | Rs. 12,000.00 |

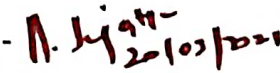
| Sl. No. | Head | Amount in INR |
|---------|---|---------------|
| 1 | Components(Ultra Sonic Sensor, Prototype car ,GSM Module, Arduino Board) | 9600.00 |
| 2 | Implementation of License Eligibility Measurement System (Interfacing Arduino Board with prototype car) | 1900.00 |
| 3 | Travel Expenses | 500.00 |
| | Total | 12,000.00 |

Evaluation Committee Members

1. Dr.C.Venkatesh - Principal

- 
20/03/2021

2. Dr.B.Sujatha - Dean(Academics)

- 
20/03/2021

3. Dr.P.Rameshkumar - Dean (R&D)

- 
20/3/21

4. Dr.P.Ponmurugan - Head (R&D)

- 
20/3/21

20/03/2021



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NAAC Accredited with A Grade

TIRUCHENGODE - 637 205 NAMAKKAL (DI) TAMILNADU



RESEARCH & DEVELOPEMENT CELL

Submitted to Correspondent sir Approval

Ref SEC/R&D/2020-2021/R/001

Date: 22.03.2021

Sir,
Sub. Requisition for permission to grant SEED money -Reg

The Research & Development cell of our college had selected the following projects to grant SEED money to implement the proposals submitted. The principal investigator has asked to carry out their work as mentioned in their report.

| Sl.No | Title of the Project | Name of the Principal Investigator | Amount |
|--------------|--|------------------------------------|------------------|
| 1 | Flood geo-morphological survey and mapping of surface water potential and degradation study for tameradarani river stretch using remote sensing and gif techniques | DR M SEENIRAJAN | 12000 00 |
| 2 | LICENSE ELIGIBILITY MEASUREMENT SYSTEM | Mr K ASHOK KUMAR | 12000 00 |
| 3 | RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IOT | Dr.P. RAMESH KUMAR | 12000.00 |
| 4 | DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM | Dr.K UMADEVI | 13000 00 |
| 5 | DESIGN AND DEVELOPMENT OF SMARK THREAD MILL BIKE | Mr P.JAGADEESWARAN | 12000 00 |
| Total | | | 61,000.00 |

P. Senthil Kumar
22/3/21
Dean(R&D)

[Signature]
22/3/21
Principal

[Signature]
22/3/21
Correspondent

VOUCHER

Date : 28.3.2021

ASHOK KUMAR

| Particulars | Rate | | Nos. | Amount | |
|--|------|----|------|--------|----|
| | Rs. | P. | | Rs. | P. |
| Implementing seed money Reference Doc: SEC/RAD/2020-2021/1. Licence Eligibility Measurement System. | | | | 12,000 | 00 |
| Total Expenditure | | | | | |
| (-) Advance Paid on..... | | | | | |
| Balance to be refunded / paid | | | | - | |

/ Refunded Rs. : Twelve thousand only.

| ED | CERTIFIED | PASSED |
|----|------------|--------|
| C | Supervisor | A.O. |

[Signature]
Signature

PRINCIPAL

TRUST

**Sengunthar Engineering College (Autonomous),
Tiruchengode**

UTILISATION CERTIFICATE FOR THE FINANCIAL YEAR 2020-2021

Name of the Scheme under which the amount was sanctioned under the Research promotion scheme of Sengunthar Charitable Trust

| Sl. No | SCT Sanction Order/Letter No. & Date under which the amount was sanctioned | Amount (Rs.) | |
|--------|--|--|--|
| 1. | SEC/R&D/2020-21/003 dated 10.03.2021 | Rs 12,000 (Rupees Twelve Thousand Only) | <p style="text-align: center;">Certified that out of Grant-in-Aid of Rs 12,000 (Rupees Twelve Thousand Only) sanctioned by the SCT during the financial year.</p> <p style="text-align: center;">Rs. 12,000 has been utilized for the purpose for which it was sanctioned and the balance of Rs. 0 remained unutilized at the end of the year.</p> |

Certified that I have satisfied myself that the conditions on which the amount was sanctioned have been duly fulfilled and that I have exercised the following checks to see that the money was actually utilized for the purpose for which it was sanctioned.


Signature of the Guide


Signature of Head of the Institute

Place: Tiruchengode

Date: 10/12/2021

FORMAT FOR RECEIPT AND PAYMENT ACCOUNT

| SI. No. | Receipt | Amount (Rs.) | SI. No. | Payments | Amount (Rs.) |
|---------|--------------------|--------------|---------|-----------------|--------------|
| 1 | To Opening Balance | 12000 | 1 | Components | 6000 |
| | | | 2 | Implementations | 3000 |
| | | | 3 | Testing | 1000 |
| | | | 4 | Conveyance | 2000 |
| | | | | Closing Balance | 0 |
| | Grand Total | 12000 | | Grant Total | 12000 |


Signature of the Guide 10/12/2021


Signature of Head of the Institute 10/12/2021

Place: Tiruchengode

Date: 10/12/2021



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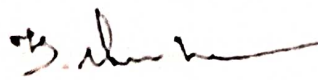
TIRUCHENGODE - 637 205 NAMAKKAL (DT) TAMILNADU



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING STATEMENT OF ACCOUNT

Design and development of a License Eligibility Measurement System

| S.NO | NAME OF THE COMPONENT | CREDIT (Rs) | DEBIT(Rs) |
|--------------------------------|-----------------------|--------------|--------------|
| 1 | Ultrasonics Sensor | 4 | 2000.00 |
| 2 | LCD | 2 | 1000.00 |
| 3 | GSM | 2 | 2000.00 |
| 4 | Arduino board | 2 | 1000.00 |
| 5 | Implementation | | 3000.00 |
| 6 | Testing | | 1000.00 |
| 7 | Conveyance | | 2000.00 |
| Total | | | Rs.12,000.00 |
| SCT- Seed Money/Grand Received | | Rs.12,000.00 | |
| Balance | | | Nil |


Signature of the Guide


Signature of the HoD

Invoice

FROM

G K V ELECTRONICS NAMAKKAL

SHANKAR DINESH
Ring Road Main Bazaar
India
gkvelectronics@gmail.com

Tax Registration Number
TINNMK00100210

TO

**SENGUNTHAR ENGINEERING COLLEGE
TIRUCHENGODE**

KUMARAMANGALAM
info@scteng.co.in

Invoice No. : 072

Invoice Date : Jun 3rd, 2021

Due: Jun 3rd, 2021

| Item | HRS/QTY | Rate | Tax | Subtotal |
|--------------------|---------|------|-----|--------------|
| Ultra Sonic Sensor | 4 | 500 | | INR 2,000.00 |
| Prototype car | 1 | 5000 | | INR 5,000.00 |
| Arduino Board | 2 | 900 | | INR 1,800.00 |
| GSM Modules | 2 | 400 | | INR 800.00 |

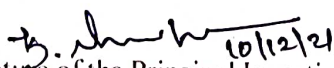
Invoice Summary

Subtotal INR 9,600.00

Total INR 9,600.00

PROJECT COMPLETION REPORT

| | | |
|-----|---|---|
| 1 | SMS Reference No | SEC/R&D/2020-2021/R/001 |
| 2 | Title of research project | LICENSE ELIGIBILITY MEASUREMENT SYSTEM |
| 3 | Name of the Principal Investigator | Mr.K.Ashokkumar,AsP/CSE |
| 4 | Name of the Co-Investigator | - |
| 5 | Name the Department | CSE |
| 6 | Effective date of starting of the project | 25.11.2020 |
| 7 | Grant approved and expenditure incurred during the period of the report | |
| 7.1 | Total amount approved | Rs.12000.00 |
| 7.2 | Total expenditure | Rs.12000.00 |
| 8 | Report of the work done: (Please attach a Brief objective of the project: i. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication or communicated) ii. Has the progress been according to original plan of work and towards achieving the objective if not, state reasons iii. Has the project been submitted for external funding, if so give details | i. Attached Report ii. Yes iii. No |
| 9 | Please indicate the difficulties, if any, experienced in implementing the project during SMS. | No |
| 10 | Outcome of the project | i. Published in Journal ii. Published in conference. |


Signature of the Principal Investigator


Signature of the Co-Principal Investigator


Signature of the Head

ABSTRACT

Now a days in current situation, test for driving license is not done before the RTO officer. it is done by the driving school, they provide certificate for driving. After the driving school given certificate they applied for driving license it was easily getting from the RTO office. During this, certification from the Driving School. some of them have a chance for fraud work, that is without drive a car or bike they will provide certificate for money, then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident, in this paper we discuss about the driver performance measuring by a eligibility test kit. A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

Finally the data will be send to the RTO office Via GSM Technology. after completing a driving course eligible candidate only getting the driving license from the RTO office. The main aim of this project helps to avoid Accident on Road and fraud done during the driving test.

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LIST OF ABBREVIATION

| S.No | Acronym | Expansion |
|-------------|----------------|--|
| 1 | UART | Universal Asynchronous ReceiverAnd Transmitter |
| 2 | RTO | Regional Transport Office |
| 3 | GSM | Global System for Mobile Communication |
| 4 | RFID | Radio Frequency Identification |
| 5 | LCD | Liquid Crystal Display |

CHAPTER-1

INTRODUCTION

1.1 Embedded System

An **embedded system** is a microprocessor-based computer hardware **system** with software that is designed to perform a dedicated function, either as an independent **system** or as a part of a large **system**. At the core is an integrated circuit designed to carry out computation for real-time operations.

An embedded system is a special-purpose computer designed to perform one or a few dedicated functions, often with real time computing constraints. Embedded systems have become very important today as they control many of the common devices we use. An embedded micro controller is a chip, which has a computer processor and all its support functions, memory (Both program and data) and I/O (including bus interfaces) built within the device. The paper proposes a RCM (Remotely Controlled Model) which discusses significance of using Micro Controller to remotely control maximum number of devices so that the applications of Embedded System can be improved by connecting more devices to the Micro controller.

Now-a-days in our country most of the existing RTO offices didn't have systematic driving license verification system. If we want to get the driving license from RTO office, it is not a difficult task now a days but maintaining the original driving license is major task to the vehicle users . On the other side vehicle users are cheating the police by maintaining fake license which was crime. Currently driving license card having details like driving license identification number and address Details of the authorized vehicle Drivers are being morphed.

1.2 Driving License Verification System

So now-a-days the persons who are maintaining fake driving license, they are removing the authorized vehicle driver license photo and the details and using same license identification number . This is the major disadvantage for the authorized driving license persons and it is advantage for the persons who are maintaining fake driving license. In order to overcome these problems an authenticating driving license system is proposed and provided to RTOs. By making use of RFID reader we can maintain authenticated driving license system. The existing method at the road transport officers was we need to fill the online driving license application form and next step is the written exam, that exam issuing a driving license by taking photo and the details of the eligible person .So in that driving license as we already know there existing a license. This is the major drawback of the existing driving license issuing system.

1.3 Eligibility Test Kit

But we face a new issues while getting a new driving license test for driving license is not done before the RTO officer. it is done by the driving school, they provide certificate for driving. After the driving school given certificate they applied for driving license it was easily getting from the RTO office. During this , certification from the Driving School. some of them have a chance for fraud work, that is without drive a car or bike they will provide certificate for money ,then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident, in this paper we discuss about the driver performance measuring by a eligibility test kit. A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

CHAPTER-2

LITERATURE SURVEY

2.1 License Test Objectives and Test Validity

The objectives of a License Test, as stated by various authors in Past reviews, Include determining the road Worthiness of applicant Vehicle (Lauer,1960), revenue raising (Waller, 1975) and Satisfying those who feel that something should be measured (Belmont Conference on State Road Test.

2.2 Establishing Driver Competence

In practice, the emphasis is usually on the Eizst of these two major objectives: the license test Is primarily seen as a means of establishing that a driver attains a certain standard of competence before being permitted to drive without supervision. The test might then serve to screen out potentially "bad^fi drivers— those who, if licensed, would present an unacceptably high accident risk. For a test to serve this purpose effectively, it must be assumed that (1) the test procedure identifies and appror lately penalises unsafe or "bad" driving behaviour; (2) such behaviour under test conditions is associated with an unacceptably high rate of accident involvement under non—test conditions. Unfortunately, evidence to support these assumptions is lacking, for two major reasons.

In relation to the first assumption, our knowledge of drivers and driving is inadequate to permit a clear and comprehensive description of the nature of safe oz unsafe driving behavior, independent OE accidents. Thus, Shaoul (1975) pointed out that in the U.K. people are taught that the correct way to steer a car around a corner is to use a shuffling action OE hands on steering wheel, avoiding crossing over the arms, and license testing officers may penal iscandidates who do not demonstrate what is considered to be a proper steering action, whereas in theU.S .A. , received

wisdom is to the contrary. In fact, there is no hard evidence that one technique is safe than the other. The same situation holds true in relation to many other driving techniques and procedure, regardless of their being dear to the hearts of driving instructors throughout the world.

The second assumption was that divers who fail or, to a lesser extent, who obtain low test scores, are more likely to be involved in subsequent accidents. However, people who fail the test can continue to drive only under the direct supervision of a licensed driver, which is not comparable to the conditions under which people passing the test can then drive. Consequently, those drivers who would have been expected on the basis of their poor test performance to be involved in the most accidents, by the license test from the sample of drivers whose subsequent accident record is investigated. In practice, the emphasis is usually on the effect of these two major objectives: the license test is primarily seen as a means of establishing that a driver attains a certain standard of competence before being permitted to drive without supervision. The test might then serve to screen out potentially "bad" drivers— those who, if licensed, would present an unacceptably high accident risk. For a test to serve this purpose effectively, it must be assumed that (1) the test procedure identifies and appropriately penalises unsafe or "bad" driving behaviour; (2) such behaviour under test conditions is associated with an unacceptably high rate of accident involvement under non—test conditions. Unfortunately, evidence to support these assumptions is lacking, for two major reasons.

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penal is candidates who do not demonstrate what is considered to be a proper steering action, whereas in the U.S.A. , received wisdom is to the contrary. In fact, there is no hard evidence that one technique is safe than the other. The same situation holds true in relation to many other driving techniques and procedure, regardless of their being dear to the hearts of driving instructors throughout the world.

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Another problem with the use of subsequent accident data to validate a license test is that performance during the test can only reflect current level of ability. However, driving ability does not remain static, particularly during the first few years of experience when significant development of driving skill (taken to include perceptual and cognitive skill as well as that related to vehicle control) is occurring. Thus, even given a perfectly valid and reliable test, it cannot be expected that, for a particular sample of drivers, the ranking of their initial test scores would remain much the same if they were all re—tested six months oz a year later.

2.3 License Test Score and Accident Record

Campbell (1958) compared a group OE drivers involved in fatal accidents with a random sample. The accident group were found to have a lower average passing score on their original road tests

than the random sample, but the groups did not differ significantly on most of the [individual manoeuvres which constituted the total score .

Lauer (1960) concluded that a single manoeuvre, para.11e1 parking with six feet clearance, is the best indicator of competence to drive as indicated by subsequent: accident rate, with a secondary indication available from correct turning manoeuvres in which signals are given. He suggested that the actual driving test should be confined to these. Goldstein (1961) found that for two groups of army driversthe correlations between road test ratings and accident record were not significant.

2.4 License Test Score and Driving Behavior

If test validity cannot be judged on the basis of the relationship between test score and accident rate, how can validity be established?

One approach is to demonstrate that a poor score on the test is positively related to the incidence OE unsafe driving behavior in other situations. However, driving behavior •is affected both by level of driving skill and by not national factors. To the extent that (a) motivation under license test conditions is different from under most normal driving conditions, and (b) motivation affects the probability of occurrence of unsafe driving behavior independently OE driving skill, then test performance cannot be expected to predict the occurrence of unsafe driving behavior under normal driving conditions.

CHAPTER-3

SYSTEM ANALYSIS

3.1 Existing System

In existing system there is no proper machine system to measure the driver performance till now it is validated by an RTO Officer manually. All the time RTO only check the driver performance not every performance will be checked. It was very long scheduled to check all the driver performance. So some of the negotiation will be there for all the driving test. So by avoiding this negotiation we made new project in proposed system.

3.2 Disadvantages of Existing System

- Consume More Times
- Possibility for fraud work
- Money Bribery for getting License
- Not a Systematic Method for Providing License

3.3 Proposed System

In existing system there is no proper machine system to measure the driver performance till now it is validated by an RTO Officer manually. All the time RTO only check the driver performance not every performance will be checked. It was very long scheduled to check all the driver performance. So some of the negotiation will be there for all the driving test. So by avoiding this negotiation we made new project in proposed system.

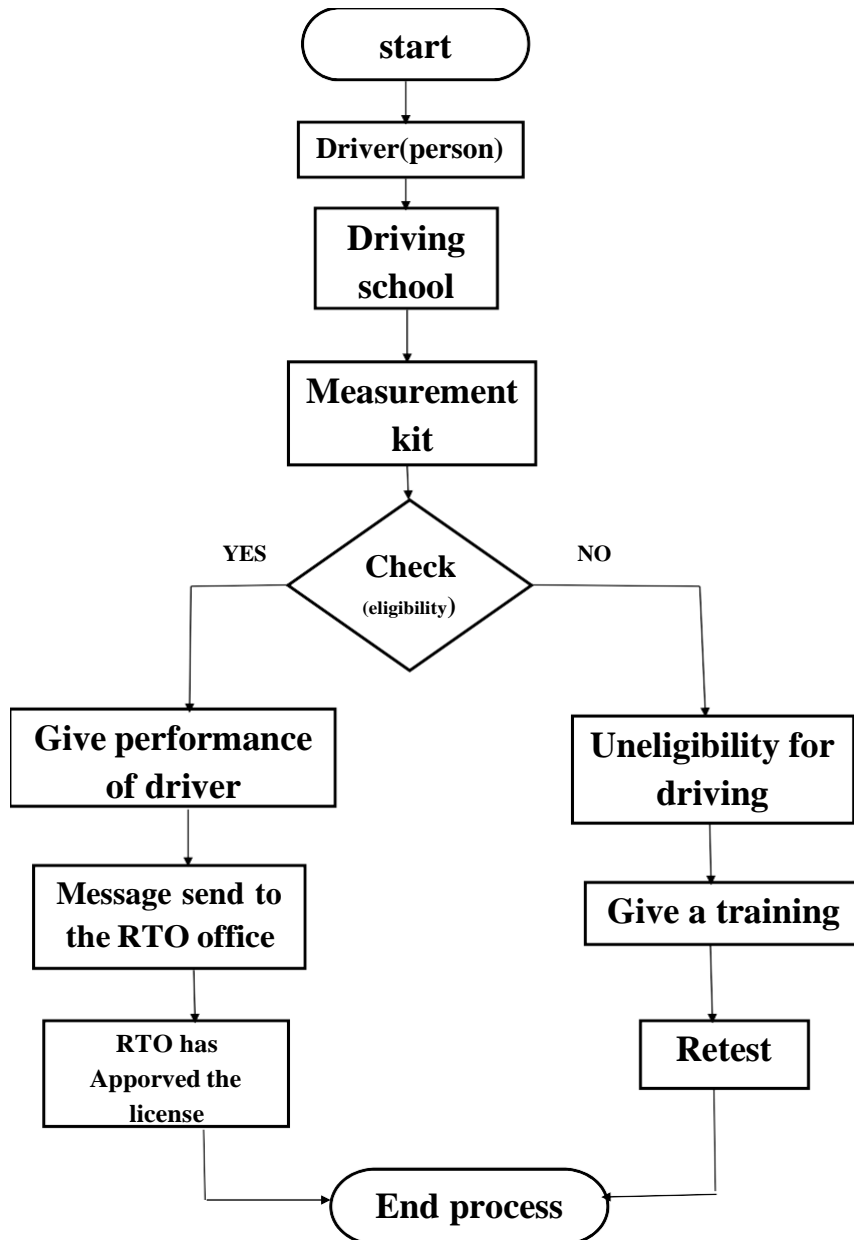


Figure 1.1.Proposed System Flow Diagram

3.4 Advantages of Proposed System

- Easily fixed in the car
- Error finding capacity
- Less chance of accident on road
- Low power conception
- Risk free system

CHAPTER 4

SYSTEM SPECIFICATION

4.1 Hardware requirements

4.1.1 Power supply unit

A power supply unit (or PSU) converts mains AC to low-voltage regulated DC power for the internal components of a computer. Modern personal computers universally use switched-mode power supplies. Some power supplies have a manual switch for selecting input voltage, while others automatically adapt to the mains voltage. The power supply unit is often abbreviated as PSU and is also known as a power pack or power converter.

Power supply:

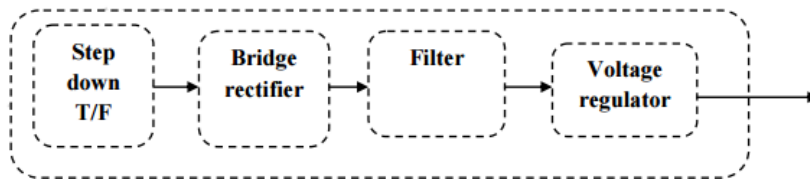


Figure 1.2 Power Supply Unit diagram

The power supply unit is the piece of hardware that's used to convert the power provided from the outlet into usable power for the many parts inside the computer case. Unlike some hardware components used with a computer that aren't necessarily needed, like a printer, the power supply is a crucial piece because without it, the rest of the internal hardware can't function.

Most modern desktop personal computer power supplies conform to the ATX specification, which includes form factor and voltage tolerances. While an ATX power supply is connected to the mains supply, it always provides a 5 Volt standby (5VSB) voltage so that the standby functions on the computer and certain peripherals are powered. ATX power supplies are turned on and off by a signal from the motherboard. They also provide a signal to the motherboard to indicate when the DC voltages are in spec, so that the computer is able to safely power up and boot.

The power supply unit is mounted just inside the back of the case. If you follow the computer's power cable, you'll find that it attaches to the back of the power supply. It's the backside that's usually the only portion of the power supply that most people will ever see. There's also a fan opening at the back of the power supply that sends air out the back of the computer case.

The side of the PSU facing outside the case has a male, three pronged port that a power cable, connected to a power source, plugs into. There is also often a power switch and a power supply voltage switch. Computer power supplies may have short circuit protection, overpower (overload) protection, overvoltage protection, under voltage protection, overcurrent protection, and over temperature protection.

External power supplies are beneficial because it allows the device to be smaller and more attractive. However, like I just described, some of these types of power supply units are attached to the power cable and, since they're generally pretty large, sometimes make it difficult to position the device against the wall. Recent power supplies have a standby voltage available, to allow most of the computer system to be powered off. When the computer is powered down but the power supply is still on, it can be started remotely via Wake-on-LAN and Wake-on-ring or locally via Keyboard Power ON (KBPO) if the motherboard supports it.

Power supplies designed for worldwide use were equipped with an input voltage selector switch that allowed the user to configure the unit for use on local power grid. In the lower voltage range, around 115 V, this switch is turned on changing the power grid voltage rectifier into a voltage doubler in delon circuit design. As a result, the large primary filter capacitor behind that rectifier was split up into two capacitors wired in series, balanced with bleeder resistors and varistors that were necessary in the upper input voltage range, around 230 V.

4.1.2 Transformer

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Electromagnetic induction produces an electromotive force within a conductor which is exposed to time varying magnetic fields. Transformers are used to increase or decrease the alternating voltages in electric power applications.

A varying current in the transformer's primary winding creates a varying magnetic flux in the transformer core and a varying field impinging on the transformer's secondary winding. This varying magnetic field at the secondary winding induces a varying electromotive force (EMF) or voltage in the secondary winding due to electromagnetic induction. Making use of Faraday's Law (discovered in 1831) in conjunction with high magnetic permeability core properties, transformers can be designed to efficiently change AC voltages from one voltage level to another within power networks.

For simplification or approximation purposes, it is very common to analyze the transformer as an ideal transformer model as presented in the two images. An ideal transformer is a theoretical, linear transformer that is lossless and perfectly coupled; that is, there are no energy losses and flux is completely confined within the magnetic core. Perfect coupling implies infinitely high core magnetic permeability and winding inductances and zero net magnetomotive force.

A varying current in the transformer's primary winding creates a varying magnetic flux in the transformer core and a varying magnetic field impinging on the secondary winding. This varying magnetic field at the secondary winding induces a varying EMF or voltage in the secondary winding due to electromagnetic induction. The primary and secondary windings are wrapped around a core of infinitely high magnetic permeability so that all of the magnetic flux passes through both the primary and secondary windings. With a voltage source connected to the primary winding and load impedance connected to the secondary winding, the transformer currents flow in the indicated directions.

According to the law of conservation of energy, any load impedance connected to the ideal transformer's secondary winding results in conservation of apparent, real and reactive power consistent.

In some applications increased leakage is desired, and long magnetic paths, air gaps, or magnetic bypass shunts may deliberately be introduced in a transformer design to limit the short-circuit current it will supply. Leaky transformers may be used to supply loads that exhibit negative resistance, such as electric arcs, mercury vapor lamps, and neon signs or for safely handling loads that become periodically short-circuited such as electric arc welders.

Operation of a transformer at its designed voltage but at a higher frequency than intended will lead to reduced magnetizing current. At a lower frequency, the magnetizing current will increase. Operation of a transformer at other than its design frequency may require assessment of voltages, losses, and cooling to establish if safe operation is practical. For example, transformers may need to be equipped with 'volts per hertz' over-excitation, ANSI function 24, relays to protect the transformer from overvoltage at higher than rated frequency.

Generation of electrical power in low voltage level is very much cost effective. Theoretically, this low voltage level power can be transmitted to the receiving end. This low voltage power if transmitted results in greater line current which indeed causes more line losses. But if the voltage level of a power is increased, the current of the power is reduced which causes reduction in ohmic or I^2R losses in the system, reduction in cross sectional area of the conductor i.e. reduction in capital cost of the system and it also improves the voltage regulation of the system. Because of these, low level power must be stepped up for efficient electrical power transmission.

This is done by step up transformer at the sending side of the power system network. As this high voltage power may not be distributed to the consumers directly, this must be stepped down to the desired level at the receiving end with the help of step down transformer. Electrical power transformer thus plays a vital role in power transmission.

Two winding transformers are generally used where ratio of high voltage and low voltage is greater than 2. It is cost effective to use auto transformer where the ratio between high voltage and low voltage is less than 2. Again a single unit three phase transformer is more cost effective than a bank of three single phase transformers unit in a three phase system. But a single three phase transformer unit is a bit difficult to transport and have to be removed from service entirely if one of the phase winding breaks down.

Step Up Transformer & Step Down Transformer - Generally used for stepping up and down the voltage level of power in transmission and distribution power system network.

Three Phase Transformer & Single Phase Transformer - Former is generally used in three phase power system as it is cost effective than later. But when size matters, it is preferable to use a bank of three single phase transformer as it is easier to transport than one single three phase transformer unit.

Oil Cooled & Dry Type Transformer - In oil cooled transformer the cooling medium is transformer oil whereas the dry type transformer is air cooled.

Outdoor Transformer & Indoor Transformer - Transformers that are designed for installing at outdoor are outdoor transformers and transformers designed for installing at indoor are indoor transformers.

Two Winding Transformer & Auto Transformer - Former is generally used where ratio between high voltage and low voltage is greater than 2. It is cost effective to use later where the ratio between high voltage and low voltage is less than 2.

4.1.3 Rectifier

A rectifier is an electrical device composed of one or more diodes that converts alternating current (AC) to direct current (DC). A diode is like a one-way valve that allows an electrical current to flow in only one direction. This process is called rectification.

A rectifier can take the shape of several different physical forms such as solid-state diodes, vacuum tube diodes, mercury arc valves, silicon-controlled rectifiers and various other silicon-based semiconductor switches.

Rectifiers have many uses, but are often found serving as components of DC power supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power. As noted, detectors of radio signals serve as rectifiers. In gas heating systems flame rectification is used to detect presence of a flame.

Because of the alternating nature of the input AC sine wave, the process of rectification alone produces a DC current that, though unidirectional, consists of pulses of current. Many applications of rectifiers, such as power supplies for radio, television and computer equipment, require a steady constant DC current (as would be produced by a battery). In these applications the output of the rectifier is smoothed by an electronic filter (usually a capacitor) to produce a steady current.

Before the development of silicon semiconductor rectifiers, vacuum tube thermionic diodes and copper oxide- or selenium-based metal rectifier stacks were used. With the introduction of semiconductor electronics, vacuum tube rectifiers became obsolete, except for some enthusiasts of vacuum tube audio equipment. For power rectification from very low to very high current, semiconductor diodes of various types (junction diodes, Schottky diodes, etc.) are widely used.

Other devices that have control electrodes as well as acting as unidirectional current valves are used where more than simple rectification is required—e.g., where variable output voltage is needed. High-power rectifiers, such as those used in high-voltage direct current power transmission, employ silicon semiconductor devices of various types. These are thyristors or other controlled switching solid-state switches, which effectively function as diodes to pass current in only one direction.

Rectifier circuits may be single-phase or multi-phase (three being the most common number of phases). Most low power rectifiers for domestic equipment are single-phase, but three-phase

rectification is very important for industrial applications and for the transmission of energy as DC (HVDC) Rectifier efficiency (η) is defined as the ratio of DC output power to the input power from the AC supply. Even with ideal rectifiers with no losses, the efficiency is less than 100% because some of the output power is AC power rather than DC which manifests as ripple superimposed on the DC waveform. For a half-wave rectifier efficiency is very poor.

Efficiency is reduced by losses in transformer windings and power dissipation in the rectifier element itself. Efficiency can be improved with the use of smoothing circuits which reduce the ripple and hence reduce the AC content of the output. Three-phase rectifiers, especially three-phase full-wave rectifiers, have much greater efficiencies because the ripple is intrinsically smaller. In some three-phase and multi-phase applications the efficiency is high enough that smoothing circuitry is unnecessary.

A real rectifier characteristically drops part of the input voltage (a voltage drop, for silicon devices, of typically 0.7 volts plus an equivalent resistance, in general non-linear)—and at high frequencies, distorts waveforms in other ways. Unlike an ideal rectifier, it dissipates some power. Peak loss is very important for low voltage rectifiers (for example, 12 V or less) but is insignificant in high-voltage applications such as HVDC.

Rectifiers are also used for detection of amplitude modulated radio signals. The signal may be amplified before detection. If not, a very low voltage drop diode or a diode biased with a fixed voltage must be used. When using a rectifier for demodulation the capacitor and load resistance must be carefully matched: too low a capacitance makes the high frequency carrier pass to the output, and too high makes the capacitor just charge and stay charged.

Rectifiers supply polarised voltage for welding. In such circuits control of the output current is required; this is sometimes achieved by replacing some of the diodes in a bridge rectifier with thyristors, effectively diodes whose voltage output can be regulated by switching on and off with phase fired controllers.

4.1.4 Bridge Rectifier

Bridge Rectifiers are the circuits which convert alternating current (AC) into direct current (DC) using the diodes arranged in the bridge circuit configuration. They usually comprise of four or more number of diodes which cause the output generated to be of the same polarity irrespective of the polarity at the input.

A bridge rectifier circuit is a common part of the electronic power supplies. Many electronic circuits require rectified DC power supply for powering the various electronic basic components from available AC mains supply. We can find this rectifier in a wide variety of electronic AC power devices like home appliances, motor controllers, modulation process, welding applications, etc.

Bridge rectifiers are classified into several types based on these factors: type of supply, controlling capability, bridge circuit's configurations, etc. Bridge rectifiers are mainly classified into single and three phase rectifiers. Both these types are further classified into uncontrolled, half controlled and full controlled rectifiers.

The nature of supply, i.e., a single phase or three-phase supply decides these rectifiers. The Single phase bridge rectifier consists of four diodes for converting AC into DC, whereas a three phase rectifier uses six diodes, as shown in the figure. These can be again uncontrolled or controlled rectifiers depending on the circuit components such as diodes, thyristors, and so on.

This bridge rectifier uses diodes for rectifying the input as shown in the figure. Since the diode is a unidirectional device that allows the current flow in one direction only. With this configuration of diodes in the rectifier, it doesn't allow the power to vary depending on the load requirement. So this type of rectifier is used in constant or fixed power supplies.

In this type of rectifier, AC/DC converter or rectifier – instead of uncontrolled diodes, controlled solid state devices like SCR's, MOSFET's, IGBT's, etc. are used to vary the output power at

different voltages. By triggering these devices at various instants, the output power at the load is appropriately changed.

The main advantage of bridge rectifier is that it produces almost double the output voltage as with the case of a full wave rectifier using center-tapped transformer. But this circuit doesn't need center tapped transformer so it resembles low-cost rectifier.

The bridge rectifier circuit diagram consists of various stages of devices like transformer, Diode Bridge, filtering and regulators. Generally all these blocks combination is called as regulated DC power supply that powers various electronic appliances.

The first stage of the circuit is a transformer which is a step-down type that changes the amplitude of the input voltage. Most of the electronic projects uses 230/12V transformer to step-down the AC mains 230V to 12V AC supply.

Next stage is a diode-bridge rectifier which uses four or more diodes depending on the type of bridge rectifier. Choosing a particular diode or any other switching device for a corresponding rectifier needs some considerations of the device like Peak Inverse Voltage (PIV), forward current I_f , voltage ratings, etc. It is responsible for producing unidirectional or DC current at the load by conducting a set of diodes for every half cycle of the input signal.

Since the output after the diode bridge rectifiers is of pulsating nature, and for producing it as a pure DC, filtering is necessary. Filtering is normally performed with one or more capacitors attached across the load, as you can observe in the below figure wherein smoothing of wave is performed. This capacitor rating also depends on the output voltage.

The last stage of this regulated DC supply is a voltage regulator that maintains the output voltage to a constant level.

4.1.5 Filter

The capacitor-input filter, also called the pi filter due to its shape that looks like the Greek letter π , is a type of electronic filter. Filter circuits are used to remove unwanted or undesired frequencies from a signal.

A typical capacitor input filter consists of a filter or reservoir capacitor C_1 , connected across the rectifier output, an inductor L , in series and another filter or smoothing capacitor, C_2 , connected across the load, R_L . A filter of this sort is designed for use at a particular frequency, generally fixed by the AC line frequency and rectifier configuration. When used in this service, filter performance is often characterized by its regulation and ripple.

The capacitor-input filter operates in three steps:

1. The capacitor C_1 offers low reactance to the AC component of the rectifier output while it offers infinite resistance to the DC component. As a result the capacitor shunts an appreciable amount of the AC component while the DC component continues its journey to the inductor L .
2. The inductor L offers high reactance to the AC component but it offers almost zero resistance to the DC component. As a result the DC component flows through the inductor while the AC component is blocked.
3. The capacitor C_2 shunts the AC component which the inductor had failed to block. As a result only the DC component appears across the load R_L .

The component value for the inductor can be estimated as an inductance that resonates the smoothing capacitor(s) at or below one tenth of the minimum AC frequency in the power supplied to the filter (100 Hz from a full-wave rectifier in a region where the power supply is 50Hz). Thus if

reservoir and smoothing capacitors of 2200 microfarads are used, a suitable minimum value for the inductor would be that which resonates 2200 microfarads (μF) to 10 Hz, i.e. 115 mH. A larger value is preferable provided the inductor can carry the required supply current.

Capacitor input filters can provide extremely pure DC supplies, but have fallen out of favour because inductors tend to be unavoidably heavy, which has led to the often-preferred choice of voltage regulators instead.

4.1.6 Regulator

In automatic control, a regulator is a device which has the function of maintaining a designated characteristic. It performs the activity of managing or maintaining a range of values in a machine. The measurable property of a device is managed closely by specified conditions or an advance set value; or it can be a variable according to a predetermined arrangement scheme. It can be used generally to connote any set of various controls or devices for regulating or controlling items or objects.

Examples are a voltage regulator (which can be a transformer whose voltage ratio of transformation can be adjusted, or an electronic circuit that produces a defined voltage), a pressure regulator, such as a diving regulator, which maintains its output at a fixed pressure lower than its input, and a fuel regulator (which controls the supply of fuel).

4.1.7 Voltage Regulator

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an

electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

A simple voltage/current regulator can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may be fine.

Feedback voltage regulators operate by comparing the actual output voltage to some fixed reference voltage. Any difference is amplified and used to control the regulation element in such a way as to reduce the voltage error. This forms a negative feedback control loop; increasing the open-loop gain tends to increase regulation accuracy but reduce stability. (Stability is avoidance of oscillation, or ringing, during step changes.) There will also be a trade-off between stability and the speed of the response to changes.

If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded, up to a point, to produce a higher output voltage—by dropping less of the input voltage (for linear series regulators and buck switching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high, the regulation element will normally be commanded to produce a lower voltage.

However, many regulators have over-current protection, so that they will entirely stop sourcing current (or limit the current in some way) if the output current is too high, and some regulators may also shut down if the input voltage is outside a given range.

In electromechanical regulators, voltage regulation is easily accomplished by coiling the sensing wire to make an electromagnet. The magnetic field produced by the current attracts a moving ferrous core held back under spring tension or gravitational pull.

As voltage increases, so does the current, strengthening the magnetic field produced by the coil and pulling the core towards the field. The magnet is physically connected to a mechanical power switch, which opens as the magnet moves into the field. As voltage decreases, so does the current, releasing spring tension or the weight of the core and causing it to retract. This closes the switch and allows the power to flow once more.

If the mechanical regulator design is sensitive to small voltage fluctuations, the motion of the solenoid core can be used to move a selector switch across a range of resistances or transformer windings to gradually step the output voltage up or down, or to rotate the position of a moving-coil AC regulator.

Early automobile generators and alternators had a mechanical voltage regulator using one, two, or three relays and various resistors to stabilize the generator's output at slightly more than 6 or 12 V, independent of the engine's rpm or the varying load on the vehicle's electrical system.

Essentially, the relay(s) employed pulse width modulation to regulate the output of the generator, controlling the field current reaching the generator (or alternator) and in this way controlling the output voltage producing back into the generator and attempting to run it as a motor. The rectifier diodes in an alternator automatically perform this function so that a specific relay is not required; this appreciably simplified the regulator design.

To control the output of generators (as seen in ships and power stations, or on oil rigs, greenhouses and emergency power systems) automatic voltage regulators are used. This is an active system. While the basic principle is the same, the system itself is more complex. An automatic voltage regulator (or AVR for short) consists of several components such as diodes, capacitors, resistors and potentiometers or even microcontrollers, all placed on a circuit board. This is then mounted near the generator and connected with several wires to measure and adjust the generator. In the first place the AVR monitors the output voltage and controls the input voltage for the exciter of the generator. By increasing or decreasing the generator control voltage, the output

voltage of the generator increases or decreases accordingly. The AVR calculates how much voltage has to be sent to the exciter numerous times a second, therefore stabilizing the output voltage to a predetermined set point. When two or more generators are powering the same system (parallel operation) the AVR receives information from more generators to match all output.

When the movable coil is positioned perpendicular to the fixed coil, the magnetic forces acting on the movable coil balance each other out and voltage output is unchanged. Rotating the coil in one direction or the other away from the center position will increase or decrease voltage in the secondary movable coil. This type of regulator can be automated via a servo control mechanism to advance the movable coil position in order to provide voltage increase or decrease. A braking mechanism or high ratio gearing is used to hold the rotating coil in place against the powerful magnetic forces acting on the moving coil.

This is the latest technology of voltage regulation to provide real-time control of voltage fluctuation, sag, surge and also to control other power quality issues such as spikes and EMI/RFI electrical noises. This uses an IGBT regulator engine generating pulse width modulated (PWM) AC voltage at high switching frequency. This AC PWM wave is superimposed on the main incoming wave through a buck-boost transformer, to provide precisely regulated AC voltage. The regulation in this technology is instantaneous, thus making it suitable for electronic machines which need precise regulated power.

Voltage regulators or stabilizers are used to compensate for voltage fluctuations in mains power. Large regulators may be permanently installed on distribution lines. Small portable regulators may be plugged in between sensitive equipment and a wall outlet. Automatic voltage regulators are used on generator sets on ships, in emergency power supplies, on oil rigs, etc. to stabilize fluctuations in power demand. For example, when a large machine is turned on, the demand for power is suddenly a lot higher.

The voltage regulator compensates for the change in load. Commercial voltage regulators normally operate on a range of voltages, for example 150–240 V or 90–280 V. Servo stabilizers are also manufactured and used widely in spite of the fact that they are obsolete and use out-dated technology.

Voltage regulators are used in devices like air conditioners, refrigerators, televisions etc. in order to protect them from fluctuating input voltage. The major problem faced is the use of relays in voltage regulators. Relays create sparks which result in faults in the product.

4.1.8 ARDUINO UNO

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world.

The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on the Processing project, which includes support for the C and C++ programming languages.

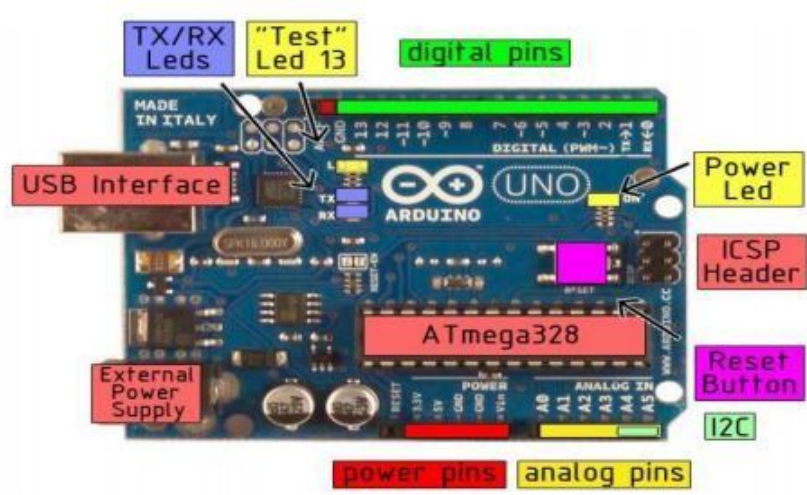


Figure 1.3.Arduino Uno Circiut Board

TECHNICAL SPECIFICATION

| | |
|-----------------------------|--|
| Microcontroller | ATmega328 |
| Operating Voltage | 5v |
| Input Voltage (recommended) | 7-12v |
| Input Voltage (limits) | 6-20v |
| Digital I/O Pins | 14 (of which 6 provide PWM output) |
| Analog Input Pins | 6 |
| DC Current per I/O Pin | 40mA |
| DC Current for 3.3V Pin | 50mA |
| Flash Memory | 32 KB of which 0.5 KB used by bootloader |
| SRAM | 2KB |
| EEPROM | 1KB |
| Clock Speed | 16MHz |

Table 1.1 Technical Specification Table

The first Arduino was introduced in 2005, aiming to provide an inexpensive and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simplerobots, thermostats, and motion detectors.

Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be manufactured by anyone. Adafruit Industries estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced, and in 2013 that 700,000 official boards were in users' hands.

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

An Arduino board historically consists of an Atmel 8-, 16- or 32-bit AVR microcontroller (although since 2015 other makers microcontrollers have been used) with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which lets users connect the CPU board to a variety of interchangeable add-on modules known as shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial bus—so many shields can be stacked and used in parallel. Prior to 2015 Official Arduinos had used the Atmel megaAVR series of chips, specifically

The ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560 and in 2015 units by other manufacturers were added. A handful of other processors have also been used by Arduino compatibles. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some variants), although some designs such as the LilyPad run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions. An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading

of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer. Currently, optibootbootloader is the default bootloader installed on Arduino UNO.

At a conceptual level, when using the Arduino integrated development environment, all boards are programmed over a serial connection. Its implementation varies with the hardware version. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and TTL-level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods, when used with traditional microcontroller tools instead of the ArduinoIDE, standard AVR ISP programming is used.

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The Diecimila, Duemilanove, and current Uno provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.10-inch (2.5 mm) headers. Several plug-in application shields are also commercially available. The Arduino Nano, and Arduino-compatible Bare Bones Board and Boarduino boards may provide male header pins on the underside of the board that can plug into solderless breadboards.

There are many Arduino-compatible and Arduino-derived boards. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by adding output drivers, often for use in school-level education to simplify the construction of buggies and small robots. Others are electrically equivalent but change the form factor, sometimes retaining

compatibility with shields, sometimes not. Some variants use completely different processors, with varying levels of compatibility.

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available. The source code for the IDE is released under the GNU General Public License, version 2. Nevertheless an official Bill of Materials of Arduino boards has never been released by the staff of Arduino.

Although the hardware and software designs are freely available under copyleft licenses, the developers have requested that the name "Arduino" be exclusive to the official product and not be used for derived works without permission. The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product.

Several Arduino-compatible products commercially released have avoided the Arduino name by using -duino name variants.

Many Arduino-compatible and Arduino-derived boards exist. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by adding output drivers, often for use in school-level education, to simplify making buggies and small robots. Others are electrically equivalent but change the form factor, sometimes retaining compatibility with shields, sometimes not. Some variants use different processors, of varying compatibility.

Arduino 328P

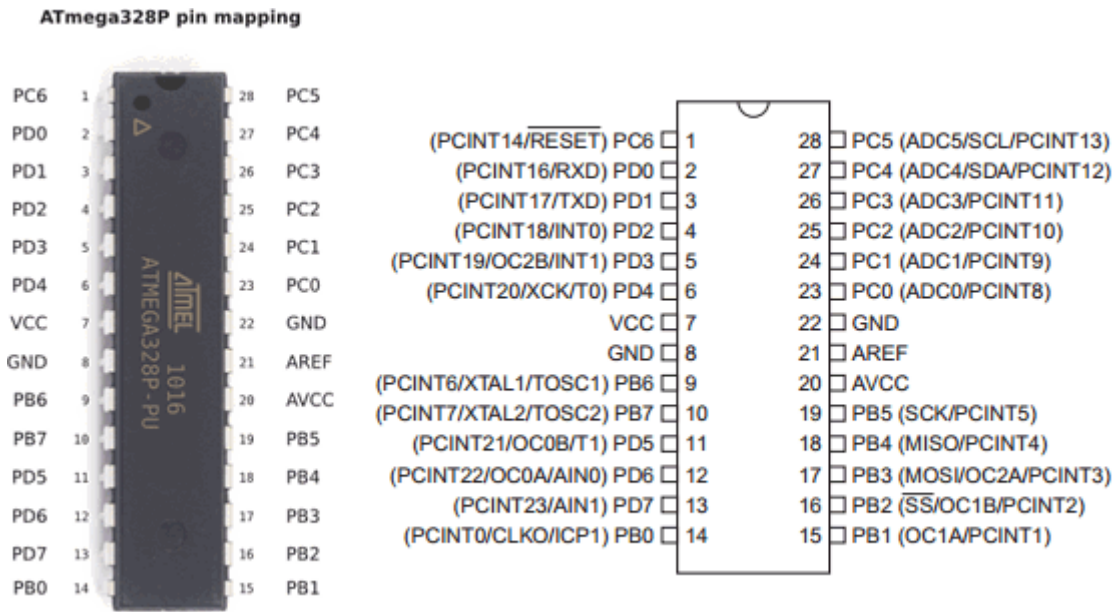


Figure 1.4.Pin Mapping

The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.

The high-performance Atmel picoPower 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software

selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Key parameters

| | |
|-------------------------------|--|
| CPU type | 8-bit AVR |
| Performance | 20 MIPS at 20 MHz ^[2] |
| Flash memory | 32 kB |
| SRAM | 2 kB |
| EEPROM | 1 kB |
| Pin count | 28-pin PDIP , MLF , 32-pin TQFP , MLF ^[2] |
| Maximum operating frequency | 20 MHz |
| Number of touch channels | 16 |
| Hardware QTouch Acquisition | No |
| Maximum I/O pins | 26 |
| External interrupts | 24 |
| USB Interface | No |
| USB Speed | No |

Table 1.2. key Parameters table for Arduino

Applications

As of 2013 the ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed[citation needed]. Perhaps the most common implementation of this chip is on the popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

Programming

Reliability qualification shows that the projected data retention failure rate is much less than 1 PPM over 20 years at 85 °C or 100 years at 25 °C.

Parallel program mode^[2]

| Programming signal | Pin Name | I/O | Function |
|---------------------------|-----------------|------------|--|
| RDY/BSY | PD1 | O | High means the MCU is ready for a new command, otherwise busy. |
| OE | PD2 | I | Output Enable (Active low) |
| WR | PD3 | I | Write Pulse (Active low) |
| BS1 | PD4 | I | Byte Select 1 (-0 = Low byte, -1 = High byte) |
| XA0 | PD5 | I | XTAL Action bit 0 |
| XA1 | PD6 | I | XTAL Action bit 1 |
| PAGEL | PD7 | I | Program memory and EEPROM Data Page Load |
| BS2 | PC2 | I | Byte Select 2 (-0 = Low byte, -1 = 2nd High byte) |
| DATA | PC[1:0]:PB[5:0] | I/O | Bi-directional data bus (Output when OE is low) |

Table1.3. Programming Mode Table

Programming mode is entered when PAGEL (PD7), XA1 (PD6), XA0 (PD5), BS1 (PD4) is set to zero. RESET pin to 0V and VCC to 0V. VCC is set to 4.5 - 5.5V. Wait 60 μs, and RESET is set to 11.5 - 12.5 V. Wait more than 310 μs. Set XA1:XA0:BS1:DATA = 100 1000 0000, pulse

XTAL1 for at least 150 ns, pulse WR to zero. This starts the Chip Erase. Wait until RDY/BSY (PD1) goes high. XA1:XA0:BS1:DATA = 100 0001 0000, XTAL1 pulse, pulse WR to zero. This is the Flash write command. And so on..

Serial Programming

| Symbol | Pins | I/O | Description |
|--------|------|-----|-----------------|
| MOSI | PB3 | I | Serial data in |
| MISO | PB4 | O | Serial Data out |
| SCK | PB5 | I | Serial Clock |

Table 1.4. Serial Programming Table

Serial data to the MCU is clocked on the rising edge and data from the MCU is clocked on the falling edge. Power is applied to VCC while RESET and SCK are set to zero. Wait for at least 20 ms and then the Programming Enable serial instruction 0xAC, 0x53, 0x00, 0x00 is sent to the MOSI pin. The second byte (0x53) will be echoed back by the MCU

4.1.9 LCD

A liquid-crystal display (LCD) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.



Figure 1.5.Liquid Crystal Display

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. LCD screens are also used on consumer electronics products such as DVD players, video game devices and clocks. LCD screens have replaced heavy, bulky cathode ray tube (CRT) displays in nearly all applications. LCD screens are available in a wider range of screen sizes than CRT and plasma displays, with LCD screens available in sizes ranging from tiny digital watches to huge, big-screen television set.

The Hitachi HD44780 LCD controller is limited to monochrome text displays and is often used in copiers, fax machines, laser printers, industrial test equipment, networking equipment, such as routers and storage devices.

Compatible LCD screens are manufactured in several standard configurations. Common sizes are one row of eight characters (8x1), and 16x2, 20x2 and 20x4 formats. Larger custom sizes are made with 32, 40 and 80 characters and with 1, 2, 4 or 8 lines. The most commonly manufactured larger configuration is 40x4.characters, which requires two individually addressable

HD44780 controllers with expansion chips as a single HD44780 chip can only address up to 80 characters. A common smaller size is 16×2, and this size is readily available as surplus stock for hobbyist and prototyping work.

Character LCDs may have a backlight, which may be LED, fluorescent, or electroluminescent. Character LCDs use a 16 contact interface, commonly using pins or card edge connections on 0.1 inch (2.54 mm) centers. Those without backlights may have only 14 pins, omitting the two pins powering the light. The pinout is as follows:

- Ground
- VCC (+3.3 to +5V)
- Contrast adjustment (VO)
- Register Select (RS). RS=0: Command, RS=1: Data
- Read/Write (R/W). R/W=0: Write, R/W=1: Read (This pin is optional due to the fact that most of the time you will only want to write to it and not read. Therefore, in general use, this pin will be permanently connected directly to ground.)
- Clock (Enable). Falling edge triggered
- Bit 0 (Not used in 4-bit operation)
- Bit 1 (Not used in 4-bit operation)
- Bit 2 (Not used in 4-bit operation)
- Bit 3 (Not used in 4-bit operation)
- Bit 4
- Bit 5

- Bit 6
- Bit 7
- Backlight Anode (+) (If applicable)
- Backlight Cathode (-) (If applicable)

The nominal operating voltage for LED backlights is 5V at full brightness, with dimming at lower voltages dependent on the details such as LED color. Non-LED backlights often require higher voltages.

The HD44780 interface supports two modes of operation, 8-bit and 4-bit. Using the 4-bit mode is more complex, but reduces the number of active connections needed. For this reason, in 4-bit mode a command is sent in two operations.

Because the operation mode is not defined at power-up (may be 8-bit or 4-bit), one must always set the operation mode using the Function Set command.

To enable 4-bit mode requires some careful selection of commands. There are two primary limitations. First, with the reduced lines, the D0-D3 lines will always be low when the LCD is in 8-bit mode. Second, the HD44780 may be in one of three states:

- (State1) 8-bit mode
- (State2) 4-bit mode, ready for first set of 4 bits
- (State3) 4-bit mode, already latched 4 bits

State 3 may occur, for example, if a prior control was aborted after sending only the first 4 bits of a command, while the LCD was in 4-bit mode.

There is a way to ensure the LCD returns to 4-bit mode of operation, as follows:

- First, set D7..D4 to 0b0011, and toggle the enable bit. From State1, the LCD will see the command as 0b0011_0000, and thus remain in 8-bit mode (State1). From State3, the LCD will see the command as 0b0011_xxxx (where xxxx are unknown bits) -- which still sets the LCD to 8-bit mode (State1). From State2, the bits are simply latched as the values for D3..D0 (State3). Therefore, after this, the HD44780 can only be in State1 or State3.
- Next, set D7..D4 to 0b0011 again, and toggle the enable bit. From State1, the LCD will again remain in 8-bit mode, as noted above. From State2, the LCD will see the command as 0b0011_0011, which sets the LCD to 8-bit mode. Therefore, after second command, the HD44780 is guaranteed to be in 8-bit mode (State1)
- Now that the LCD is ensured to be set to 8-bit mode, it is safe to request that it change to 4-bit mode. To do so, set D7..D4 to 0b0010, and toggle the enable bit. The LCD will see the command as 0b0010_0000, which will change it to use 4-bit command mode. Therefore, after this third command, the HD44780 can only be in 4-bit command mode.
- Finally, it should be noted that this sets the LCD to single-line mode, using standard 5x8 fonts, so additional FUNCTION SET commands may be needed to fully initialize the display. Once in 4-bit mode, character and control data are transferred as pairs of 4-bit "nibbles" on the upper data pins, D4-D7

4.1.10 Ultrasonic Sensor

Ultrasonic detection is most commonly used in industrial applications to detect hidden tracks, discontinuities in metals, composites, plastics, ceramics, and for water level detection. For this purpose the laws of physics which are indicating the propagation of sound waves through solid

materials have been used since ultrasonic sensors using sound instead of light for detection. Sound is a mechanical wave travelling through the mediums, which may be a solid, or liquid or gas. Sound waves can travel through the mediums with specific velocity depends on the medium of propagation. The sound waves which are having high frequency reflect from boundaries and produces distinctive echo patterns.



Figure 1.6.Ultrasonic Sensor

Operation of ultrasonic sensors

When an electrical pulse of high voltage is applied to the ultrasonic transducer it vibrates across a specific spectrum of frequencies and generates a burst of sound waves. Whenever any obstacle comes ahead of the ultrasonic sensor the sound waves will reflect back in the form of echo and generates an electric pulse. It calculates the time taken between sending sound waves and receiving echo. The echo patterns will be compared with the patterns of sound waves to determine detected signal's condition

Three Applications involving Ultrasonic detection

The distance of obstacle or discontinuities in metals is related to velocity of sound waves in a medium through which waves are passed and the time taken for echo reception. Hence the ultrasonic detection can be used for finding the distances between particles, for detecting the discontinuities in metals and for indicating the liquid level.

• Ultrasonic Distance Measurement

Ultrasonic sensors are used for distance measuring applications. These gadgets regularly transmit a short burst of ultrasonic sound to a target, which reflects the sound back to the sensor. The system then measures the time for the echo to return to the sensor and computes the distance to the target using the speed of sound within the medium.

Different sorts of transducers are utilized within industrially accessible ultrasonic cleaning devices. An ultrasonic transducer is affixed to a stainless steel pan which is filled with a solvent and a square wave is applied to it, conferring vibration energy on the liquid.

The ultrasonic distance sensors measure distance using sonar; an ultrasonic (well above human hearing) beat is transmitted from the unit and distance-to-target is determined by measuring the time required for the echo return. Output from the ultrasonic sensor is a variable-width beat that compares to the distance to the target.

Eight Features of Ultrasonic Distance Sensor

- Supply voltage: 5V (DC).
- Supply current: 15mA.
- Modulation frequency: 40Hz.
- Output: 0 – 5V (Output high when obstacle detected in range).

- Beam Angle: Max 15 degree.
- Distance: 2cm – 400cm.
- Accuracy: 0.3cm.
- Communication: Positive TTL pulse.

4.1.11 GSM

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multipleaccess (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.



Figure 1.7.GSM Module Circuit Board.

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850

MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone.

When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. For the purpose of this document, the term GSM modem is used as a generic term to refer to any modem that supports one or more of the protocols in the GSM evolutionary family, including the 2.5G technologies GPRS and EDGE, as well as the 3G technologies WCDMA, UMTS, HSDPA and HSUPA.

A GSM modem exposes an interface that allows applications such as NowSMS to send and receive messages over the modem interface. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. To perform these tasks, a GSM modem must support an –extended AT command set for sending/receiving SMS messages, as defined in the ETSI GSM 07.05 and 3GPP TS 27.005 specifications.

A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. Any phone that supports the –extended AT command set for sending/receiving SMS messages, as defined in ETSI GSM 07.05 and/or 3GPP TS 27.005, can be supported by the Now SMS & MMS Gateway. Note that not all mobile phones support this modem interface.

Due to some compatibility issues that can exist with mobile phones, using a dedicated GSM modem is usually preferable to a GSM mobile phone. This is more of an issue with MMS messaging, where if you wish to be able to receive inbound MMS messages with the gateway, the modem interface on most GSM phones will only allow you to send MMS messages. This is because the mobile phone automatically processes received MMS message notifications without forwarding them via the modem interface.

It should also be noted that not all phones support the modem interface for sending and receiving SMS messages. In particular, most smart phones, including Blackberries, iPhone, and Windows Mobile devices, do not support this GSM modem interface for sending and receiving SMS messages at all at all. Additionally, Nokia phones that use the S60 (Series 60) interface, which is Symbian based, only support sending SMS messages via the modem interface, and do not support receiving SMS via the modem interface.

GSM modems can be a quick and efficient way to get started with SMS, because a special subscription to an SMS service provider is not required. In most parts of the world, GSM modems are a cost effective solution for receiving SMS messages, because the sender is paying for the message delivery.

GSM is a cellular network, which means that cell phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, pico, femto, and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average rooftop level. Micro cells are cells whose antenna height is under average rooftop level; they are typically used in urban areas.

Picocells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and

connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

Cell horizontal radius varies depending on antenna height, antenna gain, and propagation conditions from a couple of hundred meters to several tens of kilometres. The longest distance the GSM specification supports in practical use is 35 kilometres (22 mi). There are also several implementations of the concept of an extended cell, where the cell radius could be double or even more, depending on the antenna system, the type of terrain, and the timing advance.

Indoor coverage is also supported by GSM and may be achieved by using an indoor picocell base station, or an indoor repeater with distributed indoor antennas fed through power splitters, to deliver the radio signals from an antenna outdoors to the separate indoor distributed antenna system. These are typically deployed when significant call capacity is needed indoors, like in shopping centers or airports. However, this is not a prerequisite, since indoor coverage is also provided by in-building penetration of the radio signals from any nearby cell.

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

GSM has used a variety of voice codecs to squeeze 3.1 kHz audio into between 6.5 and 13 kbit/s. Originally, two codecs, named after the types of data channel they were allocated, were used, called Half Rate (6.5 kbit/s) and Full Rate (13 kbit/s). These used a system based on linear predictive coding (LPC). In addition to being efficient with bitrates, these codecs also made it easier to identify more important parts of the audio, allowing the air interface layer to prioritize and better protect these parts of the signal.

Since many GSM network operators have roaming agreements with foreign operators, users can often continue to use their mobile phones when they travel to other countries. SIM cards (Subscriber Identity Module) holding home network access configurations may be switched to those will metered local access, significantly reducing roaming costs while experiencing no reductions in service.

GSM, together with other technologies, is part of the evolution of wireless mobile telecommunications that includes High-Speed Circuit-Switched Data (HSCSD), General Packet Radio System (GPRS), Enhanced Data GSM Environment (EDGE), and Universal Mobile Telecommunications Service (UMTS).

2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described as a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).

4.2 Software Requiriements

4.2.1 Arudino IDE

If you haven't written "code" in any computer language yet, you'll have to get used to writing very specific commands to get things done. But Arduino gives you many easy to use commands.

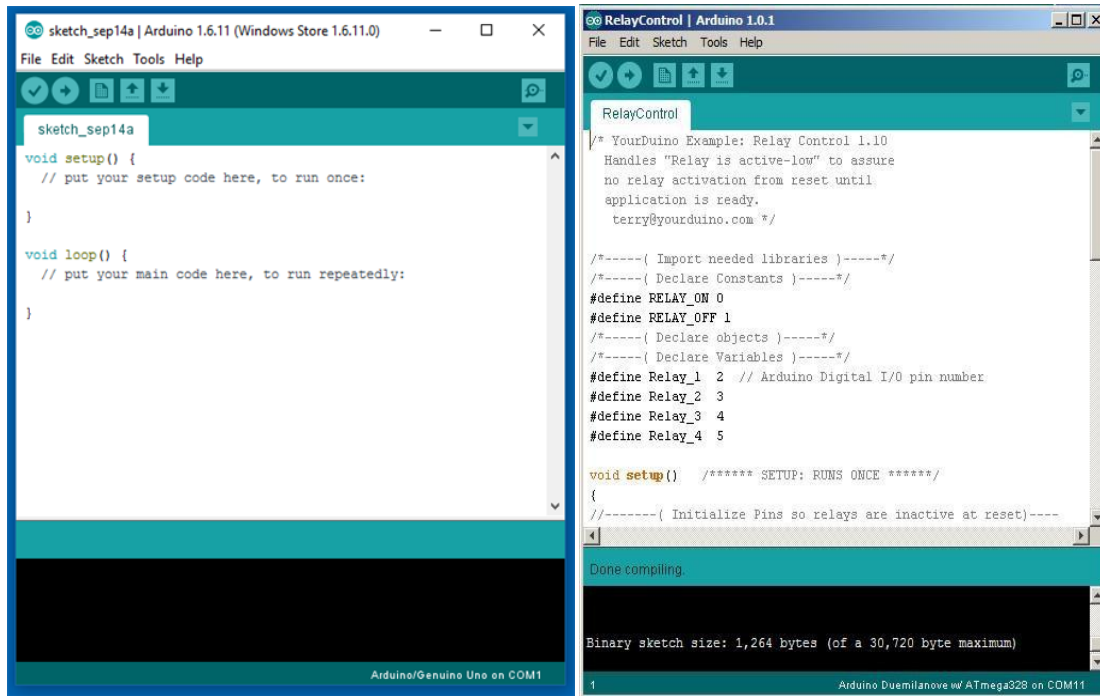


Figure 1.8.Arduino Uno Programming Sketch

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. Arduino is a small circuit board with an Atmel MicroController chip and other parts. See examples [HERE](#). Arduino is intended for use by both non-technical people with no previous programming experience and seasoned pros who love to tinker. Arduino was developed in Italy by Massimo Banzi and a group of people who believed Hardware and Software should be "Open Source" and available to everyone.

Physical Computing is quite different than writing software for personal computers where the only physical inputs are the Mouse and Keyboard. With Arduino you can connect and control literally hundreds of different devices, and write software that creates new Intelligent Devices. We can see how this goes together here.

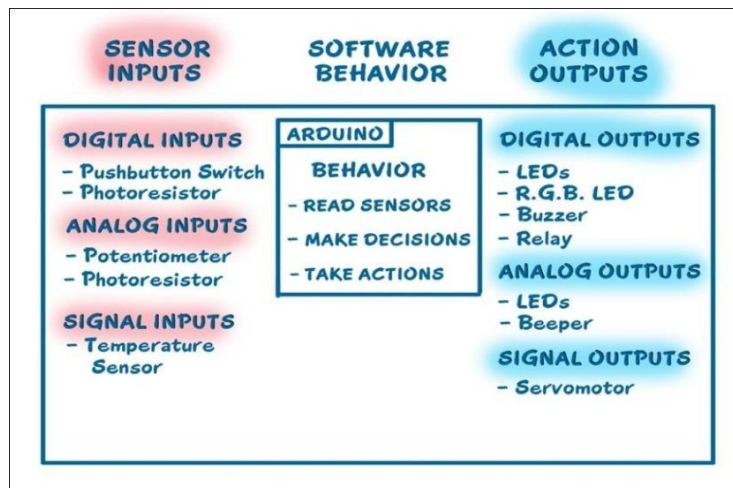


Figure 1.9. Software Implementation Diagram

SENSOR INPUTS On the left are examples of some of the Input Devices you can connect.

ACTION OUTPUTS On the right are examples of Output Devices you can control.

SOFTWARE BEHAVIOR Here is where you write software (called SKETCHES in Arduino) that makes decisions about what things are sensed with Input Devices, and what actions will be taken with the Output Devices. This may be as simple as sounding a buzzer when a switch is closed.

The Arduino IDE (Integrated Development Environment)

This is the free software you will use to create the Behavior of your project. Here's what it includes:

An **EDITOR** to create and edit the text of your software Sketch. It actively highlights Keywords in the language so typing errors are more obvious.

A **VERIFY** system that runs through your Sketch, verifies that there are no errors, and then compiles it into the machine language program that can be Uploaded to your Arduino board over the USB cable. (This is often called MAKE in other systems, and actually is quite complex, running system preprocessor, compiler, linker etc. "Under the covers").

An **UPLOAD** system that communicates with your Arduino Board over USB, loads your program into Arduino memory, and starts your program running.

A **SERIAL MONITOR** window that allows you to receive and send messages from programs running on your Arduino board. This is often used for testing and "debugging" programs.

Many **EXAMPLE** software Sketches that show how to use many different devices and techniques.

A **LIBRARY** system containing many prewritten sections of software.

A **FILE** system to save and retrieve Sketches.

A **HELP** system that includes the entire Arduino Reference document

CHAPTER - 5

PROJECT DESCRIPTION

5.1 Problem Definition

The problem identification in this project is, During certification process from the Driving School. some of them have a chance for fraud work, that is without drive a car they will provide certificate for money ,then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident. so the major problem issues is to solve the money bribery and accident met on the road

5.2 Overview Of the Project

In this project the driver performance measuring kit is fitting in the vehicle. Ultrasonic sensor is fitting in the four sides of the car, when the car is moving on a road the sensor will start sense . if wrong direction will moved, the sensor gives the wrong message in the LCD Display. Then the switch present in the Accelerator will give full race pressure switch will sense the data send to the microcontroller .after that the microcontroller will analyses the data input given. when two are more times the sensor will sense the microcontroller will collect the message will be automatically send to the information via GSM to the RTO Office.

5.3 Module Description

5.3.1 RTO Officer

The **Regional Transport Office** or **Regional Transport Authority (RTO / RTA)** is the organization of the Indianguvernment responsible for maintaining a database of drivers and a database of vehicles of India. The RTO issues driving licenses organizes collection of vehicle excise duty (also known as vehiclesfor variousroad tax and road fund license) and sells personalized. Along with this, the RTO is also responsible to inspect vehicle's insurance and clear the pollution test.

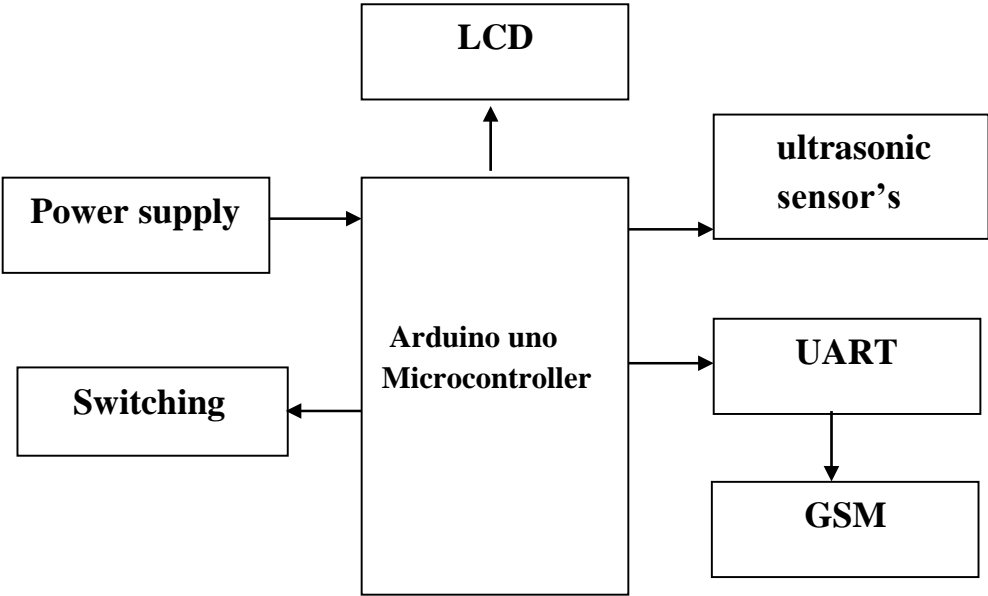
5.3.2 Driving School

Driver's education, driver education, driving education, driver's ed, or driving tuition or driving lessons is a formal class or program that prepares a new driver to obtain a learner's permit or driver's license. The formal class program may also prepare existing license holders for an overseas license conversion or medical assessment driving test or refresher course. It may take place in a classroom, in a vehicle, online, or a combination of the above. Topics of instruction include trafficcode or laws and vehicle operation. Typically, instruction will warn of dangerous conditions in driving such as road conditions, driver impairments, and hazardous weather. Instructional videos may also be shown, demonstrating proper driving strategies and the consequences for not observing the rules.

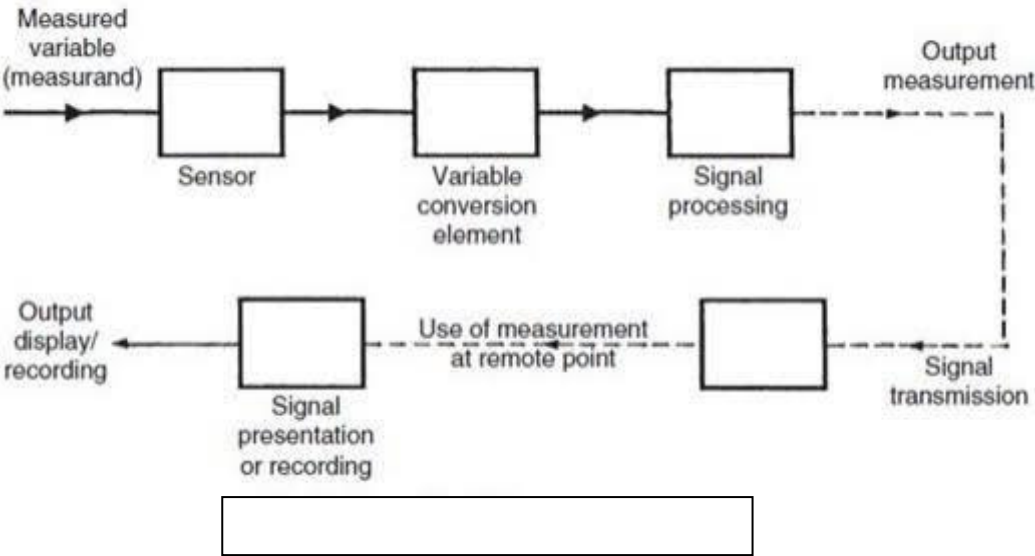
5.3.3 Candidate

Candidate is the one of most important person in this project. In this project if the candidate is applying a driving License via Driving school certification. But the Existing System is the Candidate Applying the Driving License Via Driving school and getting the License from RTO office after completing the Testing. In this Existing system Drawback is increasing and We are rectifying that drawback by invented the New project that is License Eligibility Measurement System.

5.4 Circuit Diagram



5.5 Software Implementation Diagram



5.6 Input Design

In this Project the Input design is First the Candidate applying the Driving License Via Driving School. After Completing the time Duration of the LLR then the Candidate is drive the Car. In this Project the Driving License Eligibility Measurement Kit will be fixed in the car and after the completion of testing the measurement kit will give a result that is Eligible or Non Eligible.

5.6.1 OUTPUT DESIGN

After the Completion of the testing the LCD give a result. that is the total count of the error is less than 10 then the Global System for Mobile Communication is send the Message to the RTO office License is Eligible for this candidate otherwise GSM is send the message to the RTO office License is not Eligible for this Candidate. If License is Eligible then the License is provided or the License is Not Eligible the Retest Process will be appear.

CHAPTER-6

SYSTEM TESTING

System testing is the stage of implementation, Which is aimed at ensuring that the system works accurately and efficiently before live operation commences. Testing is vital to the success of the system. An elaborate testing of data is prepared and the system is testing usingt this test data while testing errors of are noted and the corrections are mae .The users are trained to operate the developed system. Both hardware and software securities are made to run the developed system successfully in future.

- Unit Testing
- Integration Testing
- Validation Testing
- Output Testing
- User Acceptance Testing

6.1 Unit Testing

Unit testing focuses verification efforts on the smallest unit of software design and the module. This is also known as –Module Testingll. The modules are tested separately. This testing is carried out programming stage itself. In this testing step each module is found to be working satisfactorily as regard to the excepted output from the module.

6.2 Integration Testing

Integration testing is a systematic technique for construction tests to uncover errors associated within the interface. In this project, all the modules are combined, and then the entire programs tested as a whole. Thus in the integration testing step, all the errors uncovered are corrected for next testing steps, all the errors uncovered are corrected for the next steps.

6.3 Validation Testing

Validation testing is the testing where requirements are established as a part of software requirement analysis is validated against the software that has been constructed. This test provide the final assurance that the software meets all functional, behavior a land performance requirements. T errors which are uncovered during integration testing are corrected during this phase.

6.4 Output Testing

After performing the validation testing. The next step is output testing of the proposed system since no system could be useful if it does not produced the required output in the Specific format. The output generated or displayed by the system under consideration is tested asking the uses about the format required by then. Here, the output is considered into two ways one is the screen and the other is in a printed format designed according to the user needs. For the hard copy also: the output comes out as specified by the user. Hence output testing does not result in any connections in the system.

6.5 User Acceptance Testing

The testing of the software began along with coding. Since the design was fully object oriented, first the interface were developed and tested. Then unit testing was done for every module in the software for various input, such that each line of code is at least once executed this testing. A system is the key factor for the success of any system the system under consideration is tested for user acceptance by constantly keeping in touch with the prospective system uses at time of developing and making of the Arduino programming

CHAPTER - 7

CONCLUSION AND FUTURE ENHANCEMENT

By using this measuring kit it will provide a 90% of original Driver Performance and it helps to avoid the Fraudulent and Accident on the road. The certification from the Driving School doesn't have a chance for fraud work, that is without drive a car they will not provide a certificate for money ,then the person will not easily get a driving license. So avoid chance of accident on the road. In this project driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit. Then the Result send to the RTO office via GSM .

REFERENCES

Appendix-1

Source code

```
#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#include<SoftwareSerial.h>

SoftwareSerialgsm(2,3);

int led = 13;

unsigned long delayStart = 0; // the time the delay started

booldelayRunning = false; // true if still waiting for delay to finish

LiquidCrystal_I2C lcd(0x27,16,2);

#define trigPin1 5

#define echoPin1 4

#define trigPin2 7

#define echoPin2 6

#define trigPin3 9

#define echoPin3 8

#define trigPin4 11

#define echoPin4 10

int counter1 = 0;

int counter2 = 0;

int counter3 = 0;

int counter4 = 0;

intcurrentState = 0;
```

```

int previousState = 0;

int currentState1 = 0;

int previousState1 = 0;

int currentState2 = 0;

int previousState2 = 0;

int currentState3 = 0;

int previousState3 = 0;

int currentState4 = 0;

int previousState4 = 0;

int total;

void setup() {

pinMode(led, OUTPUT); // initialize the digital pin as an output.

digitalWrite(led, HIGH); // turn led on

delayStart = millis(); // start delay

delayRunning = true; // not finished yet

lcd.init();           // initialize the lcd

lcd.init();

    // Print a message to the LCD.

lcd.backlight();

pinMode(trigPin1, OUTPUT);

pinMode(echoPin1, INPUT);

pinMode(trigPin2, OUTPUT);

pinMode(echoPin2, INPUT);

pinMode(trigPin3, OUTPUT);

pinMode(echoPin3, INPUT);

```

```
pinMode(trigPin4, OUTPUT);
pinMode(echoPin4, INPUT);
lcd.begin(16, 2);
lcd.setCursor(0, 0);
lcd.print("U1:");
lcd.setCursor(6, 0);
lcd.print("U2:");
lcd.setCursor(0, 1);
lcd.print("U3:");
lcd.setCursor(6, 1);
lcd.print("U4:");
lcd.setCursor(13, 0);
lcd.print("TO:")
}
void sensor1()
{
long duration1, distance1;
digitalWrite(trigPin1, LOW);
delayMicroseconds(2);
digitalWrite(trigPin1, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin1, LOW);
duration1 = pulseIn(echoPin1, HIGH);
distance1 = (duration1/2) / 29.1;
if (distance1 <= 10){
```

```

currentState1 = 1;
}
else {
currentState1 = 0;
}
delay(100);
if(currentState1 != previousState1){
if(currentState1 == 1){
counter1 = counter1 + 1;}
lcd.setCursor(3,0);
lcd.print(counter1);
}
}
void sensor2()
{
long duration2, distance2;
digitalWrite(trigPin2, LOW);
delayMicroseconds(2);
digitalWrite(trigPin2, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin2, LOW);
duration2 = pulseIn(echoPin2, HIGH);
distance2 = (duration2/2) / 29
if (distance2 <= 10){

```

```

currentState2= 1;
}
else {
currentState2 = 0;
}
delay(100);
if(currentState2 != previousState2){
if(currentState2 == 1){
counter2 = counter2 + 1;}
lcd.setCursor(9,0);
lcd.print(counter2);
}
}
void sensor3()
{
long duration3, distance3;
digitalWrite(trigPin3, LOW);
delayMicroseconds(2);
digitalWrite(trigPin3, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin3, LOW);
duration3 = pulseIn(echoPin3, HIGH);
distance3 = (duration3/2) / 29.1;
if (distance3 <= 10){
currentState3= 1;
}
}

```



```

else {
    currentState3 = 0;
}
delay(100);
if(currentState3 != previousState3){
if(currentState3 == 1){
    counter3 = counter3 + 1;}
lcd.setCursor(3,1);
lcd.print(counter3);
}
}
void sensor4()
{
long duration4, distance4;
digitalWrite(trigPin4, LOW);
delayMicroseconds(2);
digitalWrite(trigPin4, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin4, LOW);
    duration4 = pulseIn(echoPin4, HIGH);
    distance4 = (duration4/2) / 29.1;
if (distance4 <= 10){
    currentState4= 1;
}
}

```

```

else {
  currentState4 = 0;
}
delay(100);
if(currentState4 != previousState4){
  if(currentState4 == 1){
    counter4 = counter4 + 1;}
  lcd.setCursor(9,1);
  lcd.print(counter4);
}
}
void loop() {
  sensor1();
  sensor2();
  sensor3();
  sensor4();
  lcd.setCursor(13,1);
  total=counter1+counter2+counter3+counter4;
  lcd.print(total);{
  if (delayRunning&& ((millis() - delayStart) >= 60000)) {
    delayRunning = false; // // prevent this code being run more than once
    digitalWrite(led, LOW); // turn led off
    Serial.println("Turned LED Off");{
  if(total<=10)
  {

```

```

delay(1000);

Serial.begin(9600);

gsm.begin(9600);

gsm.println("AT+CMGF=1");

Serial.println("AT+CMGF=1");

delay(1000);

gsm.println("AT+CMGS=\"+919003446612\"\\r"); //replace x by your number

Serial.println("AT+CMGS=\"+919003446612\"\\r");

delay(1000);

gsm.println("licence is eligibile for this candidate");

Serial.println("licence is eligibile for this candidate");

delay(1000);

gsm.println((char)26);

delay(1000);

}

else

{

delay(1000);

Serial.begin(9600);

gsm.begin(9600);

gsm.println("AT+CMGF=1");

Serial.println("AT+CMGF=1");

delay(1000);

gsm.println("AT+CMGS=\"+919003446612\"\\r"); //replace x by your number

Serial.println("AT+CMGS=\"+919003446612\"\\r");

```

```
delay(1000);  
gsm.println("licence is not eligible for this candidate");  
Serial.println("licence is not eligible for this candidate");  
delay(1000);  
gsm.println((char)26);  
delay(1000);  
}  
}  
}  
  
}  
}
```

Appendix-2

Screen shots



Figure 1.10 Front View of the Car



Figure 1.11 Back view of the car

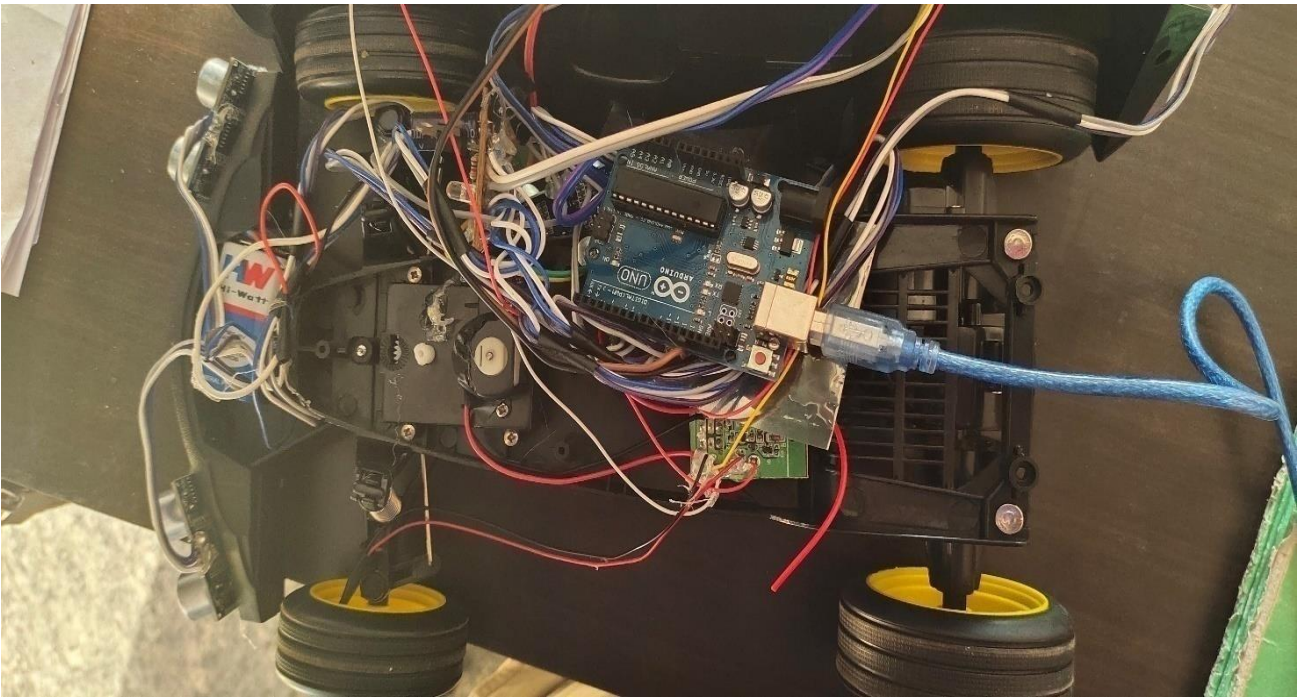


Figure 1.12 Assembling of Internal Components

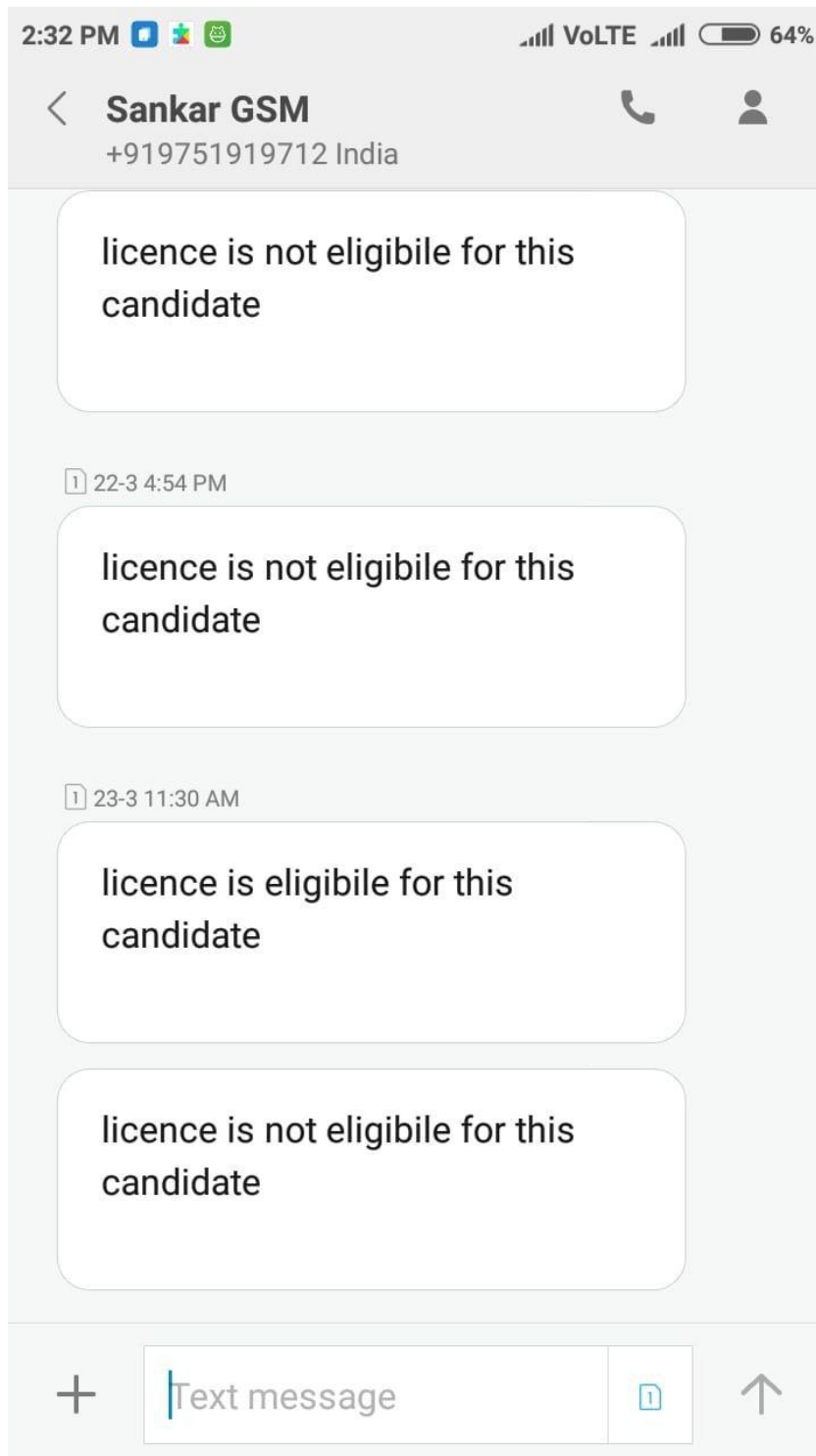


Figure 1.13 Output of the Project

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LICENSE ELIGIBILITY MEASUREMENT SYSTEM

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ABSTRACT

Now a days in current situation, test for driving license is not done before the RTO officer. it is done by the driving school, they provide certificate for driving. After the driving school given certificate they applied for driving license it was easily getting from the RTO office. During this , certification from the Driving School. some of them have a chance for fraud work, that is without drive a car or bike they will provide certificate for money ,then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident, in this paper we discuss about the driver performance measuring by a eligibility test kit. A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

Finally the data will be send to the RTO office Via GSM Technology ,after completing a driving course eligible candidate only getting the driving license from the RTO office. The main aim of this project helps to avoid Accident on Road and fraud done during the driving test.

I. INTRODUCTION

Now-a-days in our country most of the existing RTO offices didnt have systematic driving license verification system. If we want to get the driving license from RTO office, it is not a difficult task now a days but maintaining the original driving license is major task to the vehicle users . On the other side vehicle users are cheating the police by maintaining fake license which was crime. Currently driving license card having details like driving license identification number and address Details of the authorized vehicle Drivers are being morphed. So now-a-days the persons who are maintaining fake driving license, they are removing the authorized vehicle driver license photo and the details and using

same license identification number . This is the major disadvantage for the authorized driving license persons and it is advantage for the persons who are maintaining fake driving license. In order to overcome these problems an authenticating driving license system is proposed and provided to RTOs. By making use of RFID reader we can maintain authenticated driving license system. The existing method at the road transport officers was we need to fill the online driving license application form and next step is the written exam, that exam issuing a driving license by taking photo and the details of the eligible person .So in that driving license as we already know there existing a license. This is the major drawback of the existing driving license issuing system.

But we face new issues while getting a new driving license test for driving license is not done before the RTO officer. it is done by the driving school, they provide certificate for driving. After the driving school given certificate they applied for driving license it was easily getting from the RTO office. During this, certification from the Driving School. some of them have a chance for fraud work, that is without drive a car or bike they will provide certificate for money ,then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident, in this paper we discuss about the driver performance measuring by a eligibility test kit. A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

In this project we measure the driver performance, and analyze how he drives a car full complete report will be automatically generate and send final report via GSM technology

II. METHODOLOGY

A. Embedded System

An embedded system is a computer system—a combination of a Computer Processor, Computer Memory and Input Output Peripheral devices—that has a dedicated function within a larger mechanical or electrical system. It is embedded as part of a complete device often including electrical or electronic hardware and mechanical parts. Because an embedded system typically controls physical operations of the machine that it is embedded within, it often has real-time computing constraints.

B. Existing System

In existing system there is no proper machine system to measure the driver performance till now it is validate by an RTO Officer manually. all the time

RTO only check the driver performance not every performance will be checked. it was very long scheduled to check all the driver performance. so some of the negotiation will be there for all the driving test. So by avoiding this negotiation we made new project in proposed system.

C. Problem Statement

The problem identification in this project is, During certification process from the Driving School. some of them have a chance for fraud work, that is without drive a car they will provide certificate for money, then the person will easily get a driving license. These type of a person have a 90% chance of accident on the road. By avoid these type of accident. so the major problem issues is to solve the money bribery and accident met on the road.

D. Proposed System

A main aim of the project helps to measure the performance of a driver. in this project driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit. Finally the collecting data will be send to the RTO office Via GSM Technology ,after completing a driving course eligible candidate only getting the driving license from the RTO office.

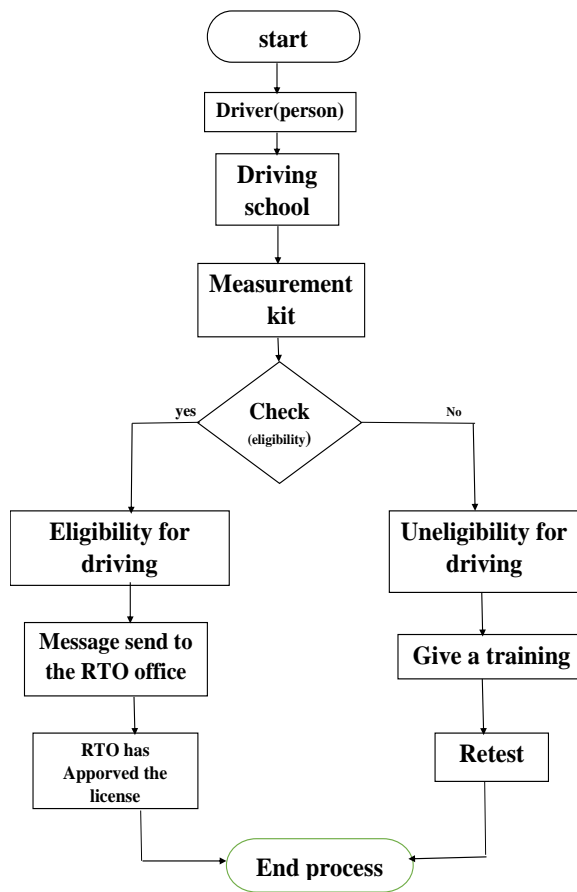
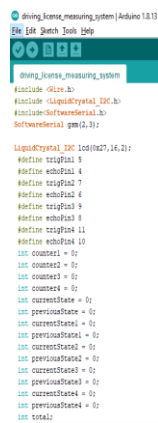


Fig. 1. FLOWCHART FOR PROPOSED METHODOLOGY

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1. Arduino IDE



SENSOR INPUTS: On the left are examples of some of the Input Devices you can connect

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into the machine language program that can be Uploaded to your Arduino board over the USB cable.

(This is often called MAKE in other systems, and actually is quite complex, running system

preprocessor, compiler, linker etc. "Under the covers").

An UPLOAD system that communicates with your Arduino Board over USB, loads your program into

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A liquid-crystal display (LCD) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

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GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone.

When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

III. HARDWARE DESIGN

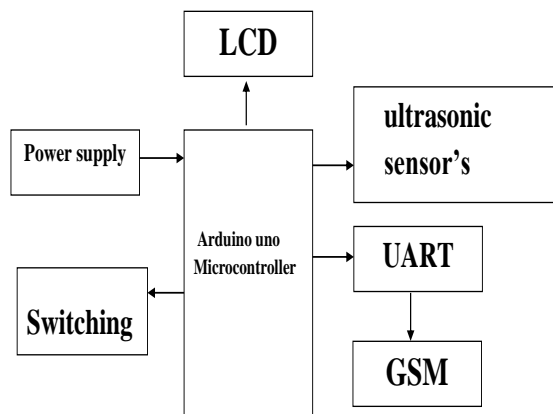


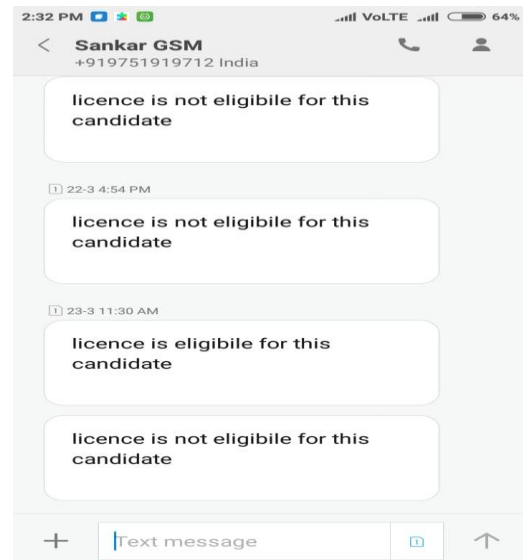
Fig. 2. HARDWARE DIAGRAM

IV. WORKING EXPLANATION

In this project the driver performance measuring kit is fitting in the vehicle. Ultrasonic sensor is fitting in the four sides of the car, when the car is moving on a road the sensor will start sense. If wrong direction will be moved, the sensor gives the wrong message in the LCD Display. Then the switch present in the Accelerator will give full race pressure switch will sense the data send to the microcontroller. After that the microcontroller will analyse the data input given. When two or more times the sensor will sense the microcontroller will collect the message will be automatically send to the information via GSM to the RTO Office.

V. RESULTS

By using this driver eligibility measuring kit certification from the Driving School doesn't have a chance for fraud work. In this paper a driver eligibility measuring kit will help to analyze the member who is driving the car and their driving data will be collected from the sensors to the microcontroller and the data is automatically updated to the test kit, the message will be sent to the candidate.



VI. CONCLUSION

By using this driver performance measuring kit certification from the Driving School doesn't have a chance for fraud work, that is without driving a car they will not provide a certificate for money, then the person will not easily get a driving license. So we avoid the chance of an accident on the road. In this paper a driver performance measuring kit will help to analyze the member who is driving the car and their driving data will be collected from the sensors to the microcontroller and the data is automatically updated to the test kit.

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LICENSE ELIGIBILITY MEASUREMENT SYSTEM

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Sengunthar Engineering College (Autonomous), Tiruchengode.

ABSTRACT

Now a days in current situation, test for driving license is not done before the RTO officer. it is done by the driving school, they provide certificate for driving. After the driving school given certificate they applied for driving license it was easily getting from the RTO office. During this , certification from the Driving School. some of them have a chance for fraud work, that is without drive a car or bike they will provide certificate for money ,then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident, in this paper we discuss about the driver performance measuring by a eligibility test kit. A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

Finally the data will be send to the RTO office Via GSM Technology ,after completing a driving course eligible candidate only getting the driving license from the RTO office. The main aim of this project helps to avoid Accident on Road and fraud done during the driving test.

I. INTRODUCTION

Now-a-days in our country most of the existing RTO offices didnt have systematic driving license verification system. If we want to get the driving license from RTO office, it is not a difficult task now a days but maintaining the original driving license is major task to the vehicle users . On the other side vehicle users are cheating the police by maintaining fake license which was crime. Currently driving license card having details like driving license identification number and address Details of the authorized vehicle Drivers are being morphed. So now-a-days the persons who are maintaining fake driving license, they are removing the authorized vehicle driver license photo and the details and using same license identification number . This is the major disadvantage for the authorized driving license persons and it is advantage for the persons who are maintaining fake driving license. In order to overcome these problems an authenticating driving license system is proposed and provided to RTOs. By making use of RFID reader we can maintain authenticated driving license system. The existing method at the road transport officers was we need to fill the online driving license application form and next step is the written exam, that exam issuing a driving license by taking photo and the details of the

eligible person .So in that driving license as we already know there existing a license. This is the major drawback of the existing driving license issuing system.

But we face new issues while getting a new driving license test for driving license is not done before the RTO officer. it is done by the driving school, they provide certificate for driving. After the driving school given certificate they applied for driving license it was easily getting from the RTO office. During this, certification from the Driving School. some of them have a chance for fraud work, that is without drive a car or bike they will provide certificate for money ,then the person will easily get a driving license. These type of person have a 90% chance of accident on the road. By avoid these type of accident, in this paper we discuss about the driver performance measuring by a eligibility test kit. A driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.

In this project we measure the driver performance, and analyze how he drives a car full complete report will be automatically generate and send final report via GSM technology

II. METHODOLOGY

A.Embedded System

An embedded system is a computer system—a combination of a Computer Processor, Computer Memory and Input Output Peripheral devices—that has a dedicated function within a larger mechanical or electrical system. It is embedded as part of a complete device often including electrical or electronic hardware and mechanical parts. Because an embedded system typically controls physical operations of the machine that it is embedded within, it often has real-time computing constraints.

B.Existing System

In existing system there is no proper machine system to measure the driver performance till now it is validate by an RTO Officer manually. all the time RTO only check the driver performance not every performance will be checked. it was very long scheduled to check all the driver performance. so some of the negotiation will be there for all the driving test. So by avoiding this negotiation we made new project in proposed system.

C. Problem Statement

The problem identification in this project is, During certification process from the Driving School. some of them have a chance for fraud work, that is without drive a car they will provide certificate for money,then the person will easily get a driving license.These type of a person have a 90% chance of accident on the road. By avoid these type of accident. so the major problem issues is to solve the money bribery and accident met on the road.

D. Proposed System

A main aim of the project helps to measure the performance of a driver. in this project driver performance measuring kit will helps to analyze the member who is driving the car and their driving data will be collected from the sensors to Microcontroller and the data is automatically updated to the test kit.Finally the collecting data will be send to the RTO office Via GSM Technology ,after completing a driving course eligible candidate only getting the driving license from the RTO office.

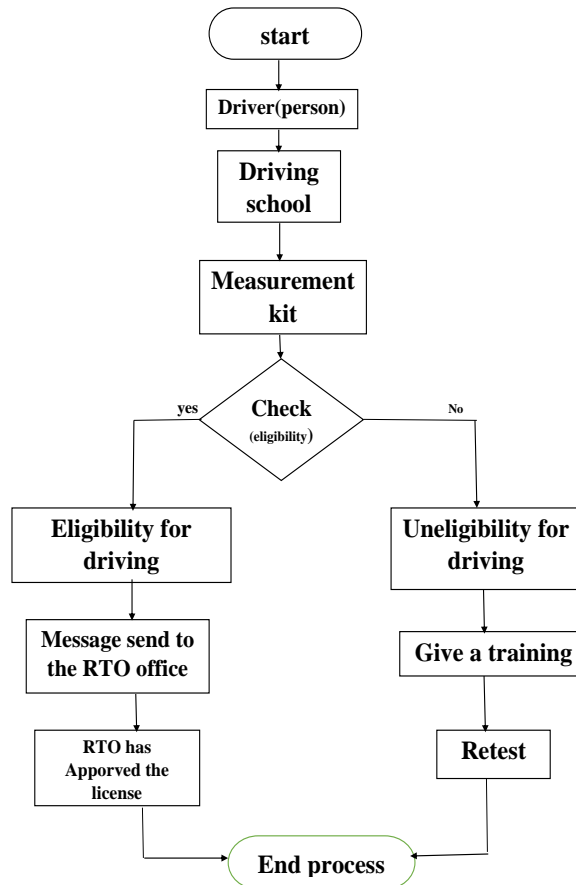


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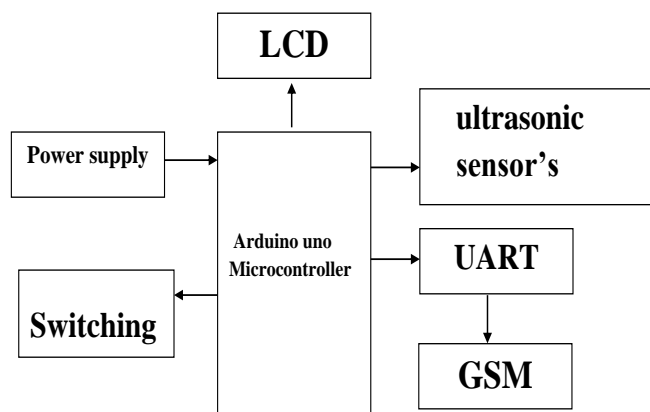


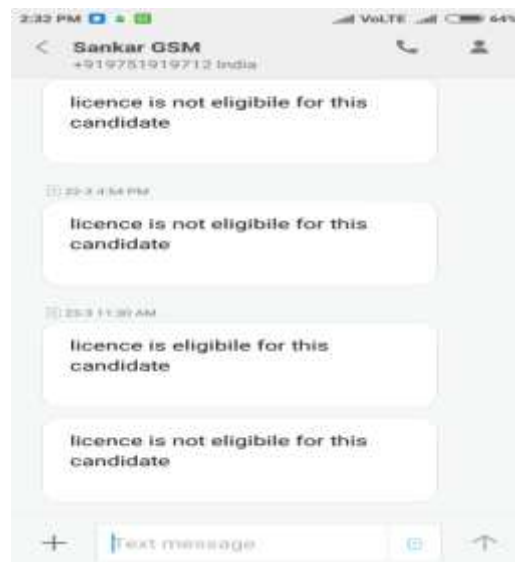
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Sengunthar Engineering College (AUTONOMOUS), Tiruchengode
has presented a paper titled
License Eligibility Measurement System

in
5th INTERNATIONAL CONFERENCE ON ENGINEERING, TECHNOLOGY AND SCIENCE
at Muthayammal College of Engineering, Rasipuram, Namakkal Dt., Tamilnadu
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This is to certify that the paper entitled

“LICENSE ELIGIBILITY MEASUREMENT SYSTEM”

Authored by

K. ASHOK KUMAR

From

Sengunthar Engineering College.

Has been published in

SPJMR JOURNAL, VOLUME 11, ISSUE 4, APRIL- 2021.



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Dr. K.M. Pandey
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**RESEARCH AND DEVELOPMENT CELL
SENGUNTHAR ENGINEERING COLLEGE**

A PROJECT REPORT

**RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING
IOT**

Submitted by

Dr.P.Ramesh Kumar

Professor/ECE

Department of Electronics and Communication Engineering

Sengunthar Engineering College

Tiruchengode

Ref: SEC/ECE/SEED/2020-21/ 1

To

The Chairman
Research and Development Cell
Sengunthar Engineering College
Tiruchengode-637211

25.11.2020

Respected Sir,


Sub: Submission of Research Project Scheme (2020-2021) proposal – Reg..Greetings from Electronics and Communication Engineering, Sengunthar Engineering College!

We are happy to submit our Research Project Scheme (2020-2021) proposal “**RFID Based Bus Monitoring System for Institution Using IOT**” under the guidance of Dr.P.Ramesh Kumar, Professor, Department of Electronics and Communication Engineering. Here with we have enclosed with Research Project Scheme (2020-2021) proposal form for your kind perusal.

We are expecting your kind consideration towards this proposal.

Thanking You

Your's faithfully


25.11.20
(Professor/ECE)

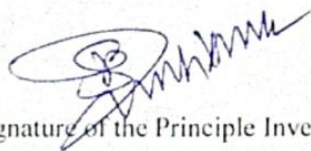
Encl:

1. Research Project Scheme (2020-2021) proposal.

| RESEARCH PROJECTS SCHEME (2020-2021) - PROPOSAL | | |
|---|---|--|
| 1 | Name of the Principle Investigator | : Dr.P.Ramesh Kumar, Ph.D., |
| | Department / Designation | : Electronics and Communication Engineering / Professor |
| | Institutional Address | : Sengunthar engineering college (Autonomous), Tiruchengode-637205, Namakkal (Dt) |
| | Phone No. & Mobile No. | : 04288-255716 (College) , 99428-69100 (Guide) |
| 2 | Project Title | : RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IOT |
| 3 | Sector in which your Project proposal is to be Considered | : Engineering and Technology |
| 4 | Project Details | : Separate sheet was attached |
| 5 | Has a similar project been carried out in your college / elsewhere? If so furnish details of the previous project and highlight the improvements suggested in the present one | : No, We are implementing new innovative project. |

CERTIFICATE

This is to certify that Dr.P.Ramesh Kumar, Professor, Department of Electronics and Communication Engineering , is a bonafide of our college and it is also certified that utilization certificate and final report will be sent to the Research and Development Council after completion of the project by the end of December 2021.



Signature of the Principle Investigator



Signature of the HOD



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PROJECT DETAILS

RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IOT

ABSTRACT

This project is about RFID based displaying system which displays the status of the bus movement using IoT module and Embedded System. To achieve automatic display of entry and exit time of the transports and detect the authenticated vehicles using RFID. RFID reader sends the data to the microcontroller which is used to monitor authentication information. Then details will update in controller and IoT after that information will pass through internet using IoT module.

1. INTRODUCTION

Now a days, all the sectors maintaining the ledger to monitor regular status of the transports and other areas with the manual working. Using this method reducing the workload to maintain the database to without the manual need. The system will use IoT as the basis for the application and basic android application will be interfacing with the updated database to provide the real-time data to the user. This will ensure to give a solution to the implementation of transport monitor by using RFID method. In this proposed system used to monitor the toll collection systems, public and private transports, traffic management, Industries to maintaining the ledger and authentication.

2. OBJECTIVE

This project ensures that monitoring of a vehicle movement like entry and exit status of transports and also found the authentication information to the vehicles without the manual need to ledger control monitoring.



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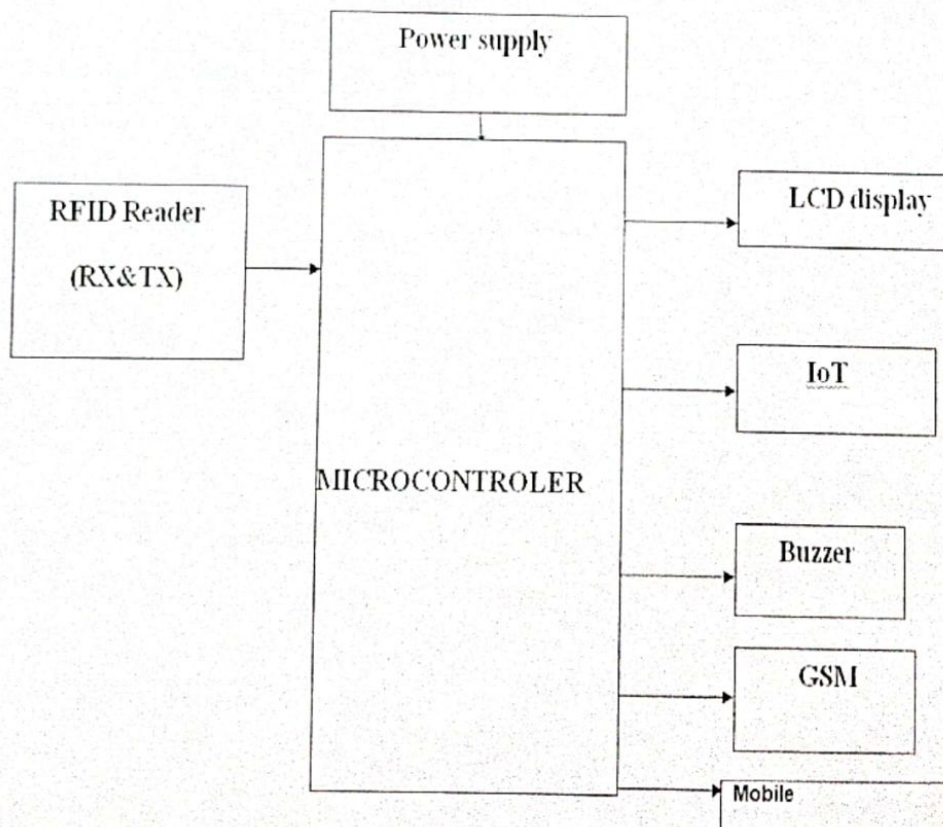
3. METHODOLOGY

There are two sections in our project one is transmitter section which is placed on bus and another section is receiver section placed on bus stop. Bus is consistently sending a message through IoT module. When bus comes in the range of the bus stop, bus stop receives the message which indicates that bus arrives from the bus if its authentication it's will allow if it's not in data means it will alert through buzzer and not authenticate. Every detailed information will be displaced in LCD display.

4. WORK PLAN

This project is used to give a intimation through the IoT module to authentication of vehicle in all the sectors and also give status of the transport such as movement, entry and exit time.

5. BLOCK DIAGRAM



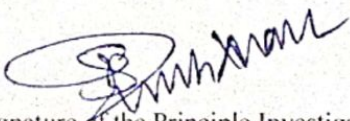



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BUDGET

| PROJECT BUDGET | | | |
|--|-----------------------|----------|------------------------|
| S.NO | NAME OF THE COMPONENT | QUANTITY | PRICE OF THE COMPONENT |
| 1. | Microcontroller | 1 | 500 |
| 2. | RFID Tag | 1 | 410 |
| 3. | RFID Reader | 1 | 360 |
| 4. | LCD display | 1 | 360 |
| 5. | Buzzer | 1 | 100 |
| 6. | Power supply | 1 | 920 |
| 7. | Peripherals | 2 | 670 |
| 8. | Wireless Module | 1 | 5040 |
| 9. | Implementation | | 2200 |
| 10. | Conveyance | | 1440 |
| TOTAL PROJECT BUDGET (A) | | | Rs.15000.00 |
| In kind Donation(B) By our college | | | |
| GSM | | 1 | 3000.00 |
| In kind Donation Subtotal (B) | | | 3000.00 |
| Required Amount for the project(A-B) | | | Rs.12,000.00 |


Signature of the Principle Investigator


Signature of the HOD

PROJECT EVALUATION REPORT

| | |
|---|--|
| Name of the Investigator | Dr.P.RAMESH KUMAR |
| Name of the Co-Investigator | - |
| Name of the Department | Electronics and Communication Engineering |
| Title of project | RFID based bus monitoring system for institution using IoT |
| Recommendation of the evaluation committee (Recommended/Revision/Not Recommended) | Recommended |
| Financial allocation recommended | Rs. 12,000.00 |

| Sl. No. | Head | Amount in INR |
|---------|---|---------------|
| 1 | Components(Power Supply, Wireless Module and Peripherals) | 6630.00 |
| 2 | Consumables (Resistor,Capacitor,Diode,Wire) | 1730.00 |
| 3 | Implementation of RFID based bus monitoring system | 2740.00 |
| 4 | Travel Expenses | 900.00 |
| | Total | 12,000.00 |

Evaluation Committee Members

1. Dr.C.Venkatesh - Principal
2. Dr. B.Sujatha - Dean(Academics)
3. Dr.P.Rameshkumar - Dean (R&D)
4. Dr.P.Ponmurugan - Head (R&D)

[Signature]
20/03/2021

[Signature]
20/03/2021

[Signature]
20/3/21

[Signature]
20/3/21

RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IoT

| Sl. No. | Head | Components /Description |
|---------|-----------------|--|
| 1 | Components | 1.Power Supply 2.Wireless Module 3.Peripherals 4.Microcontroller 5.RFID Tag 6. RFID Reader |
| 2 | Consumables | 1. Resistor 2. Capacitor 3. Diode 4. Wire |
| 3 | Implementation | 1.Assembling and Soldering the Circuit Components 2.Bus movement at the required place will be observed and interfaced. |
| 4 | Travel Expenses | Purchase components and consumables |



SENGUNTHAR ENGINEERING COLLEGE

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RESEARCH & DEVELOPEMENT CELL

Submitted to Correspondent sir Approval

Ref: SEC/R&D/2020-2021/R/001


Date: 22.03.2021

Sir,

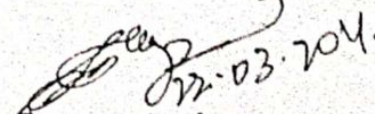
Sub: Requisition for permission to grant SEED money -Reg

The Research & Development cell of our college had selected the following projects to grant SEED money to implement the proposals submitted. The principal investigator has asked to carry out their work as mentioned in their report.

| SI.No | Title of the Project | Name of the Principal Investigator | Amount |
|--------------|--|------------------------------------|------------------|
| 1 | Flood geo-morphological survey and mapping of surface water potential and degradation study for tameradarani river stretch using remote sensing and gif techniques | DR.M.SEENIRAJAN | 12000.00 |
| 2 | LICENSE ELIGIBILITY MEASUREMENT SYSTEM | Mr.K.ASHOK KUMAR | 12000.00 |
| 3 | RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IOT | Dr.P. RAMESH KUMAR | 12000.00 |
| 4 | DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM | Dr.K.UMADEV I | 13000.00 |
| 5 | DESIGN AND DEVELOPMENT OF SMARK THREAD MILL BIKE | Mr. P.JAGADEESWARAN | 12000.00 |
| Total | | | 61,000.00 |


22/3/21
Dean(R&D)


22/3/21
Principal i/c.


22.03.2021
Correspondent

VOUCHER

No.

Date: 28-3-2021

To Dr. P. RAMESH KUMAR.

| Particulars | Rate | | Nos. | Amount | |
|---|------|----|------|--------|----|
| | Rs. | P. | | Rs. | P. |
| Implementing Seed Money. Refrence No: SC (R&D) 2020-2021/1 RFID based bus monitoring system for Institution using IoT. | | | | 12,000 | 00 |
| Total Expenditure | | | | 12,000 | 00 |
| (-) Advance Paid on..... | | | | | |
| Balance to be refunded / paid | | | | - | |

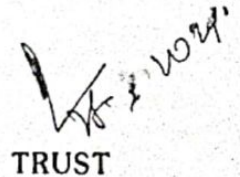
Received / Refunded Rs.: Twelve thousand only

| PREPARED | CERTIFIED | PASSED |
|-----------|------------|--------|
| Staff I/C | Supervisor | A.O. |


Signature

PRINCIPAL

TO
AR


TRUST


Sengunthar Engineering College
(Autonomous)
Tiruchengode

UTILISATION CERTIFICATE - (2020-2021)

Name of the Scheme under which the amount was sanctioned under the Research promotion scheme of Sengunthar Charitable Trust

| Sl. No | SCT Sanction Order/Letter No. & Date under which the amount was sanctioned | Amount (Rs.) | Remarks |
|--------|--|--|---|
| 1. | SEC/R&D/2020-21/003 dated 10.12.2021 | Rs 12,000 (Rupees Twelve Thousand Only) | Certified that out of Grant-in-Aid of Rs 12,000 (Rupees Twelve Thousand Only) sanctioned by the SCT during the financial year Rs. 12,000 has been utilized for the purpose for which it was sanctioned and the balance of Rs. 0 remained unutilized at the end of the year. |

Certified that I have satisfied myself that the conditions on which the amount was sanctioned have been duly fulfilled and that I have exercised that the money was actually utilized for the purpose for which it was sanctioned.


Signature of the Principal Investigator

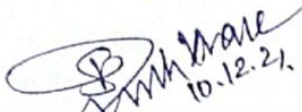

Signature of Head of the Institute

Place: Tiruchengode

Date: 10.12.21

FORMAT FOR RECEIPT AND PAYMENT ACCOUNT

| Sl. No. | Receipt | Amount (Rs.) | Sl. No. | Payments | Amount (Rs.) |
|---------|--------------------|--------------|---------|------------------------|--------------|
| 1 | To Opening Balance | 12000 | 1 | Components | 8100 |
| | | | 2 | Implementations | 2000 |
| | | | 3 | Testing | 1000 |
| | | | 4 | Conveyance | 900 |
| | | | | Closing Balance | 0 |
| | Grand Total | 12000 | | Grand Total | 12000 |


Signature of the Principal Investigator


Signature of Head of the Institute

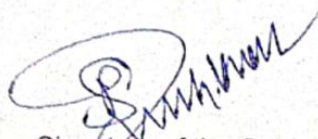
Place: Tiruchengode

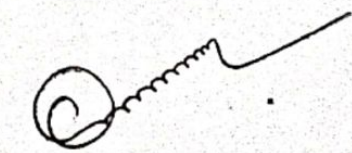
Date: 10.12.21

SENGUNTHAR ENGINEERING COLLEGE
DEPARTMENT OF ELECTRONICS AND COMMUNICATION
ENGINEERING
STATEMENT OF ACCOUNT

RFID Based Bus Monitoring System For Institution Using IOT

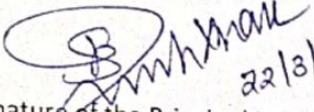
| S.NO | NAME OF THE COMPONENT | CREDIT (Rs) | DEBIT(Rs) |
|---------------------------------------|-----------------------|---------------------|--------------|
| 1 | Microcontroller | | 500 |
| 2 | RFID Tag | | 410 |
| 3 | RFID Reader | | 360 |
| 4 | LCD display | | 360 |
| 5 | Buzzer | | 100 |
| 6 | Power supply | | 920 |
| 7 | Peripherals | | 670 |
| 8 | Wireless Module | | 5040 |
| 9 | Implementation | | 2200 |
| 10 | Conveyance | | 1440 |
| Total | | | Rs.12,000.00 |
| SCT- Seed Money/Grant Received | | Rs.12,000.00 | |
| Balance | | | Nil |

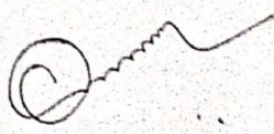

Signature of the Guide


Signature of the HOD

PROJECT COMPLETION REPORT

| | | |
|-----|---|--|
| 1 | SMS Reference No | SEC/R&D/2020-2021/R/001 |
| 2 | Title of research project | RFID based Bus monitoring System for Institution using IOT |
| 3 | Name of the Principal Investigator | Dr.P.RAMESH KUMAR |
| 4 | Name of the Co-Investigator | |
| 5 | Name the Department | Electronics and Communication Engineering |
| 6 | Effective date of starting of the project | 22.3.2021 |
| 7 | Grant approved and expenditure incurred during the period of the report | |
| 7.1 | Total amount approved | 12,000.00 |
| 7.2 | Total expenditure | 12,000.00 |
| 8 | Report of the work done: (Please attach a Brief objective of the project: i. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication or communicated) ii. Has the progress been according to original plan of work and towards achieving the objective if not, state reasons iii. Has the project been submitted for external funding, if so give details | i. Attached Report ii. Yes iii. No |
| 9 | Please indicate the difficulties, if any, experienced in implementing the project during SMS. | No |
| 10 | Outcome of the project | |


Signature of the Principal Investigator
22/3/21.


Signature of the Head

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LIST OF ABBREVIATIONS

| | |
|---------|---|
| ALU | Arithmetic and Logic Unit |
| CPU | Central Processing Unit |
| DC | Direct Current |
| ESD | Electro Static Discharge |
| VCC | Digital power supply |
| GND | Ground |
| IE | Interrupt Enable |
| IP | Interrupt priority |
| ISP | In-System Programmable |
| IEEE | Institute of Electrical and Electronics Engineers |
| INT | Interrupt |
| I/O | Input/output |
| μ C | Microcontroller |
| MCU | Microcontroller unit |
| ALE | Address latch enable |
| SFR | Special function registers |
| PCON | Power control register |
| TCON | Timer control registers |
| TMOD | Timer mode |
| ROM | Read only memory |
| RAM | Random access memory |
| UART | Universal asynchronous receiver/transmitter |

ABSTRACT

The present generation requires the information time to time. The use of technology have been increasing day by day. So we are planning for the combination of present technology with the requirement of information transmission, we planned for the creative approach of “Vehicle Tracking System using GPS and GSM”.

To overcome the drawbacks of the previous methods of paper based and we introduce a project to track a **vehicle using GPS and GSM**. This **Vehicle Tracking System** can also be used for Accident Detection Alert System, Soldier Tracking System and many more, by just making few changes in hardware and software and widely in tracking Cabs/Taxis, stolen vehicles, school/colleges buses etc.

CHAPTER 1

INTRODUCTION

1.1 OBJECTIVE

College bus Tracking System (VTS) is the technology used to determine the location of a vehicle using different methods like GPS and other radio navigation systems operating through satellites and ground based stations. By following triangulation or trilateration methods the tracking system enables to calculate easy and accurate location of the vehicle. Vehicle information like location details, speed, distance traveled etc. can be viewed on a digital mapping with the help of a software via Internet. Even data can be stored and downloaded to a computer from the GPS unit at a base station and that can later be used for analysis. This system is an important tool for tracking each vehicle at a given period of time and now it is becoming increasingly popular for people having expensive cars and hence as a theft prevention and retrieval device.

- i. The system consists of modern hardware and software components enabling one to track their vehicle online or offline. Any vehicle tracking system consists of mainly three parts mobile vehicle unit, fixed based station and, database and software system.
- ii. Vehicle Unit: It is the hardware component attached to the vehicle having either a GPS/GSM modem. The unit is configured around a primary modem that functions with the tracking software by receiving signals from GPS satellites or radio station points with the help of antenna. The controller modem converts the data and sends the vehicle location data to the server.
- iii. Fixed Based Station: Consists of a wireless network to receive and forward the data to the data center. Base stations are equipped with tracking software and geographic map useful for determining the vehicle location. Maps of every city and landmarks are available in the based station that has an in-built Web Server.
- iv. Database and Software: The position information or the coordinates of each visiting points are stored in a database, which later can be viewed in a display screen using digital maps. However, the users have to connect themselves to the web server with

College Bus Tracking System Using GPS and GSM

the respective vehicle ID stored in the database and only then she/he can view the location of vehicle traveled.

1.2 INTRODUCTION TO EMBEDDED SYSTEMS

The microprocessor-based system is built for controlling a function or range of functions and is not designed to be programmed by the end user in the same way a PC is defined as an embedded system. An embedded system is designed to perform one particular task albeit with different choices and options.

Embedded systems contain processing cores that are either microcontrollers or digital signal processors. Microcontrollers are generally known as "chip", which may itself be packaged with other microcontrollers in a hybrid system of Application Specific Integrated Circuit (ASIC). In general, input always comes from a detector or sensors in more specific word and meanwhile the output goes to the activator which may start or stop the operation of the machine or the operating system.

An embedded system is a combination of both hardware and software, each embedded system is unique and the hardware is highly specialized in the application domain. Hardware consists of processors, microcontroller, IR sensors etc. On the other hand, Software is just like a brain of the whole embedded system as this consists of the programming languages used which makes hardware work. As a result, embedded systems programming can be a widely varying experience.

An embedded system is combination of computer hardware and software, either fixed incapability or programmable, that is specifically designed for particular kind of application device. Industrial machines, automobiles, medical equipment, vending machines and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system. Embedded systems that are programmable are provided with a programming interface, and embedded systems programming id specialized occupation.

College Bus Tracking System Using GPS and GSM

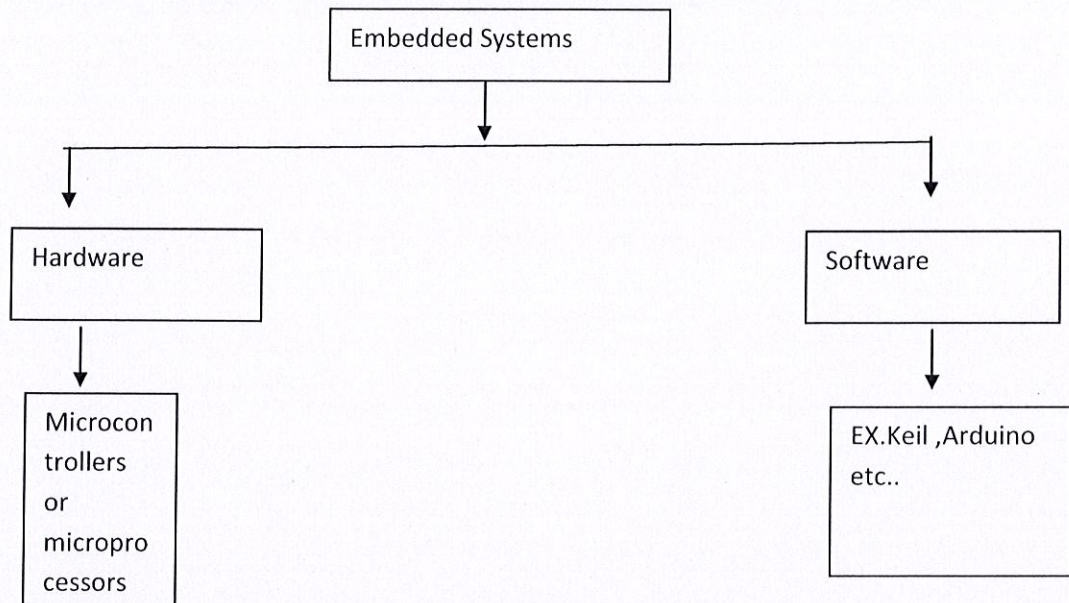


Figure 1.1 Block diagram of embedded system

Figure 2.1 illustrates the Block diagram of Embedded System (ES consists of hardware and software part which again consists of programming language and physical peripherals respectively).

On the other hand, the microcontroller is a single silicon chip consisting of all input, output and peripherals on it. A single microcontroller has the following features:

1. Arithmetic and logic unit
2. Memory for storing program
3. EEPROM for nonvolatile and special function registers
4. Input/output ports
5. Analog to digital converter
6. Circuits
7. Serial communication ports

1.3 APPLICATIONS OF EMBEDDED SYSTEM

We are living in the embedded world. You are surrounded with many embedded products and your daily life largely depends on the proper functioning's of these gadgets, television, radio, CD player of your living room, washing machines or microwave

College Bus Tracking System Using GPS and GSM

oven in your kitchen, card readers, access controllers ,palm devices of your work space enable to do many of your tasks very effectively. Apart from all these, many controllers embedded in your car take care of your car operation between the bumper and most of the times tend to ignore all these controllers.

In recent days you are showered with variety of information about these embedded controllers in many places. All kind of magazines and journals regularly dish out details about latest technologies, new devices: fast applications which make you believe that your basic survival is controlled by these embedded products. Now you can agree to that fact these embedded products have successfully invaded into our world. you must be wandering about these embedded controllers or systems.

The computer you use to compose your mails, or create a document or analyze the database is known as standard desktop computer. These desktop computers are manufactured to serve many purpose and applications.

1.3.1 MILITARY AND AEROSPACE SOFTWARE APPLICATIONS

From in-orbit embedded system to jumbo jets to vital battlefield networks, designer's performance, scalability, and high-availability facilities consistently turn to the Linux OS, RTOS and LinuxOS-178RTOS for software certification to DO-178B rich in system resources and networking serviced, Linux OS provides an off-the-shelf software platform with hard real-time response backed by powerful distributed computing (COBRA). high reliability's software certification, and long term support options.

1.3.2 COMMUNICATIONS APPLICATIONS

Five-nine" availability, compact PCI hot swap support, and hard real-time response Linux OS delivers on these key requirements and more for today's carrier-class systems. Scalable kernel configurations, distributed computing capabilities, intergraded communications stacks, and fault-management facilities make Linux OS the ideal choice for companies looking for single operating system for all embedded telecommunication applications from complex central to single line/trunk cards.

College Bus Tracking System Using GPS and GSM

1.3.3 ELECTRONICS APPLICATIONS AND CONSUMER DEVICES

As the number of powerful embedded processor in consumer devices continues to rise, the blue cat Linux operating system provides a highly reliable and royalty-free option for system designers. And as the wireless appliance revolution rolls on, web enabled navigation systems, radios, personal communication devices, phones and PDAs all benefit from the cost-effective dependability, proven stability and full product life cycle support opportunities associated with blue cat embedded Linux. Blue cat has teamed up with industry leaders to make it easier to build Linux mobile phones with java integration.

1.4 INDUSTRIAL AUTOMATION AND PROCESS CONTROL SOFTWARE

Designers of industrial and process control systems know from experience that Linux works operating system provide the security and reliability that their industrial applications require. From ISO 9001 certification to fault-tolerance, secure partitioning and high availability, we've got it all. The advantage of our 20 years of experience with the embedded system. Now a day's embedded system widely using in the industrial areas to reduce to time perform the particular task .This replacing the less work and also more efficient gives the accurate result.

CHAPTER 2

BLOCK DIAGRAM AND DESCRIPTION

2.1 BLOCK DIAGRAM OF THE PROJECT

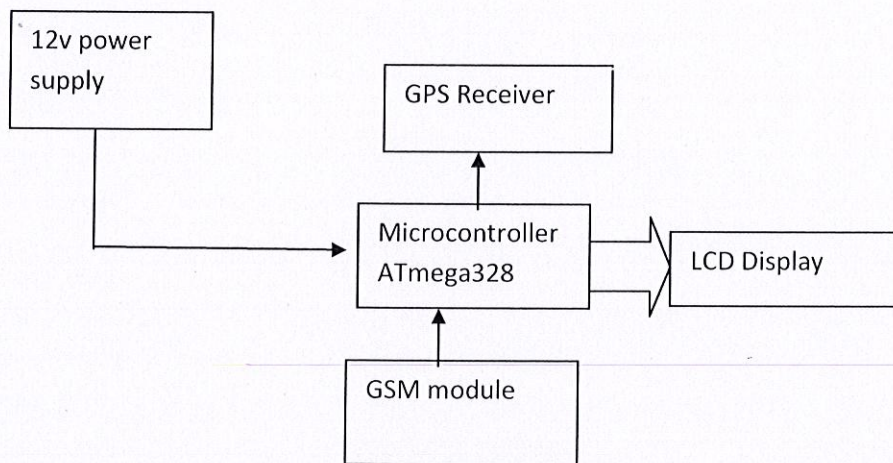


Fig:2.1.Block diagram

2.2 FUNCTIONS OF EACH BLOCK

POWER SUPPLY:

The primary function of a power supply is to convert one form of electrical energy into another and, as a result power supplies.

MICROCONTROLLER:

The microcontroller is used to manipulate the serial operation based the program present in the output is taken from one of the four ports.

LCD DISPLAY:

LCDs are available to display arbitrary images which can be displayed or hidden, such as preset words, digits and 7 segment displays as in a digital clock. They use some basic technology, except that arbitrary images are made up of a large number of pixels, while other displays have larger elements.

College Bus Tracking System Using GPS and GSM

CRYSTAL OSCILLATOR:

Crystal oscillator is used to produce oscillated pulses which is given to the microcontroller.

GSM MODEM:

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz.

GPS RECEIVER:

GPS, in full Global Positioning System, space-based radio-navigation system that broadcasts highly accurate navigation pulses to users on or near the Earth. In the United States' Navstar GPS, 24 main satellites in 6 orbits circle the Earth every 12 hours. In addition, Russia maintains a constellation called GLONASS (Global Navigation Satellite System).

CHAPTER 3 TECHNOLOGIES USED

3.1 GSM TECHNOLOGY

3.1.1 DEFINITION OF GSM

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz.

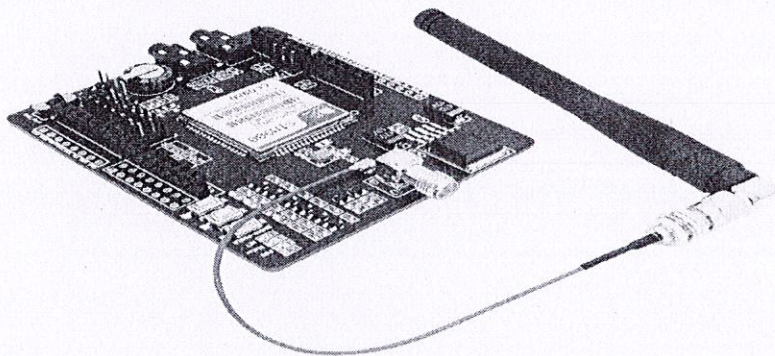


Figure3.1 GSM module

3.1.2 HISTORY OF GSM

Global system for mobile communication is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership. GSM, the Global System for Mobile communications, is a digital cellular communications system, which has rapidly gained acceptance and market share worldwide, although it was initially developed in a European context. In addition to digital transmission, GSM incorporates many advanced services and features, including ISDN compatibility and

College Bus Tracking System Using GPS and GSM

worldwide roaming in other GSM networks. The advanced services and architecture of GSM have made it a model for future third generation cellular systems, such as UMTS. This will give an overview of the services offered by GSM, the system architecture, the radio transmission

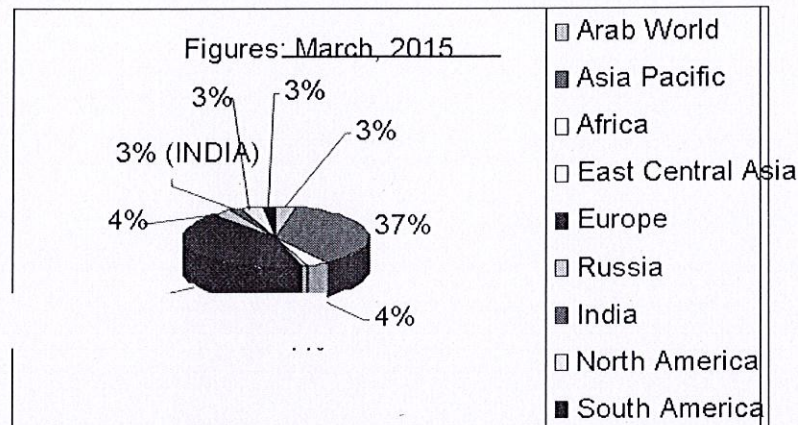


Figure3.2 Graph for GSM module

3.1.3 GSM Services

- Tele-services
- Bearer or Data Services
- Supplementary services

Tele-services:

Telecommunication services that enable voice communication via mobile phones
Offered services, Mobile telephony, Emergency calling

Bearer or Data Services:

Include various data services for information transfer between GSM and other networks like PSTN, ISDN etc at rates from 300 to 9600 bps ,Short Message Service (SMS) up to 160 character alphanumeric data transmission to/from the mobile terminal Unified, Messaging Services(UMS),Group 3 fax, Voice mailbox, Electronic mail

Supplementary services

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Call related services like Call Waiting- Notification of an incoming call while on the handset, Call Hold- Put a caller on hold to take another call, Call Barring- All calls, outgoing calls, or incoming calls, Call Forwarding- Calls can be sent to various numbers defined by the user, Multi Party Call Conferencing - Link multiple calls together

- CLIP – Caller line identification presentation
- CLIR – Caller line identification restriction

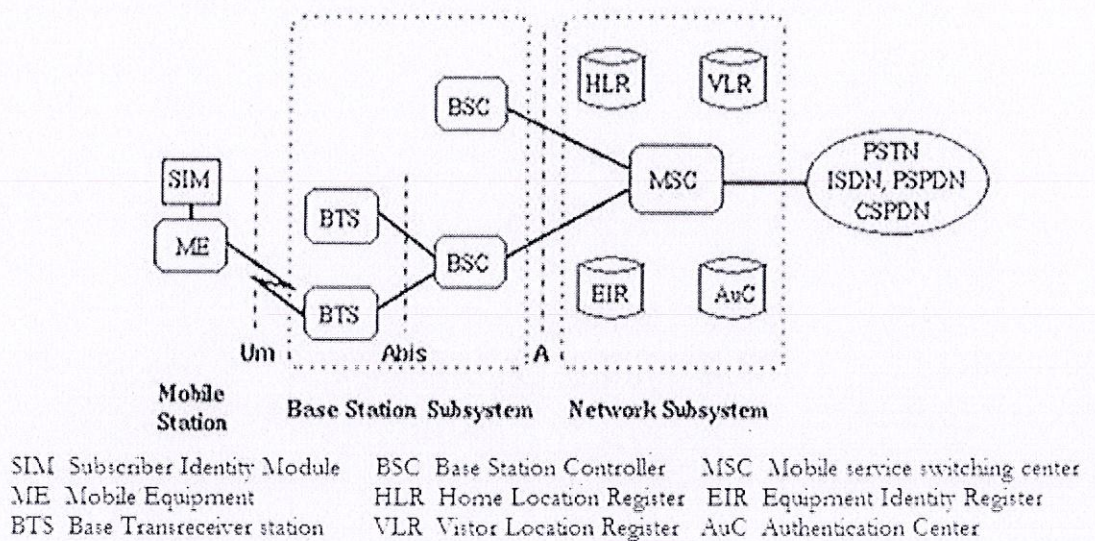


Figure3.3 GSM Network Architecture

3.1.4 Operation GSM

The basis of the GPS is a constellation of satellites that are continuously orbiting the earth. These satellites, which are equipped with atomic clocks, transmit radio signals that contain their exact location, time, and other information. The radio signals from the satellites, which are monitored and corrected by control stations, are picked up by the GPS receiver. A Global Positioning System receiver needs only three satellites to plot a rough, 2D position, which will not be very accurate.

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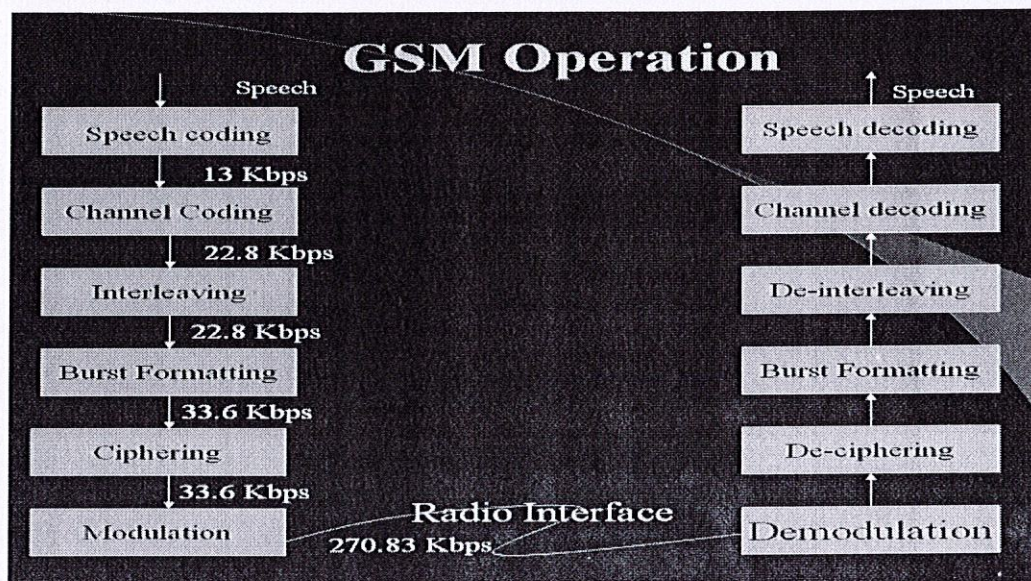


Figure3.4 GSM operation

3.1.5 Security in GSM

- On air interface, GSM uses encryption and TMSI instead of IMSI.
- SIM is provided 4-8 digit PIN to validate the ownership of SIM
- 3 algorithms are specified :
 - A3 algorithm for authentication
 - A5 algorithm for encryption
 - A8 algorithm for key generation

3.1.6 Characteristics of GSM Standard

- Fully digital system using 900,1800 MHz frequency band.
- TDMA over radio carriers(200 KHz carrier spacing.
- 8 full rate or 16 half rate TDMA channels per carrier.
- User/terminal authentication for fraud control.
- Encryption of speech and data transmission over the radio path.
- Full international roaming capability.
- Low speed data services (upto 9.6 Kb/s).
- Compatibility with ISDN.

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- Support of Short Message Service (SMS).

3.1.7 Advantages of GSM over Analog system

- Capacity increases
- Reduced RF transmission power and longer battery life.
- International roaming capability.
- Better security against fraud (through terminal validation and user authentication).
- Encryption capability for information security and privacy.
- Compatibility with ISDN, leading to wider range of services.

3.1.8 GSM Applications

- Mobile telephony
- GSM-R
- Telemetry System
 - Fleet management
 - Automatic meter reading
 - Toll Collection
 - Remote control and fault reporting of DG sets

3.1.9 Future of GSM

- 2nd Generation
 - GSM -9.6 Kbps (data rate)
- Generation (Future of GSM)
 - HSCSD (High Speed circuit Switched data) its data rate : 76.8 Kbps (9.6 x 8 kbps)
 - GPRS (General Packet Radio service) its data rate: 14.4 - 115.2 Kbps
 - EDGE (Enhanced data rate for GSM Evolution) its data rate: 547.2 Kbps (max)
- 3 Generation
 - WCDMA(Wide band CDMA its data rate : 0.348 – 2.0 Mbps

CHAPTER 4

HARDWARE IMPLEMENTATION

4.1. ATMEGA328 Microcontroller Description

The Atmel AVR® core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs, 1 byte-oriented 2-wire Serial Interface (I2C), a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main oscillator and the asynchronous timer continue to run. Atmel offers the QTouch® library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully debounced reporting of touch keys and includes Adjacent Key Suppression® (AKS™) technology for unambiguous detection of key events. The easy-to-use QTouch Suite toolchain allows you to explore, develop and debug your own touch applications. The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core.

The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

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The ATmega328/P is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

4.1.2 FEATURES OF ATMEG

- 28-pin AVR Microcontroller
- Flash Program Memory: 32 kbytes
- EEPROM Data Memory: 1 kbytes
- SRAM Data Memory: 2 kbytes
- I/O Pins: 23
- Timers: Two 8-bit / One 16-bit
- A/D Converter: 10-bit Six Channel
- PWM: Six Channels
- RTC: Yes with Separate Oscillator
- MSSP: SPI and I²C Master and Slave Support
- USART: Yes
- External Oscillator: up to 20MHz

4.1.3 ADVANTAGES/ IMPROVEMENTS IN ATMEG328

1. Still runs on 5 V, so legacy 5 V stuff interfaces cleaner
2. Even though it's 5 V capable, newer parts can run to 1.8 V. This wide range is very rare.
3. Nice instruction set, very good instruction throughput compared to other processors (HCS08, PIC12/16/18).
4. High quality GCC port (no proprietary crappy compilers!)
5. "PA" variants have good sleep mode capabilities, in micro-amperes.
6. Well rounded peripheral set
7. QTouch capability

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4.1.4 Pin diagram of ATMEGA328

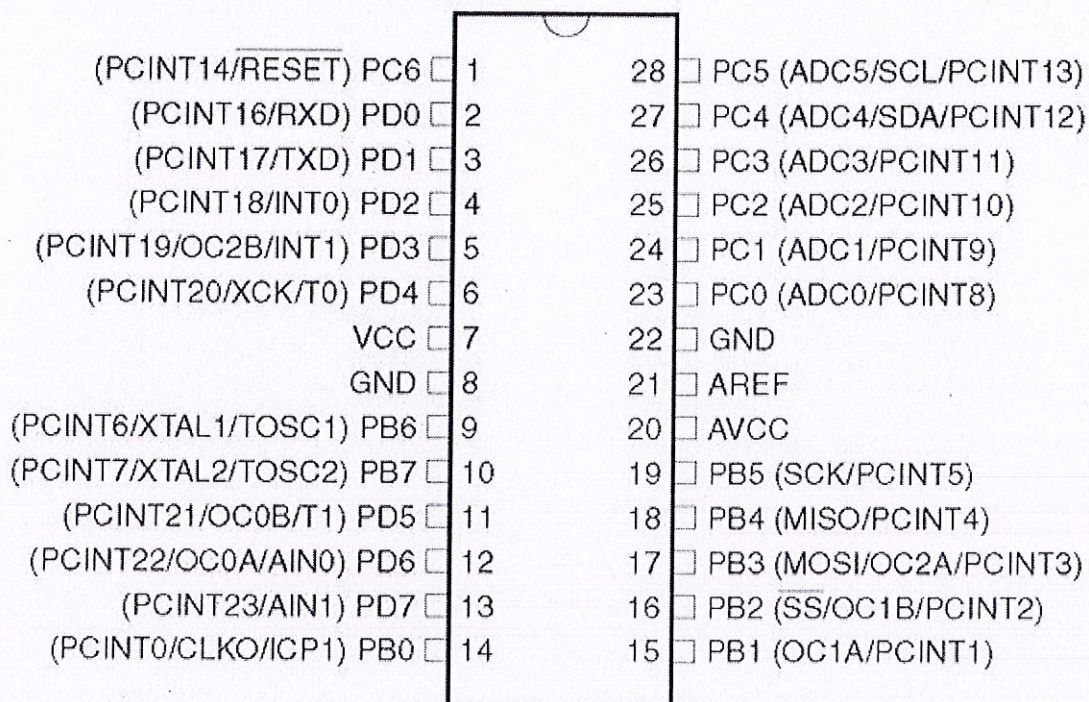


Fig 4.1: Pin Configuration

4.1.5 PIN EXPLANATION

| Pin Number | Description | Function |
|------------|-------------|--------------------------|
| 1 | PC6 | Reset |
| 2 | PD0 | Digital Pin (RX) |
| 3 | PD1 | Digital Pin (TX) |
| 4 | PD2 | Digital Pin |
| 5 | PD3 | Digital Pin (PWM) |
| 6 | PD4 | Digital Pin |
| 7 | Vcc | Positive Voltage (Power) |
| 8 | GND | Ground |

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Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier.

If the Internal Calibrated RC Oscillator is used as chip clock source, PB[7:6] is used as TOSC[2:1] input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

4.1.5.4. Port C (PC[5:0])

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC[5:0] output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

4.1.5.5. PC6/RESET

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C.

If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a Reset.

The various special features of Port C are elaborated in the *Alternate Functions of Port C* section.

4.1.5.6. Port D (PD[7:0])

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

4.1.5.7. AVCC

AVCC is the supply voltage pin for the A/D Converter, PC[3:0], and PE[3:2]. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC[6:4] use digital supply voltage, VCC.

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4.5.8. AREF

AREF is the analog reference pin for the A/D Converter.

4.1.5.9. ADC[7:6] (TQFP and VFQFN Package Only)

In the TQFP and VFQFN package, ADC[7:6] serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

4.2 Arduino Uno Board Description

we will learn about the different components on the Arduino board. We will study the Arduino UNO board because it is the most popular board in the Arduino board family. In addition, it is the best board to get started with electronics and coding. Some boards look a bit different from the one given below, but most Arduinos have majority of these components in common.

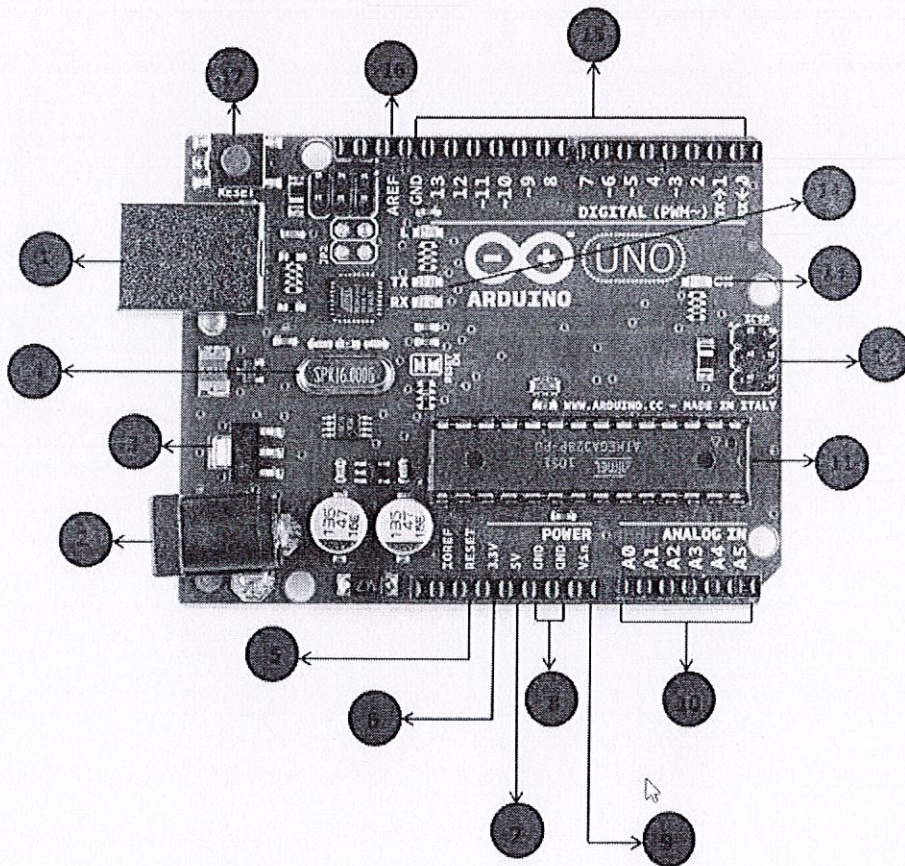


FIG:4.2.Arduino UNO board

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4.2.1 Power USB

Arduino board can be powered by using the USB cable from your computer. All we need to do is connect the USB cable to the USB connection (1).

4.2.2 Power (Barrel Jack)

Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack (2).

4.2.3 Voltage Regulator

The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.

4.2.4 Crystal Oscillator

The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz.

4.2.5 Arduino Reset

We can reset your Arduino board, i.e., start your program from the beginning. We can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, we can connect an external reset button to the Arduino pin labelled RESET (5).

4.2.6 Pins (3.3, 5, GND, Vin)

- 3.3V (6) – Supply 3.3 output volt
- 5V (7) – Supply 5 output volt
- Most of the components used with Arduino board works fine with 3.3 volt and 5 volt.

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- GND (8)(Ground) – There are several GND pins on the Arduino, any of which can be used to ground wer circuit.
- Vin (9) – This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.

4.2.7 Analog pins

- The Arduino UNO board has five analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

4.3 LIQUID CRYSTAL DISPLAY (16 X 2)

LCD stands for **Liquid Crystal Display**. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

These components are “specialized” for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

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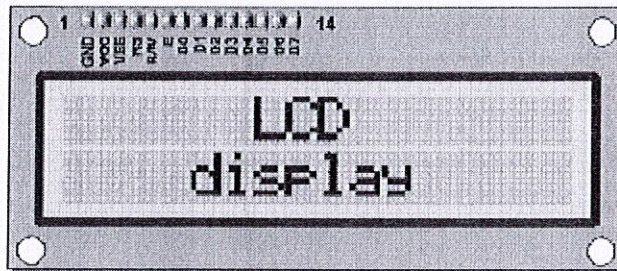


Fig 4.3 : LCD Display

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (*Hitachi*) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

Pins Functions

There are pins along one side of the small printed board used for connection to the microcontroller. There are total of 14 pins marked with numbers (16 in case the background light is built in). Their function is described in the table below:

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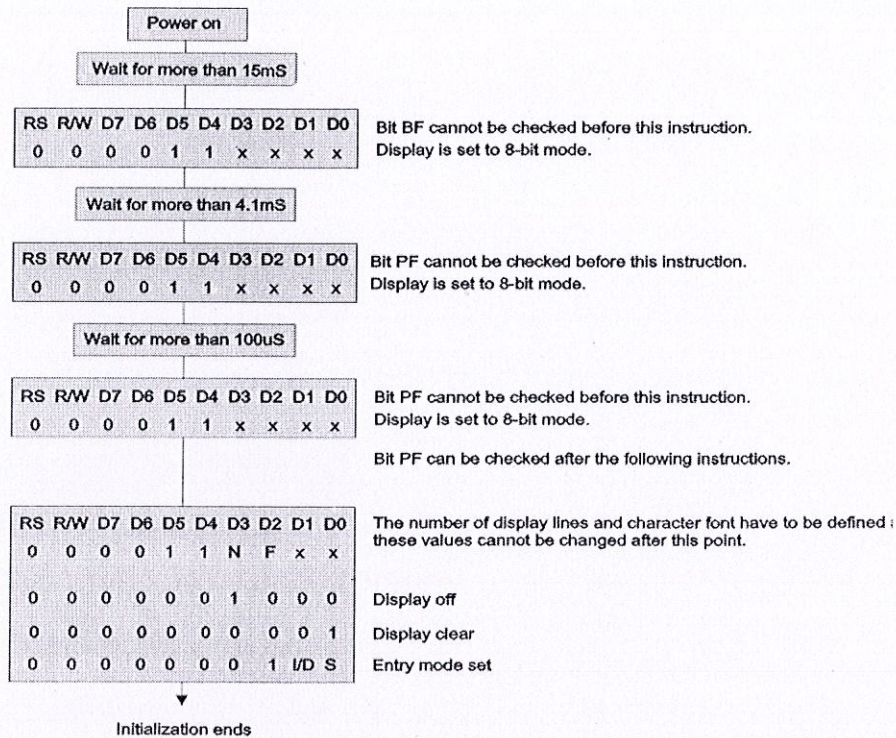


Figure 4.3.1: Procedure on 8-bit initialization.

LCD screen:

LCD screen consists of two lines with 16 characters each. Each character consists of 5x7 dot matrix. Contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-V_{dd} is applied on pin marked as V_{ee}. Trimmer potentiometer is usually used for that purpose. Some versions of displays have built in backlight (blue or green diodes). When used during operating, a resistor for current limitation should be used (like with any LE diode).

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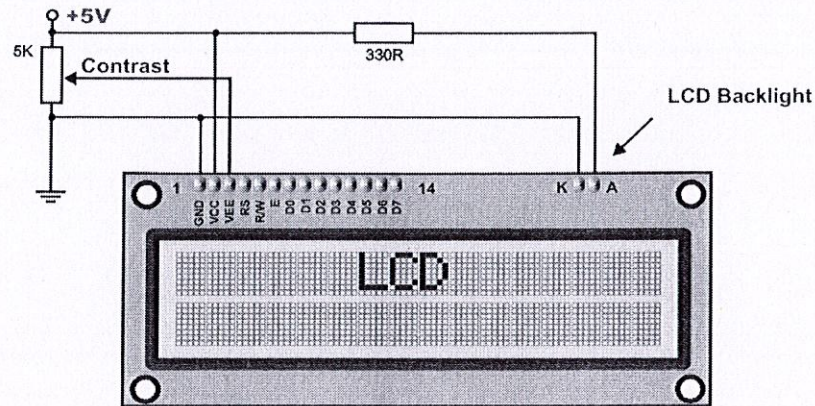


Figure 4.3.2: Internal Structure of LCD

LCD Basic Commands

All data transferred to LCD through outputs D0-D7 will be interpreted as commands or as data, which depends on logic state on pin RS:

RS = 1 - Bits D0 - D7 are addresses of characters that should be displayed. Built in processor addresses built in “map of characters” and displays corresponding symbols. Displaying position is determined by DDRAM address. This address is either previously defined or the address of previously transferred character is automatically incremented.

RS = 0 - Bits D0 - D7 are commands which determine display mode. List of commands which LCD recognizes are given in the table below:

| Command | RS | RW | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Execution Time |
|------------------------|----|----|----|----|----|----|----|----|-----|----|----------------|
| Clear display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1.64Ms |
| Cursor home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | X | 1.64mS |
| Entry mode set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | 40uS |
| Display on/off control | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | U | B | 40uS |

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| | | | | | | | | | | | |
|-----------------------------|---|---|----|---------------|---------------|----|-----|-----|------|------|------|
| Cursor/Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | D/C | R/L | x | X | 40uS |
| Function set | 0 | 0 | 0 | 0 | 1 | DL | N | F | x | X | 40uS |
| Set CGRAM address | 0 | 0 | 0 | 1 | CGRAM address | | | | | 40uS | |
| Set DDRAM address | 0 | 0 | 1 | DDRAM address | | | | | 40uS | | |
| Read "BUSY" flag (BF) | 0 | 1 | BF | DDRAM address | | | | | - | | |
| Write to CGRAM or DDRAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 40uS |
| Read from CGRAM or DDRAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 40uS |

Fig:4.3.1:LCDdiscription

4.4. POWER SUPPLY

In this project we have power supplies with +5V & -5V option normally +5V is enough for total circuit. Another (-5V) supply is used in case of OP amp circuit. Transformer primary side has 230/50HZ AC voltage whereas at the secondary winding the voltage is step downed to 12/50hz and this voltage is rectified using two full wave rectifiers. The rectified output is given to a filter circuit to filter the unwanted ac in the signal. After that the output is again applied to a regulator LM7805 (to provide +5v) regulator. Whereas LM7905 is for providing -5V regulation.

(+12V circuit is used for stepper motors, Fan and Relay by using LM7812 regulator same process like above supplies).

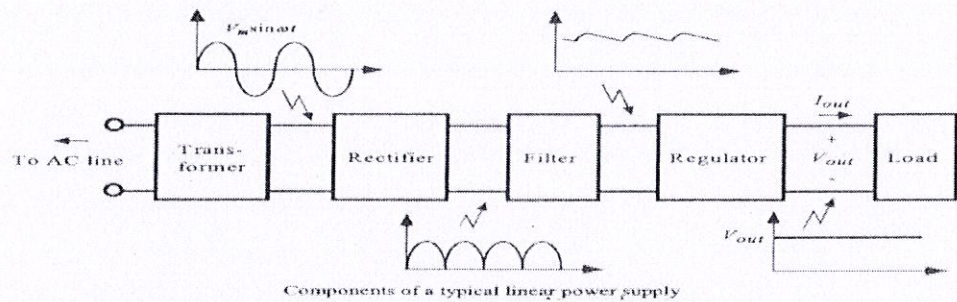


Fig 4.4: Block Diagram Of Power Supply

4.4.1 TRANSFORMER

Transformers are used to convert electricity from one voltage to another with minimal loss of power. They only work with AC (alternating current) because they require a changing magnetic field to be created in their core. Transformers can increase voltage (step-up) as well as reduce voltage (step-down).

Alternating current flowing in the primary (input) coil creates a continually changing magnetic field in the iron core. This field also passes through the secondary (output) coil and the changing strength of the magnetic field induces an alternating voltage in the secondary coil. If the secondary coil is connected to a load the induced voltage will make an induced current flow. The correct term for the induced voltage is 'induced electromotive force' which is usually abbreviated to induced e.m.f.

4.4.2 RECTIFIERS

The purpose of a rectifier is to convert an AC waveform into a DC waveform (OR) Rectifier converts AC current or voltages into DC current or voltage. There are two different rectification circuits, known as 'half-wave' and 'full-wave' rectifiers. Both use components called diodes to convert AC into DC.

4.4.3 FILTERS

A filter circuit is a device which removes the ac component of rectifier output but allows

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the dc component to the load. The most commonly used filter circuits are capacitor filter, choke

input filter and capacitor input filter or pi-filter. We used capacitor filter here.

The capacitor filter circuit is extremely popular because of its low cost, small size, little weight and good characteristics. For small load currents this type of filter is preferred. it is commonly used in transistor radio battery eliminators.

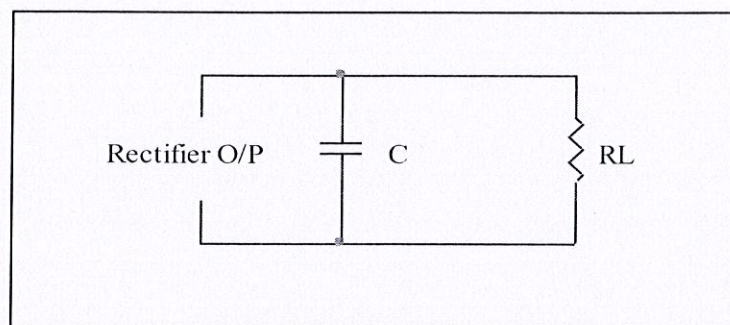


Fig 4.4.1: Block Diagram Of Capacitive Filter

4. 4MESSAGE MANAGEMENT

Message Management General Description:

Playback and record operations are managed by on-chip circuitry. There are several available messaging modes depending upon desired operation. These message modes determine message management style, message length, and external parts count. Therefore, the designer must select the Appropriate operating mode before beginning the design. Operating modes do not affect voice quality; for information on factors affecting quality refer to the Sampling Rate & Voice Quality section. The device supports five message management modes (defined by the MSEL1, MSEL2 and /M8_OPTION pins shown in Figures 1 and 2):

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- Random access mode with 2, 4, or 8 fixed-duration messages Tape mode, with multiple variable-duration messages, provides two options:
 - Auto rewind
 - Normal

Modes cannot be mixed. Switching of modes after the device has recorded an initial message is not recommended. If modes are switched after an initial recording has been made some unpredictable message fragments from the previous mode may remain present, and be audible on playback, in the new mode. These fragments will disappear after a Record operation in the newly selected mode. Table 1 defines the decoding necessary to choose the desired mode. An important feature of the APR9600 Message management capabilities is the ability to audibly prompt the user to change in the device's status through the use of "beeps" superimposed on the device's output. This feature is enabled by asserting a logic high level on the BE pin. **Random Access Mode**

Random access mode supports 2, 4, or 8 Message segments of fixed duration. As suggested recording or playback can be made randomly in any of the selected messages.

The length of each message segment is the total recording length available (as defined by the selected sampling rate) divided by the total number of segments enabled (as decoded in Table1). Random access mode provides easy indexing to message segments.

Functional Description .

On power up, the device is ready to record or playback, in any of the enabled message segments. To playback, /CE must be set low to enable the device and /RE must be set high to disable recording & enable playback. You initiate playback by applying a high to low edge on the message trigger pin that represents the message segment you intend to playback. Playback will continue until the end of the message is reached. If a high to low edge occurs on the same message trigger pin during playback, playback of the current message stops immediately. If a different message trigger pin pulses during playback, playback of the current message stops immediately (indicated by one beep) and playback of the new message segment begins. A delay equal to 8,400 cycles of the sample clock will be encountered before the device starts playing the new message. If a message trigger pin is held low, the selected message is played back repeatedly as long as

College Bus Tracking System Using GPS and GSM

the trigger pin stays low. A period of silence, of duration equal to 8,400 cycles of the sampling clock, will be inserted during looping as an indicator to the user of the transition between the end and the beginning of the message.

Tape mode manages messages sequentially much like traditional cassette tape recorders. Within tape mode two options exist, auto rewind and normal. Auto rewind mode configures the device to automatically rewind to the beginning of the message immediately following recording or playback of the message. In tape mode, using either option, messages must be recorded or played back sequentially, much like a traditional cassette tape recorder.

A. Function Description of Recording in Tape Mode using the Auto Rewind Option On power up, the device is ready to record or playback, starting at the first address in the memory array. To record, /CE must be set low to enable the device and /RE must be set low to enable recording. A falling edge of the /M1_MESSAGE pin initiates voice recording (indicated by one beep). A subsequent rising edge of the /M1_MESSAGE pin during recording stops the recording (also indicated by one beep). If the M1_MESSAGE pin is held low beyond the end of the available memory, recording will stop automatically (indicated by two beeps). The device will then assert a logic low on the /M7_END pin until the /M1 Message pin is released. The device returns to standby mode when the /M1_MESSAGE pin goes high again. After recording is finished the device will automatically rewind to the beginning of the most recently recorded message and wait for the next user input. The auto rewind function is convenient because it allows the user to immediately playback and review the message without the need to rewind. However, caution must be practiced because a subsequent record operation will overwrite the last recorded message unless the user remembers to pulse the /M2_Next pin in order to increment the device past the current message. A subsequent falling edge on the /M1_Message pin starts a new record operation, overwriting the previously existing message. You can preserve the previously recorded message by using the /M2_Next input to advance to the next available message segment. To perform this function, the /M2_NEXT pin must be pulled low for at least 400 cycles of the sample clock. The auto

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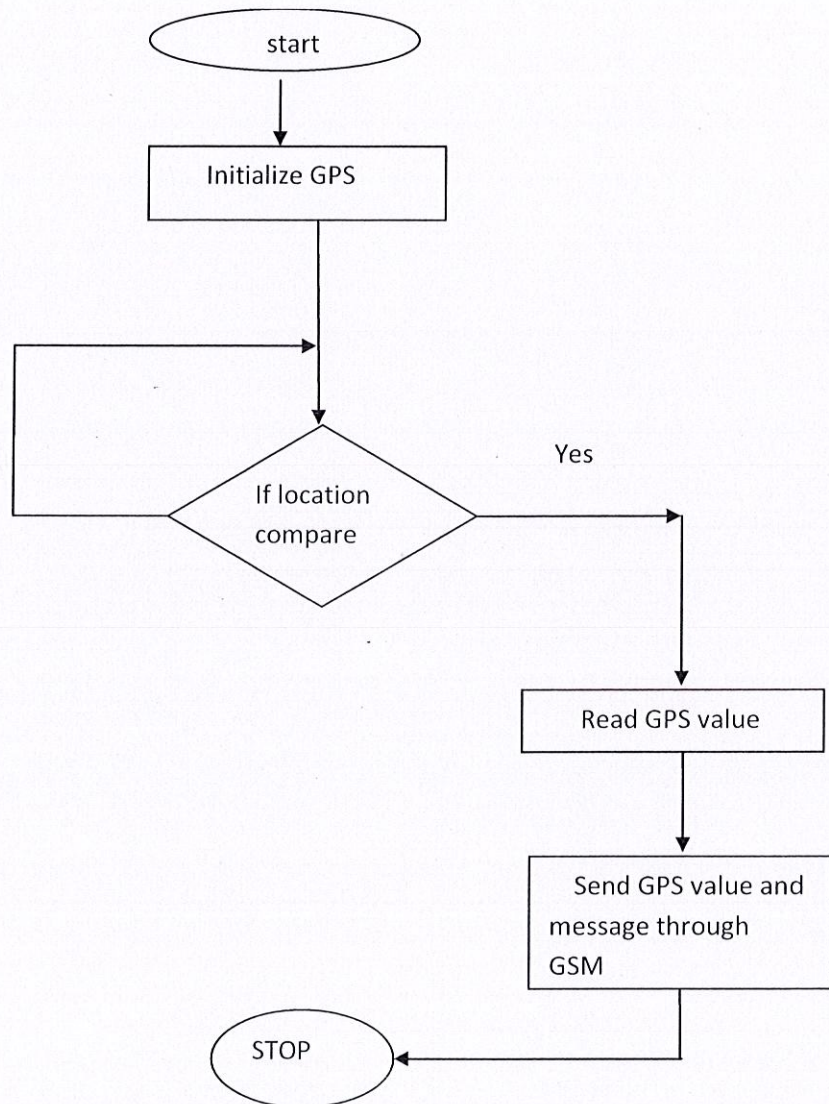
rewind mode allows the user to record over the just recorded message simply by initiating a record sequence without first toggling the /M2_NEXT pin.

To record over any other message however requires a different sequence. You must pulse the /CE pin low once to rewind the device to the beginning of the voice memory. The /M2_NEXT pin must then be pulsed low for the specified number of times to move to the start of the message you wish to overwrite. Upon arriving at the desired message a record sequence can be initiated to overwrite the previously recorded material. After you overwrite the message it becomes the last available message.

CHAPTER 5

FLOWCHART & WORKING PROCEDURE

5.1 FLOW CHART



College Bus Tracking System Using GPS and GSM

5.2 WORKING PROCEDURE

This project clearly uses two main modules of GSM and a microcontroller. The user when sends the messages through his phones those reaches the GSM ,through the AT commands all those messages reaches the microcontroller. That microcontroller takes the data in terms of bits through the Max232.Those information will be transmitted to the LCD display.

5.3.ALGORITHM

- 1.Initialize the LCD display.
- 2.Initialize the baud rate at 38400.
- 3.By using the AT commands to read the SMS data.
- 4.Sent At+CMGR=1.
- 5.Read the data from the GSM modem.
- 6.The string should be scroll at the bottom line.
- 7.In top displays Phone number.
- 8.This action will continuous for all 30 SMS.
- 9.Once the SMS read that will be deleted.
- 10.If SMS is important, that will rotate those many time as we declares to rotate.

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CHAPTER 6

SOFTWARE IMPLEMENTATION

6.1 CREATING PROJECT IN ARDUINO 1.7.11 VERSION.

Arduino uno Installation

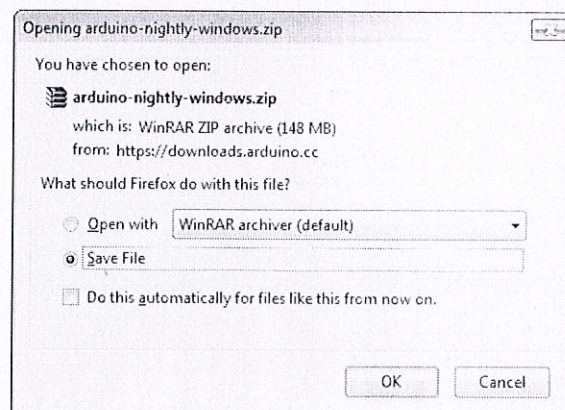
In this we will get know of the process of installation of Arduino IDE and connecting Arduino uno to Arduino IDE.

Step 1

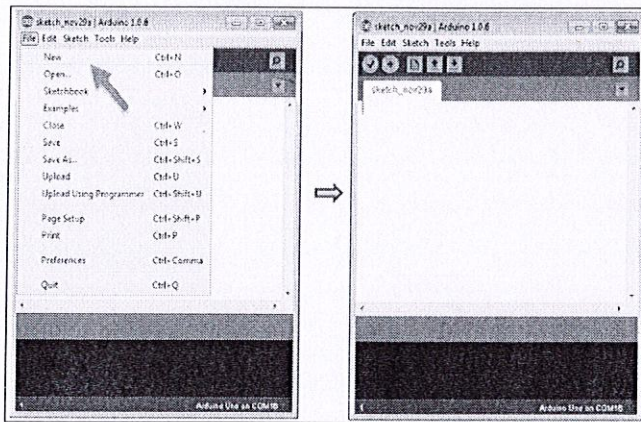
First we must have our Arduino board (we can choose our favorite board) and a USB cable. In case we use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, we will need a standard USB cable (A plug to B plug), t

In case we use Arduino Nano, we will need an A to Mini-B cable..

Step 2 – Download Arduino IDE Software. We can get different versions of Arduino IDE from the Download page on the Arduino Official website. We must select software, which is compatible with operating system (Windows, IOS, or Linux). After file download is complete, unzip the file.



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* Open an existing project example.

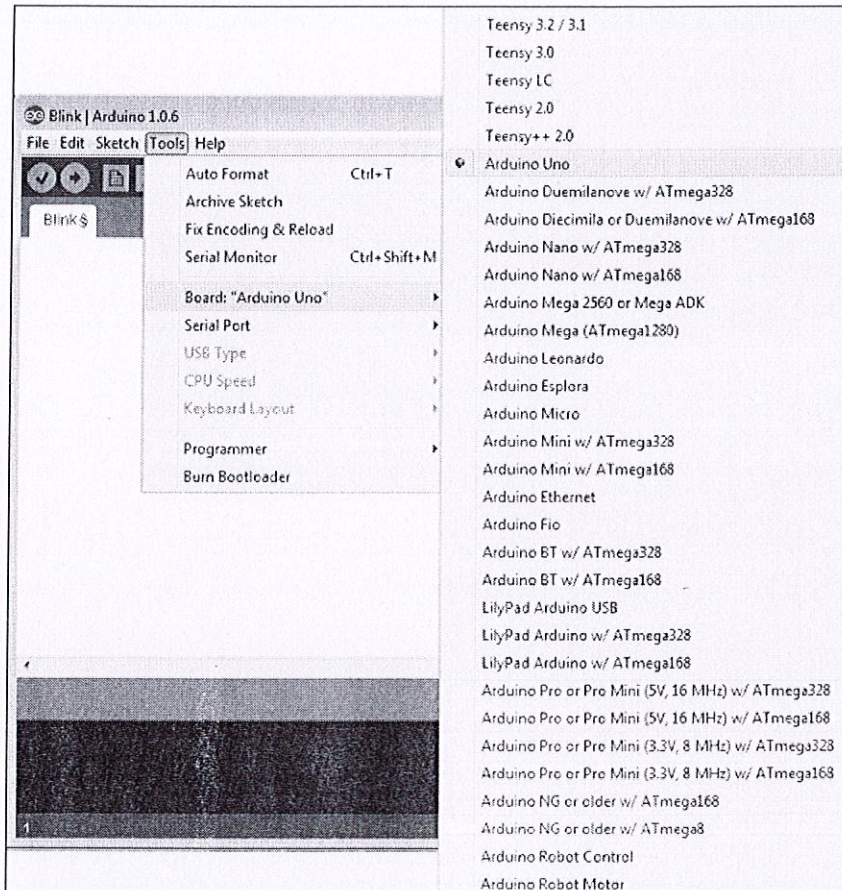
To create a new project, select File → New.

To open an existing project example, select File → Example → Basics → Blink.

Here, we are selecting just one of the examples with the name Blink. It turns the LED on and off with some time delay. We can select any other example from the list.

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Step 6 – Select our Arduino board.



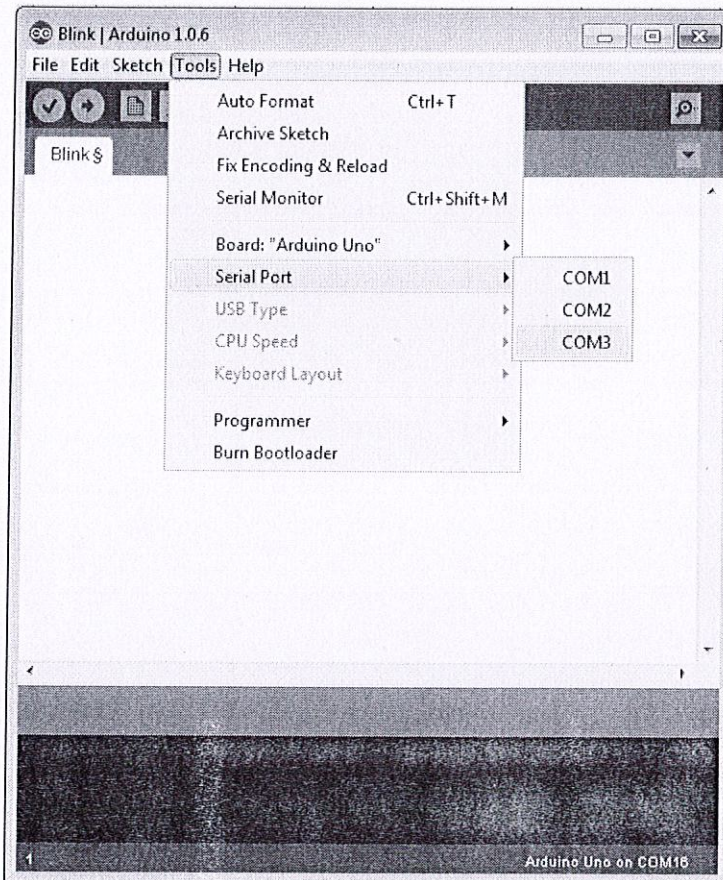
To avoid any error while uploading program to the board, we must select the correct Arduino board name, which matches with the board connected to our computer.

Go to Tools → Board and select board.

Here, we have selected Arduino Uno board according to our tutorial, but we must select the name matching the board that we are using.

Step 7 – Select our serial port.

College Bus Tracking System Using GPS and GSM

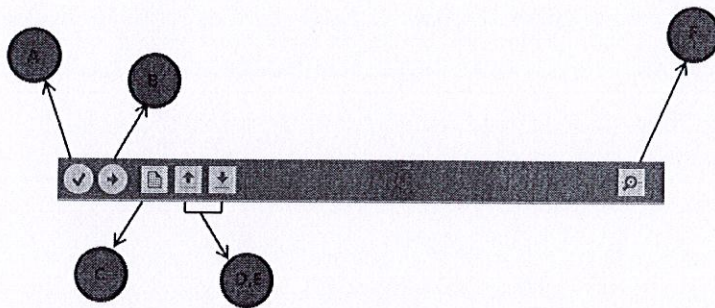


Select the serial device of the Arduino board. Go to Tools → Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, we can disconnect our Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

Step 8 – Upload the program to our board.

Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.

College Bus Tracking System Using GPS and GSM



A – Used to check if there is any compilation error.

B – Used to upload a program to the Arduino board.

C – Shortcut used to create a new sketch.

D – Used to directly open one of the example sketch.

E – Used to save wer sketch.

F – Serial monitor used to receive serial data from the board and send the serial data to the board.

Now, simply click the "Upload" button in the environment. Wait a few seconds; we will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.

Note – If we have an Arduino Mini, NG, or other board, we need to press the reset button physically on the board, immediately before clicking the upload button on the Arduino Software.

CHAPTER 7

SOURCE CODE & RESULT

7.1 SOURCE CODE

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 7, 6, 5, 4);
String inputString3="";
String Logitude="";
String Latitude="";
int SMSPIN=8;
boolean Sent;
void setup() {
  lcd.begin(16, 2);
  // put your setup code here, to run once:
  Serial.begin(9600);
  Serial.println("GPS Ready");
  inputString3.reserve(200);
  Logitude.reserve(20);
  Latitude.reserve(20);
  pinMode(SMSPIN,INPUT);
  lcd.print("System Ready");
  Sent=true;
}

void loop() {
  ReadSerialData();

  //delay(100);
}

void ReadSerialData() {
  char inChar;
  inputString3="";
  do {if(Serial.available()){inChar=(char)Serial.read();} } while(inChar!='$');

  do {if(Serial.available()){inChar=(char)Serial.read();inputString3=inputString3+inChar;}
  } while(inChar!='\n');
  if(inputString3[2]=='R' &&inputString3[3]=='M' &&
  inputString3[4]=='C'){CheckForLatitude();}
}

void CheckForLatitude()
```


College Bus Tracking System Using GPS and GSM

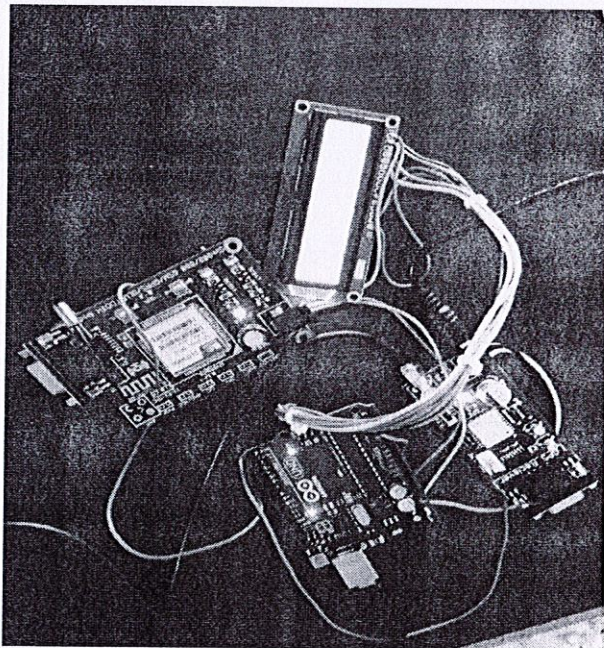
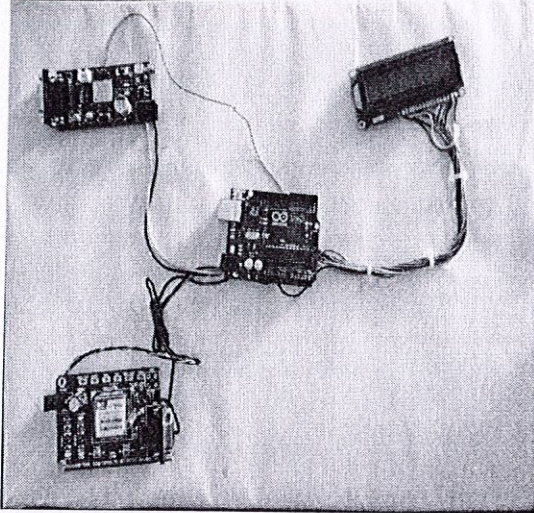
```
{
  int i=0;
  char DataType;
  Logitude="";
  Latitude="";
  do {i++;} while(inputString3[i]!=',');
  do {i++;} while(inputString3[i]!=',');
  i++; DataType=inputString3[i];i++;
  do {i++;Latitude=Latitude+inputString3[i];} while(inputString3[i]!=',');
  i++; Latitude=Latitude+inputString3[i];i++;
  do {i++;Logitude=Logitude+inputString3[i];} while(inputString3[i]!=',');
  i++; Logitude=Logitude+inputString3[i];i++;
  Serial.print("Data Type:");Serial.println(DataType);
  Serial.print("Latitude:");Serial.println(Latitude);
  Serial.print("Longitude:");Serial.println(Logitude);
  lcd.setCursor(0, 0);
  lcd.print("Lat :");lcd.print(Latitude);
  lcd.setCursor(0, 1);
  lcd.print("Long:");lcd.print(Logitude);
  if(Latitude=="1551" &&
  Logitude=="8004"){SendSMS("8978361752");SendSMS("8978361752");SendSMS("89
  78361752");}
  if(Latitude=="1555" && Logitude=="8014"){SendSMS("8978361752");}
}

void SendSMS(String Number)
{
  lcd.setCursor(0,1);
  lcd.print("SMS Sending");
  Serial.println("AT");
  delay(1000);
  Serial.println("AT+CSMP=17,167,0,0");
  delay(1000);
  Serial.print("AT+CMGS=");Serial.print("");Serial.print(Number);Serial.println("");
  delay(3000);
  Serial.println("Bus is On the Way:");
  Serial.print((char)0x1a);
  delay(10000);
}
```


College Bus Tracking System Using GPS and GSM

7.2 RESULT

These are the outputs which are observed for our project while under working.



College Bus Tracking System Using GPS and GSM

College Bus Tracking System Using GPS and GSM

CHAPTER 8 CONCLUSION & FUTURE ENHANCEMENT

CONCLUSION

The project titled “tracing down the vehicle using GSM and satellite communication” is a model for vehicle tracking unit with the help of gps receivers and GSM modem. Vehicle Tracking System resulted in improving overall productivity with better fleet management that in turn offers better return on your investments. Better scheduling or route planning can enable you handle larger jobs loads within a particular time. Vehicle tracking both in case of personal as well as business purpose improves safety and security, communication medium, performance monitoring and increases productivity. So in the coming year, it is going to play a major role in our day-to-day living.

We have completed the project as per the requirements of our project. Finally the aim of the project i.e. to trace the vehicle is successfully achieved.

FUTURE SCOPE

- We can use the EEPROM to store the previous Navigating positions up to 256
- locations and we can navigate up to N number of locations by increasing its
- memory.
- We can reduce the size of the kit by using GPS+GSM on the same module.
- We can increase the accuracy up to 3m by increasing the cost of the GPS receivers.
- We can use our kit for detection of bomb by connecting to the bomb detector.
- With the help of high sensitivity vibration sensors we can detect the accident.
- Whenever vehicle unexpectedly had an accident on the road with help of vibration
- sensor we can detect the accident and we can send the location to the owner,
- hospital and police.
- We can use our kit to assist the traffic. By keeping the kits in the entire vehicles and by knowing the locations of all the vehicles.
- If anybody steals our car we can easily find our car around the globe.

CHAPTER 9

REFERENCES

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- [2]. Asaad M. J. Al-Hindawi, Ibraheem Talib, "Experimentally Evaluation of GPS/GSM Based System Design", Journal of Electronic Systems Volume 2 Number 2 June 2012
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- [4]. V.Ramya, B. Palaniappan, K. Karthick, "Embedded Controller for Vehicle In-Front Obstacle Detection and Cabin Safety Alert System", International Journal of Computer Science & Information Technology (IJCSIT) Vol 4, No 2, April 2012.
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SENGUNTHAR ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)

Recognized Under Section 2(f) & 12(B) of the UGC Act, 1956

MAAC Accredited with 'A' Grade

TIRUCHENGODE - 627 205 NAMAKKAL (Dt) TAMILNADU



&

**RESEARCH AND DEVELOPMENT CELL
SENGUNTHAR ENGINEERING COLLEGE**

A PROJECT REPORT

**DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION
SYSTEM**

Submitted by

Dr.K.Uma Devi

Professor/HOD

Department of Electrical and Electronics Engineering

Sengunthar Engineering College

Tiruchengode

Ref: SEC/EEE/SEED/2020-21/ 1

25.11.2020

To
The Chairman
Research and Development Cell
Sengunthar Engineering College
Tiruchengode-637211

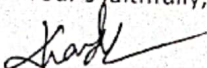
Respected Sir,

Sub: Submission of Research Project Scheme (2020-2021) proposal – Reg. Greetings from Electrical and Electronics Engineering Department, Sengunthar Engineering College!

We are happy to submit our Research Project Scheme (2020-2021) proposal "**Detection of Water Leakage in Public Distribution System**" under the guidance of Dr.K.Umadevi, Professor&Head, Department of Electrical and Electronics Engineering. Here with we have enclosed with Research Project Scheme (2020-2021) proposal form for your kind perusal.

We are expecting your kind consideration towards this proposal.

Thanking You

Your's faithfully,

(HoD/EEE)

Encl:

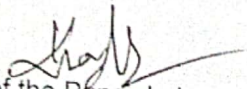
1. Research Project Scheme (2020-2021) proposal.

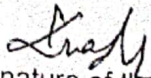
RESEARCH PROJECTS SCHEME (2020-2021) - PROPOSAL

| | | | |
|---|---|---|--|
| 1 | Name of the Principle Investigator | : | Dr.K.Umadevi |
| | Department / Designation | : | Electrical and Electronics Engineering / Professor |
| | Institutional Address | : | Sengunthar engineering college (Autonomous), Tiruchengode-637205, Namakkal (Dt) |
| | Phone No. & Mobile No. | : | 04288-255716 (College) , 8667484320 (Guide) |
| 2 | Project Title | : | DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM |
| 3 | Sector in which your Project proposal is to be Considered | : | Engineering and Technology |
| 4 | Project Details | : | Separate sheet to be attached |
| 5 | Has a similar project been carried out in your college / elsewhere? If so furnish details of the previous project and highlight the improvements suggested in the present one | : | No, We are implementing new innovative project. |

CERTIFICATE

This is to certify that Mr./Miss. Dr.K.Umadevi, Professor & Head, Department of Electrical and Electronics Engineering, is a bonafide of our college and it is also certified that utilization certificate and final report will be sent to the Research and Development Council after completion of the project by the end of December 2021.


Signature of the Principle Investigator


Signature of the HOD

PROJECT DETAILS

DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM

INTRODUCTION

It is important to appreciate the fact that only 3 per cent of the world's water is fresh and roughly one-third of it is inaccessible. The rest is very unevenly distributed and the available supplies are increasingly contaminated with wastes and pollution from industry, agriculture and households.

The water level in the world is decreasing so fast as the population increases. India is under severe water crisis. Nowadays water is the deciding factor for every mankind activities in the world example navigation to other states or countries. 60 million liters (MLD) water daily on an average, out of the 200MLD water supplied to the 60 wards of core city a day. While evaporation accounts for a small percentage, civic body officials said much of the potable water was going waste due to pipe leakages

The accidents which happen in the water supply system networks are usually high. For instance, about one million accidents have happened in water supply system networks in the country in 1998. This damage costs about 20% of the total income of the Water and Waste Company. This cost has been for repairing, rebuilding and improving of the network. Over 30% of these accidents have happened on the pipelines of the water supply system networks. Many factors are involved in the leakage detection of the water in the network. Some of these effective factors will be paid to in this article.

Another hydraulic parameter, which determines the performance condition and the servicing of urban water supply system network, is pressure with a high importance. High pressure causes the increasing of leak, and the loss of consuming water and the number of the accidents in the network. On the other hand, low pressure in the network causes the inability of complete supplying water or result in providing unsuitable water. The pressure also is effective on the stability and the structure of the system. With high pressure, the probability of the accidents and the crack of the system increase and the stability performance and suitable servicing of the network endangered.

OBJECTIVE:

To indicate the pipe breakdown or big leakage waste by knowing the flow of water in the pipe being travelled.

METHODOLOGY:

The methodology of this project is to identify the breakage of the water pipe by the difference measured in the flow meter between the normal flow and the overflow of water when breakage takes place. The second step of the project goes to automatic gate valve closing system for the particle pipe which was broke down may be with the alarming system.

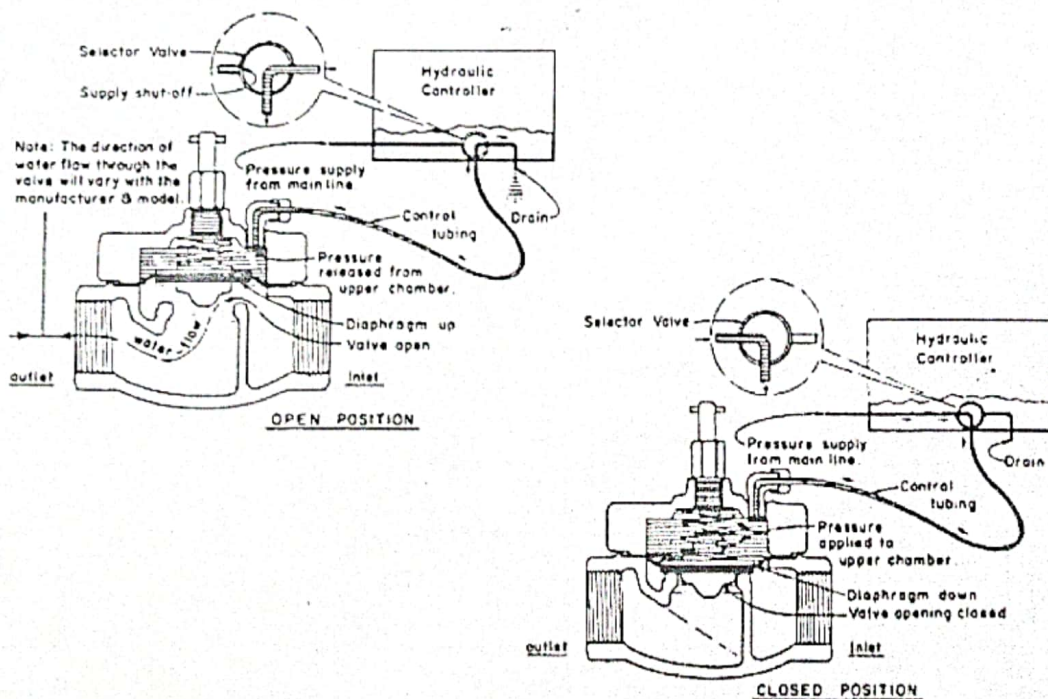
$$Q = V \times A$$

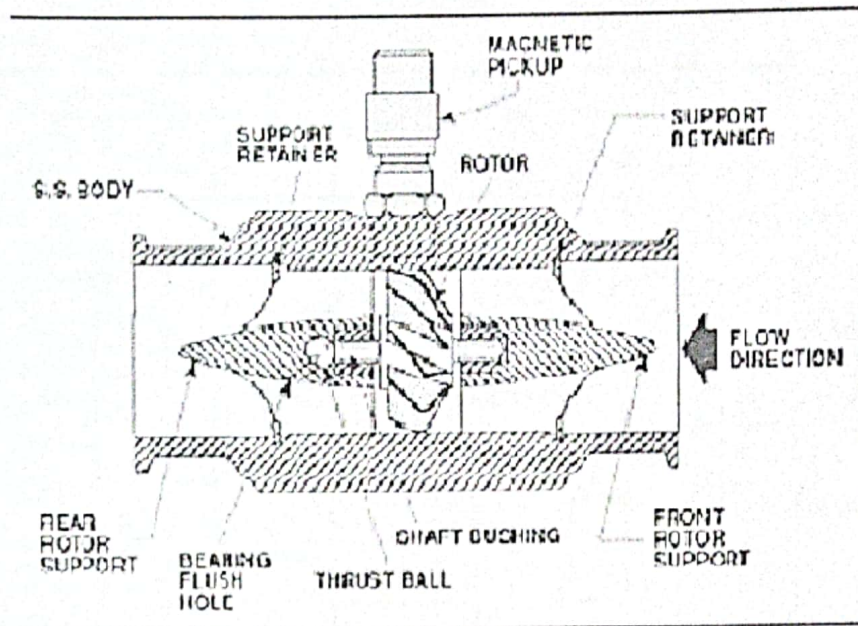
where

Q = liquid flow through the pipe

V = average velocity of the flow

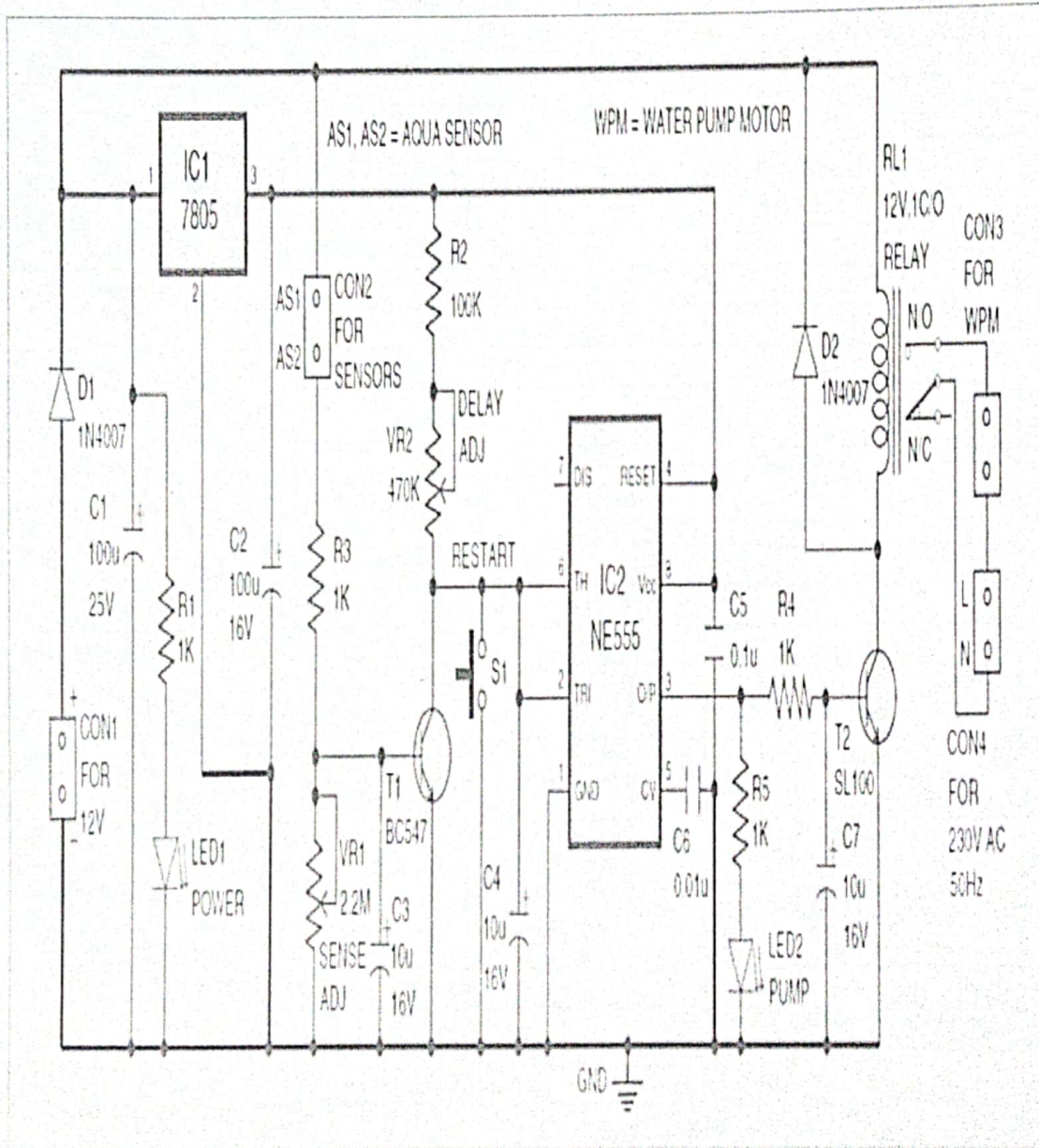
A = cross-sectional area of the pipe





WORKPLAN:

The work plan goes with the combination of flow meter and the control circuit with the output unit as automatic valve closing system.



BUDGET

| PROJECT BUDGET | | | |
|--|------------------------------|-----------------|-------------------------------|
| S.NO | NAME OF THE COMPONENT | QUANTITY | PRICE OF THE COMPONENT |
| 1. | WIRELESS MODULE | 1 | 1300 |
| 2. | SENSOR | 4 | 400 |
| 3. | IC1 7805 | 1 | 10 |
| 4. | IC2 NE555 | 1 | 10 |
| 5. | AQUA SENSOR | 1 | 300 |
| 6. | WATER PUMP MOTOR | 1 | 900 |
| 7. | LED | 2 | 250 |
| 8. | DIODE | 2 | 10 |
| 9. | RESISTOR | 6 | 10 |
| 10. | TRANSISTOR | 2 | 10 |
| 11. | CAPACITOR | 7 | 400 |
| 12. | WIRING | - | 400 |
| 13. | WATER PIPE LINE SETUP | | 4600 |
| 14. | WIRELESS MODULE | 1 | 3800 |
| 15. | IMPLEMENTATION | | 2500 |
| 16. | TESTING | | 400 |
| 17. | CONVEYANCE | | 1500 |
| TOTAL PROJECT BUDGET (A) | | | Rs.16800.00 |
| In kind Donation(B) By our college | | | |
| | WIRELESS MODULE | 1 | 3800.00 |
| In kind Donation Subtotal (B) | | | 3800.00 |
| Required Amount for the project(A-B) | | | Rs.13,000.00 |

Signature of the Principle Investigator

Signature of the HOD

PROJECT EVALUATION REPORT

| | |
|---|--|
| Name of the Investigator | Dr.K.UMADEVI |
| Name of the Co-Investigator | - |
| Name of the Department | Electrical and Electronics Engineering |
| Title of project | Deduction of water leakage in public distribution system |
| Recommendation of the evaluation committee (Recommended/Revision/Not Recommended) | Recommended |
| Financial allocation recommended | Rs. 13,000.00 |


| Sl. No. | Head | Amount in INR |
|---------|--|---------------|
| 1 | Components(Water pipe line set up, Wireless Module, Water Pump Motor) | 6800.00 |
| 2 | Consumables (Sensor, Aqua Sensor , IC2NE55,Diode,LED,IC17805,Wire,Resistor,Capacitor.Transistor) | 1800.00 |
| 3 | Implementation of water leakage system | 3450.00 |
| 4 | Travel Expenses | 950.00 |
| | Total | 13,000.00 |

Evaluation Committee Members

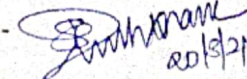
1. Dr.C.Venkatesh - Principal

- 
20/03/2021

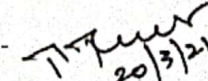
2. Dr.B.Sujatha - Dean(Academics)

- 
20/03/2021

3. Dr.P.Rameshkumar - Dean (R&D)

- 
20/3/21

4. Dr.P.Ponmurugan - Head (R&D)

- 
20/3/21

DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM

| Sl. No. | Head | Components /Description |
|---------|--|---|
| 1 | Components | 1. Water pipe line set up 2. Wireless Module 3. Water Pump Motor |
| 2 | Consumables | 1. Sensor 2. Aqua Sensor 3. IC2NE55 4. Diode 5. LED 6. IC17805 7. Wire 8. Resistor 9. Capacitor 10. Transistor |
| 3 | Implementation of water leakage system | 1. Water pipe line setup 2. Assembling and Soldering the circuit components |
| 4 | Travel Expenses | Purchase components and consumables |



SENGUNTHAR ENGINEERING COLLEGE (AUTONOMOUS)

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NAAC Accredited with 'A' Grade

TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU



RESEARCH & DEVELOPEMENT CELL

Submitted to Correspondent for Approval

Ref: SEC/R&D/2020-2021/R/001

Date: 22.03.2021

Sir,

Sub: Requisition for permission to grant SEED money -Reg

The Research & Development cell of our college had selected the following projects to grant SEED money to implement the proposals submitted, The principal investigator has asked to carry out their work as mentioned in their report.

| Sl.No | Title of the Project | Name of the Principal Investigator | Amount |
|--------------|--|------------------------------------|------------------|
| 1 | Flood geo-morphological survey and mapping of surface water potential and degradation study for tameradarani river stretch using remote sensing and gif techniques | DR.M.SEENIRAJAN | 12000.00 |
| 2 | LICENSE ELIGIBILITY MEASUREMENT SYSTEM | Mr.K.ASHOK KUMAR | 12000.00 |
| 3 | RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IOT | Dr.P. RAMESH KUMAR | 12000.00 |
| 4 | DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM | Dr.K.UMADEVI | 13000.00 |
| 5 | DESIGN AND DEVELOPMENT OF SMARK THREAD MILL BIKE | Mr. P.JAGADEESWARAN | 12000.00 |
| Total | | | 61,000.00 |

22/3/21
Dean(R&D)

22/3/21
Principal i/c.

22.03.2021
Correspondent

VOUCHER

Date : 28.12.21

No. To: Dr. K. UMADEVI

| Particulars | Rate | | Nos. | Amount | |
|--|------|----|------|--------|----|
| | Rs. | P. | | Rs. | P. |
| Implementing seed money. Ref Doc : SEC/RAD/2020-2021/1. detection of water leakage in public distribution system. | | | | 13,000 | 00 |
| Total Expenditure | | | | | |
| (-) Advance Paid on..... | | | | | |
| Balance to be refunded / paid | | | | | |

Received / Refunded Rs. : Thirteen thousand only

| | | |
|-----------------|------------------|---------------|
| PREPARED | CERTIFIED | PASSED |
| Staff I/C | Supervisor | A.O. |

Signature

For K. U. V. TRUST

PRINCIPAL

Sengunthar Engineering College
(Autonomous)
Tiruchengode

UTILISATION CERTIFICATE - (2020-2021)

Name of the Scheme under which the amount was sanctioned under the Research promotion scheme of Sengunthar Charitable Trust

| Sl. No | SCT Sanction Order /Letter No. & Date under which the amount was sanctioned | Amount (Rs.) | Remarks |
|--------|---|--|---|
| 1. | SEC/R&D/2020-21/003 dated 10.12.2021 | Rs 13,000 (Rupees Thirteen Thousand Only) | Certified that out of Grant-in-Aid of Rs 13,000 (Rupees Thirteen Thousand Only) sanctioned by the SCT during the financial year Rs. 13,000 has been utilized for the purpose for which it was sanctioned and the balance of Rs. 0 remained unutilized at the end of the year. |

Certified that I have satisfied myself that the conditions on which the amount was sanctioned have been duly fulfilled and that I have exercised the following checks to see that the money was actually utilized for the purpose for which it was sanctioned.


Signature of the guide

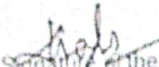

Signature of Head of the Institute

Place: Tiruchengode

Date: 10/12/2021

FORMAT FOR RECEIPT AND PAYMENT ACCOUNT

| Sl. No. | Receipt | Amount (Rs.) | Sl. No. | Payments | Amount (Rs.) |
|---------|--------------------|--------------|---------|-----------------|--------------|
| 1 | To Opening Balance | 13000 | 1 | Components | 8500 |
| | | | 2 | Implementations | 2000 |
| | | | 3 | Testing | 1000 |
| | | | 4 | Conveyance | 1500 |
| | | | | Closing Balance | 0 |
| | Grand Total | 13000 | | Grand Total | 13000 |


Signature of the guide


Signature of Head of the Institute

Place: Tiruchengode

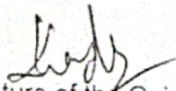
Date: 10/12/2021

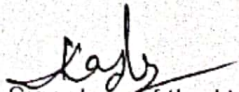
SENGUNTHAR ENGINEERING COLLEGE
DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING

STATEMENT OF ACCOUNT

Detection of Water Leakage in Public Distribution System

| S.NO | NAME OF THE COMPONENT | CREDIT (Rs) | DEBIT(Rs) |
|--------------------------------|-----------------------|--------------|--------------|
| 1 | WIRELESS MODULE | | 1300 |
| 2 | SENSOR | | 400 |
| 3 | IC1 7805 | | 10 |
| 4 | IC2 NE555 | | 10 |
| 5 | AQUA SENSOR | | 300 |
| 6 | WATER PUMP MOTOR | | 900 |
| 7 | LED | | 250 |
| 8 | DIODE | | 10 |
| 9 | RESISTOR | | 10 |
| 10 | TRANSISTOR | | 10 |
| 11 | CAPACITOR | | 400 |
| 12 | WIRING | | 400 |
| 13 | WATER PIPE LINE SETUP | | 4600 |
| 14 | IMPLEMENTATION | | 2500 |
| 15 | TESTING | | 400 |
| 16 | CONVEYANCE | | 1500 |
| Total | | | Rs.13,000.00 |
| SCT- Seed Money/Grant Received | | Rs.13,000.00 | . |
| Balance | | Nil | |


Signature of the Guide


Signature of the HOD

Original for Recipient

INVOICE NO:216

Date: MAY 04, 2021

ICON SYSTEM

ICON SYSTEM

49,C
AMMAN COMPLEX,
ABIRAMI THEATRE OPP ROAD,
Erode, TamilNadu(TN-33),
PIN Code 638011, India

Billto:

SENGUNTHAR ENGINEERING
COLLEGE
KUMARAMANGALAM(PO)
Tiruchengode, TamilNadu(TN- 34),
PIN Code 637205, India

Shipto:

SENGUNTHAR ENGINEERING
COLLEGE
KUMARAMANGALAM(PO)
Tiruchengode, Tamil Nadu (TN - 34),
PIN Code 637205, India

| NO | PRODUCT | QTY | UNIT PRICE | AMOUNT |
|--------------|-----------------|-----|------------|----------------|
| 1 | WIRELESS MODULE | 1 | 1300.00 | 1300.00 |
| 2 | SENSOR | 4 | 100.00 | 400.00 |
| 3 | IC17805 | 1 | 10.00 | 10.00 |
| 4 | IC2NE55 | 1 | 10.00 | 10.00 |
| 5 | ACEVA SENSOR | 1 | 300.00 | 300.00 |
| 6 | PUMP MOTOR | 1 | 900.00 | 900.00 |
| 7 | LED | 2 | 125.00 | 250.00 |
| 8 | DIODE | 2 | 5.00 | 10.00 |
| 9 | RESISTOR | 6 | 2.00 | 10.00 |
| 10 | TRANSISTOR | 2 | 5.00 | 10.00 |
| 11 | CAPACITOR | 7 | 57.14 | 400.00 |
| 12 | WIRING | - | 400.00 | 400.00 |
| 13 | PIPELINE | - | 4600.00 | 4600.00 |
| TOTAL | | | | 8600.00 |

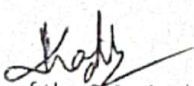
Total: EIGHT THOUSAND SIX HUNDRED ONLY



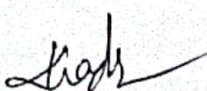
AUTHORIZED SIGNATORY

PROJECT COMPLETION REPORT

| | | |
|-----|---|--|
| 1 | SMS Reference No | SEC/R&D/2020-2021/R/001 |
| 2 | Title of research project | DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM |
| 3 | Name of the Principal Investigator | Dr.K.UMADEVI |
| 4 | Name of the Co-Investigator | - |
| 5 | Name the Department | ELECTRICAL AND ELECTRONICS ENGINEERING |
| 6 | Effective date of starting of the project | 22.03.2021 |
| 7 | Grant approved and expenditure incurred during the period of the report | |
| 7.1 | Total amount approved | Rs.13000 |
| 7.2 | Total expenditure | Rs.13000 |
| 8 | Report of the work done: (Please attach a Brief objective of the project: i. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication or communicated) ii. Has the progress been according to original plan of work and towards achieving the objective if not, state reasons iii. Has the project been submitted for external funding, if so give details | i. Attached Report ii. Yes iii. No |
| 9 | Please indicate the difficulties, if any, experienced in implementing the project during SMS. | No |
| 10 | Outcome of the project | |


Signature of the Principal Investigator

—
Signature of the Co-Principal Investigator


Signature of the Head

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Abstract

The water supply shortage has increased in recent years due to overpopulation, climate change and obsolete water facilities, where deteriorated pipes cause most of the water leaks. The problem is not the size of the leak, but the time it takes to detect it. This paper presents the implementation of a system installed in the hydraulic facilities of a residence, to detect water leaks. The system consists of a water sensor installed by a water reservoir of interest, a microprocessor to interpret the data and evaluate whether it is a water leak or not, an SMS alert message, and an electrical actuator to shut off the main water supply to avoid leakage.

Chapter 1: Introduction and Background

With the growth of the world population, the demand of fresh water has increased causing serious problems in the field of water supply. Therefore, control of water has become a considerable issue today. Scientists, technicians, politicians, and generally, many other inhabitants of the planet become increasingly educated on the subject. The threat of pollution hovers over and limits water supplies. The shortage of this vital liquid requires great attention. The proportion of fresh water found in rivers, lakes, and underground sources comprise only 3% of the total amount of water on earth [2]. In addition, the water found needs treatment for human consumption, to eliminate particles and organism harmful to health, and ultimately must distribute through pipes to homes safely [3].

This work focuses on the issue of distribution, more specifically, on the issue of “water leaks” in residential areas. Anyone who’s had a water heater, dishwasher or burst pipe disaster in their home knows how important early detection can be. Even those slow leaks that only cause mold damage require expenses to repair. The more water spilled (or splashed) the more money the repairs cost to residents. For this reason, it’s crucial to have some system installed in residences to detect water leaks.

The water detector electronic device is designed to detect the presence of water and provide an alert in time to allow the prevention of water damage. A common design includes a small cable or device that lies flat on a floor and relies on the electrical conductivity of water to decrease the resistance across two contacts. The device then sounds an audible alarm together with providing onward signaling in the presence of enough water to bridge the contacts. These provide usefulness in a normally occupied area near any infrastructure that has the potential to leak water, such as HVAC, water pipes, drain pipes, vending machines, dehumidifiers, or watertanks.

Water leak detection is an expression more commonly used for larger, integrated systems installed in modern buildings or those containing valuable artifacts, materials or other critical assets where early notification of a potentially damaging leak proves beneficial. Specifically, water leak detection has become a necessity in data centers, trading floors, banks, archives, and homes. The water leak detection industry, small yet specialized, has only a few manufacturers

operating world-wide [8]. The original application was in the void created by "computer room" floors in the days of large mainframe computer systems. These use a modular, raised floor based on structural "floor tile" usually 600 mm square and supported at the corners by pedestals [18]. The void created gave easy access and routing for the mass of power, networking and other interconnecting cables associated with larger computer systems - processors, drives, routers etc. mainframe computers also generated large amounts of heat so a void under the floor could also serve as a plenum to distribute and diffuse chilled air around the computer room. Chilled water pipes generally run through the void along with the drains for condensates associated with refrigeration plant. In addition, designers found the floor void a very convenient place to route other wet services feeding bathrooms, radiators and other facilities [15]. A leak occurring within a floor void would therefore go unnoticed until the hydrostatic head of pressure meant that the water found its way through to floors below where its dripping through the ceiling penetrates the joints and connectors of the power or network cabling and cause system failure from short circuits.

Current digital water leak detection systems can locate multiple water leaks to within 1 meter resolution over a complex network of cables running several kilometers [20]. This functionality reduces the downtime and potential damage caused by inaccurate reporting common with older analogue based systems [20].

The Z-Wave equipped Fibaro Flood Sensor (\$59) includes a tilt sensor (so the user knows if someone moved it), temperature sensor, a siren, a light, a built-in Z-wave network range tester, and it can be wired or wireless. The company says it works with any professionally-installed alarm system, but the user can also set it up. With a Fibaro Relay installed, the sensor can also automatically shut off a solenoid valve. The Flood Sensor requires Fibaro's Home Center 2 or another Z-Wave hub.

The Wally system doesn't use Z-Wave or Bluetooth or Zigbee. It uses a proprietary wireless system that takes advantage of the copper wires in your walls and treats them like antennas for the system. The moisture sensor (which also detects temperature and humidity) helps with large water emergencies and also alerts the user about slowly developing moisture—the kind that can lead to mold damage. The user also needs the Wally hub and the sensor for this system. A customer can purchase the hub with six sensors for \$299. Individually the sensors cost \$35.

This paper presents the instrumentation of a Water Leak Detection System (WLDS), a simple but cost effective water detection system, implemented in residential areas and offers a detailed description of the system throughout the following chapters. The next chapter dives into the WLDS system specifications and customer needs.

Chapter 2: Design Specifications

Chapter 2 describes the thought process behind creating the WLDS, the customers likely to buy this product, and the design specifications of the product.

Customer Needs Assessment

Homeowners are the primary users of my product. When someone owns a house or, more specifically, any piece of property, they don't realize how much that item means to them until destroyed by water damage. My family just recently had a water leak from one of the toilets in the upstairs bathroom that ended up dripping through the ceiling down onto the ground floor guest bedroom. The whole ceiling required replacement and ended up costing my parents a fortune. Therefore, I decided to create a low-cost water leak detection system for home owners. The needs of the customer include affordability, easy maintenance, easy setup, and reliability. In the case with my parents, the decision to purchase a low-cost leak detection system like mine and install it before the leaks became a significant problem would halt any of their water problems. Easy maintenance means that the user can keep the system running without having to put much work into it. Easy setup means that the time it takes to install the system should take no longer than 1 hour. Finally, nobody wants to buy a system that works for a month and then breaks; the system must be reliable, continuously running without taking up too much power and function properly over extended periods of time.

Specifications and Requirements

The Water Leak Detection System offers a solution to the problem. Users need an affordable system that draws little power to ensure low running costs [9]. The system must also function accurately so that when the user becomes alerted of a leak, it identifies an actual leak and does not make an error within the sensor. It needs to be autonomous requiring no user input beyond the initial installation. By owning the WLDS, users do not have to worry about checking their water reservoir of interest for water leaks or the wasting of water.

The WLDS consists of an actuator installed in the main water pump of a residence, and a device based on sensors to detect leaks. A microcontroller processes the readings from the water sensor [17]. If an unusual flow of water, the system issues a warning by sending a short text message (SMS: Short Message Service) to the mobile phone of the user. Along with the text message, an electrical actuator installed at the user's main water pump stops the flow of water so

that no further leakage occurs. The WLDS detects and eliminates a water leakage in a short time, because in most cases, the problem originates not from the leak itself, but the time to detect it. The microcontroller deactivates the water pump, if the water sensor detects 20mL or more water leakage. ¼ mL of water equals approximately a drop of water from a faucet, so 20mL of water ensures no false alarm [9]. The actuator and water sensor used to deactivate the water pump is small and light enough for any user to carry and install. The actuator can obtain power from a wall socket which negates the need for additional power [4]. The water sensor features battery powered hardware, allowing maximum mobility so that it may run for at least 30hours. Ideally, installation only requires mounting the water sensor, installing the actuator into the water pump, and plugging in the motor to the nearest residential power outlet. Table 2-1 summarizes detailed marketing requirements as well as the engineering specifications of the proposed WLDS.

TABLE 2-1
WATER LEAK DETECTION SYSTEM REQUIREMENTS AND SPECIFICATION

| Marketing Requirements | Engineering Specifications | Justification |
|-------------------------------|---|---|
| 2,5,7 | Meets standards of International Protection code IP51 | The unit sits in an outdoor setting exposed to various amounts of dust and condensation. This requires a level of weather resistance. |
| 2,5,7 | Meets NFPA 70 National Electric Code Safety Standards | Product uses electrical equipment. Meeting this standard keeps the user safe from electrical hazards. |
| 2,5,7 | This product meets Functional Safety Listed to applicable UL Standards and requirements by UL | Product meets UL Standards to keep user safe. |
| 2,3,4 | Deactivates the water pump if the water sensor senses more than 1.5 mL of water | ¼ mL of water equals approximately a drop of water from a faucet, sink among other examples. Any more than 1.5 mL of water leaking/6 water droplets characterizes a leak. |
| 1,5 | All materials cost less than \$100 | The price ceiling keeps the system affordable. |
| 2,5,8 | Requires no additional user | Residents don't have to worry about their water |

| | | |
|-------|---|---|
| | input beyond initial installation | pump system. |
| 5,6,8 | Battery powered actuator | Mobile actuator incase users need to move to different location/pipe. |
| 5,6 | Actuator must run for at least 30 hours. | Actuator must be able to run continuously for at least 30 hours to ensure cost effectiveness for the user. |
| 5,6 | Battery powered water sensor | A mobile sensor so the user doesn't have to worry about plugging into a wall socket. |
| 5,6 | Water sensor must run for at least 30 hours. | The sensors must run for an extended period before batteries need replacement. |
| 1,3,5 | Actuator consumes less than 500 mW during standby operation | During its inactive state, it uses minimal power to maintain efficient function. |
| 5,6,8 | Installation takes less than 1 hour for an untrained user | The device comes ready out of the box, requiring only that the user install the sensors, attach their actuator, and plug the device in. |
| 5,6,8 | Actuator and water sensor must have dimensions smaller than 8"x5"x3" | This size restraint ensures the device places easily and does not require excessive space. |
| 5,6,8 | Actuator weighs less than 5 lbs. | A user can more easily carry a lighter device. |
| 5,6,8 | Water sensor weighs less than 2 lbs. | Makes sensors light enough to place at user friendly locations |
| 5,8 | Speaker outputs warning beep no louder than 80 dB, and no quieter than 50 dB. | Typical alarm clocks are built between 50-100 dB. Warning sound must have dB in this range to hear from anywhere in house. |

Marketing Requirements

1. Affordable
2. Autonomous
3. Low Power Consumption
4. Accurate Pump Control
5. Unobtrusive
6. Easy to Install
7. Weather Resistant
8. User Friendly

Chapter 3: System Design and Functional Decomposition

Chapter 3 will focus on the main design of the WLDS system and a functional breakdown of each component within the system. Figure 3-1 and Table 3-1 show the level 0 block diagram and the input signals of the WLDS system consecutively. The microcontroller within the WLDS relies on the data from the water sensor to accurately control the water pump. For simplicity and ease of use, the AC power source provides power to the fuse and actuator. The microcontroller then makes a decision based on the status of the sensor, and it outputs a signal to the actuator, sends a text alert to the user, and sounds an 80 dB alarm so the user can hear when home.

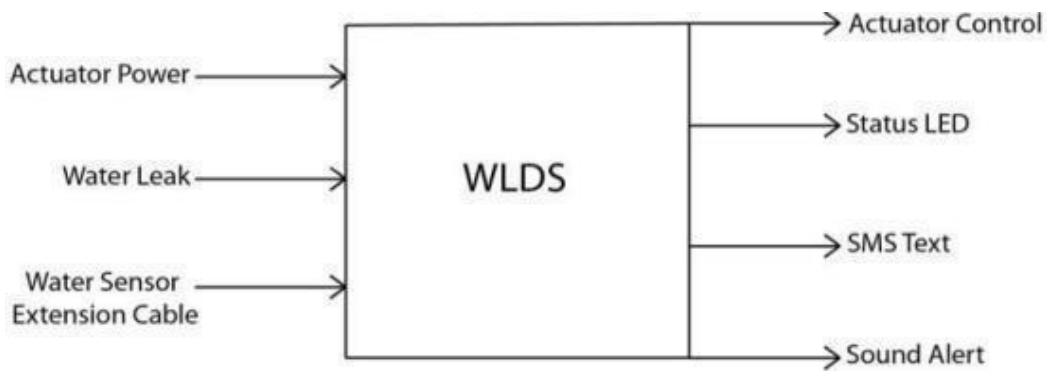


Figure 3-1: Level 0 Block Diagram

TABLE 3-1
LEVEL 0 WATER LEAK DETECTION SYSTEM FUNCTIONAL REQUIREMENTS

| Module | Water Leak Detection System |
|---------------|---|
| Inputs | -Actuator Power -Water Sensor: Sensitive to 1.5mL -Sensor Extension Cable: Extra sensing radius |
| Outputs | -SMS alert text message -Actuator Control: Shuts off main water pump when detected leak -Status LED: Turns red when powered on -Sound Alert: 80 dB alarm |
| Functionality | Water sensor detects leak at water reservoir. Alerts the user via sms message and alarm. Actuator shuts off main water pump. |

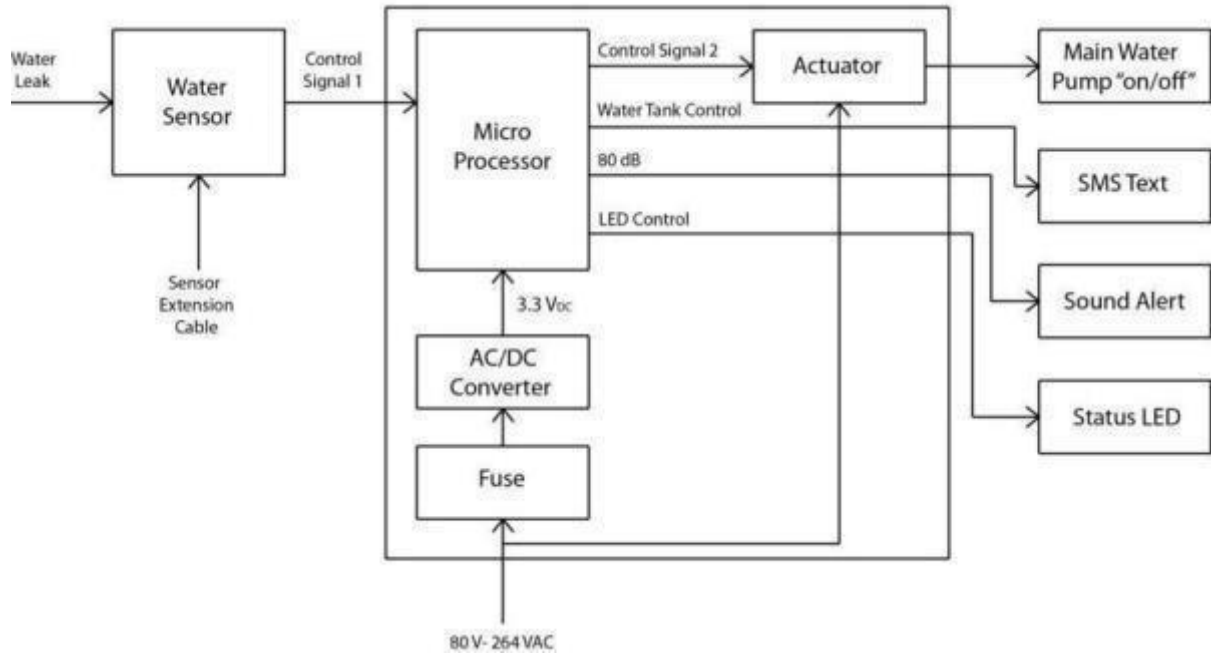


Figure 3-2: Level 1 Block Diagram

Figure 3-2 shows the level 1 block diagram of the system which features the major modules and their connections. The line voltage feeds into the AC/DC power module [4]. The resulting voltage powers the microprocessor and LED. The line voltage splits off to feed the actuator which relies on a control signal from the microprocessor to determine whether the line voltage passes on to stop the water pump.

TABLE 3-2
LEVEL 1 WLDS - 1A SLOBLO FUSE

| | |
|---------------|--|
| Module | -1A SLOBLO FUSE |
| Inputs | -Power: ~80-264 VAC 50/60Hz |
| Outputs | -Power: ~80-264 VAC 50/60Hz |
| Functionality | -Protect the AC/DC converter from large currents |

Table 3-2 shows information about the 1A SLOBLO fuse. This fuse provides overcurrent protection for the AC/DC converter [2]. SLOBLO allows short surges of current through without blowing the fuse. This ensures the components can source the starting current they need.

TABLE 3-3
LEVEL 1 WLDS - LED

| | |
|---------------|--|
| Module | -Status LED |
| Inputs | -DC: 3.3 VDC |
| Outputs | -Red Light |
| Functionality | -Produce light signifying a powered system |

Table 3-3 shows information regarding the LED. The LED uses the power output of the AC/DC converter to produce light, signifying power to the system.

TABLE 3-4
LEVEL 1 WLDS - POWER MODULE

| | |
|---------------|---|
| Module | -AC/DC Converter |
| Inputs | -Power: ~80-264 VAC 50/60Hz |
| Outputs | -DC: 3.3 VDC |
| Functionality | -Rectify the AC signal and steps down the DC voltage to 3.3V. |

Table 3-4 shows information about the AC/DC Converter module. The AWPC accepts universal AC input such that the AWPC could be used anywhere regardless the available local residential AC input. In this module the system rectify the AC signal provided by an electricity company, then step down the DC voltage to 3.3V [6].

TABLE 3-5
LEVEL 1 WLDS - WATER SENSOR MODULE

| | |
|---------------|---|
| Module | -Water sensor |
| Inputs | -Water Leak -Sensor Extension Cable |
| Outputs | -Control Signal 1: 3.3 VDC |
| Functionality | -Constantly monitoring for water leak. -Extension cable for bigger sensing radius. |

Table 3-5 shows the module for the Water Sensor. The module monitors a given area for a water leak. As an example, the sensor has an output signal of 3.3V which outputs a control signal to the microcontroller when the system detects a leak.

TABLE 3-6
LEVEL 1 WLDS - MICROPROCESSOR MODULE

| | |
|---------------|---|
| Module | -Microprocessor |
| Inputs | -Control Signal 1 -Power: 1.8V~3.6 V |
| Outputs | -Control Signal 2 -Water Tank Control -Sound Alert ~80 dB -LED control ~3.3 V |
| Functionality | -Process data from the control signal and sends out a control signals to other parts of system. |

Table 3-6 shows the input and output signals of the Microcontroller module. The microcontroller processes data acquired from the water sensor and sends an output signal to the actuator. The microprocessor also produces a sound alert and text alert, when it receives the input.

TABLE 3-7
LEVEL 1 WLDS - ACTUATOR MODULE

| | |
|---------------|--|
| Module | -ACTUATOR |
| Inputs | -Power: ~80-264 VAC 50/60Hz -Control Signal 2 |
| Outputs | -Main Water Pump “On/Off” |
| Functionality | -Shut the main water pump off when control signal is received. |

Table 3-7 shows the input and output signals information of the actuator module. This module waits for the controls signal 2 to activate to stop (or deactivated to start) pumping water to into the user's home.

The WLDS modules building process is recorded below in Chapter 4, as well as the estimated and actual cost of the project.

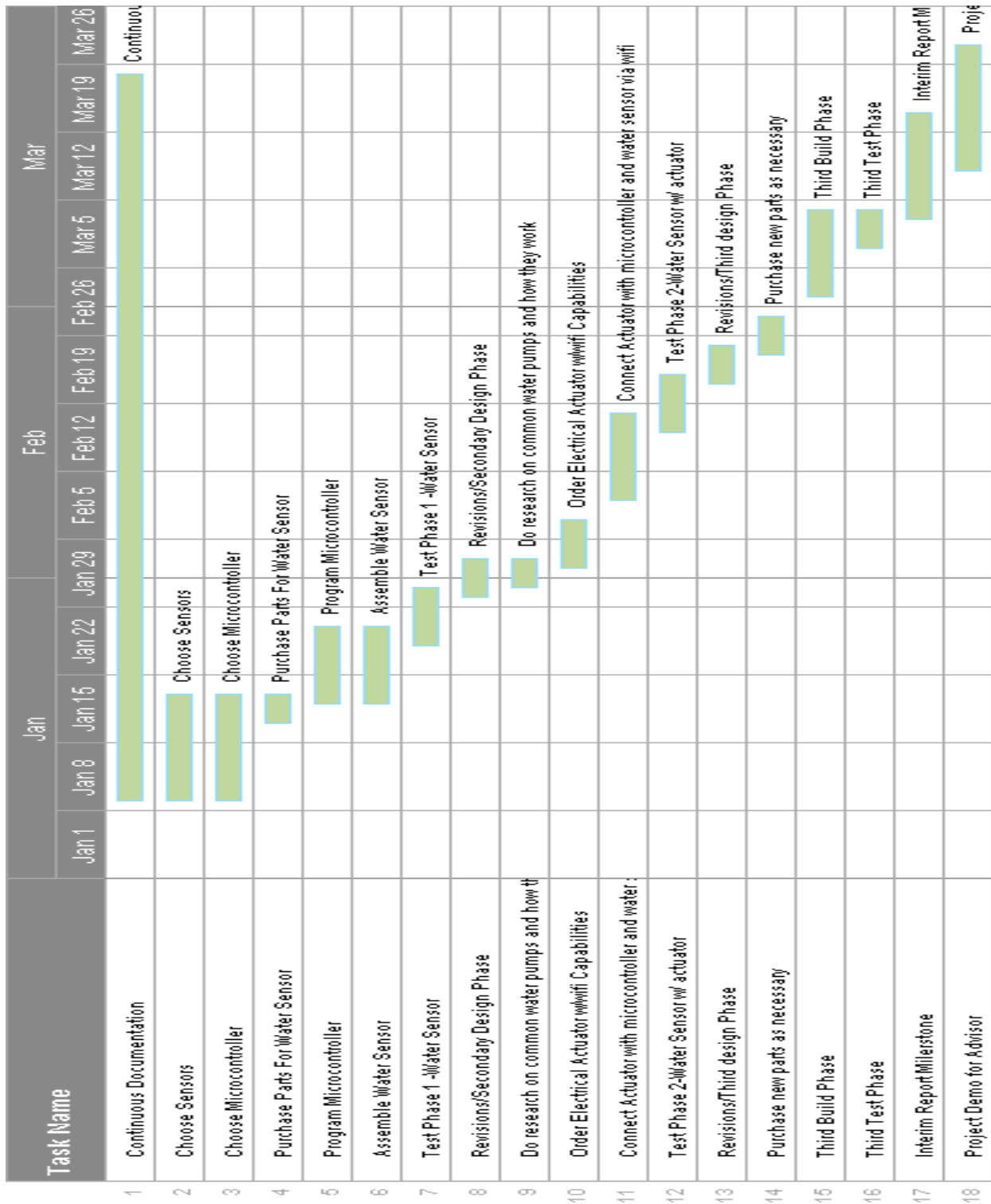


Figure 4-2: Winter 2017 Project Gantt Chart

Figure 4-2 above shows certain project milestones completed by the end of winter quarter.

TABLE 4-1

Project Deliverables

| Delivery Date | Deliverable Description |
|----------------------|--------------------------------|
| February 16 | Design Review |
| March 17 | EE 461 Review w/Advisor |
| March 24 | EE 461 report |
| April 28 | EE 462 Design Review |
| May 19 | ABET Sr. Project Analysis |
| June 1 | Sr. Project Expo Poster |
| June 15 | EE 462 Report |

Table 4-1 above shows the milestones completed for the WLDS throughout Fall, Winter, and Spring quarter.

TABLE 4-2
ESTIMATED PROJECT COSTS

| Cost Estimates | | |
|----------------|--------------------|-------|
| | Item | Cost |
| System Parts | | |
| | Enclosure Material | \$40 |
| | Controller | \$15 |
| | Circuitry & Wires | \$30 |
| | Sensors | \$25 |
| | Subtotal | \$100 |
| Testing Parts | | |
| | Water Pump | \$100 |
| | Tubing | \$20 |
| | Containers | \$20 |
| | Subtotal | \$140 |
| | Grand Total | \$240 |

Table 4-2 shows the anticipated cost estimates for the Water Leak Detection System. Simulating a water pump requires tubing and containers. Cost estimates include wires and circuit boards because the system requires wires to make connections between components and the circuit board to integrate the components. The section labeled other includes tools such as hot glue, and electric tape. And finally, the enclosure material serves as the material cost estimate for the box used to protect all the circuitry from the weather, dust, and water that may endanger the inner circuitry.

Assuming the average electrical engineer receives a pay between \$25/hr to \$35/hr and an estimated time of 200 hours to make the product, the labor costs range from \$5000 to \$7000. Using a most likely cost of \$6000, the estimated labor cost equals the most likely cost.

TABLE 4-3
WINTER 2017 PROJECT COSTS

| Item | Cost |
|--------------------------------|--------------|
| Arduino Microcontoller(x2) | \$32 |
| Xbee Wifi Module(x2) | \$54 |
| Mini Usb Cable(x2) | \$10 |
| Eco Worthy 12V Linear Actuator | \$50 |
| 3V Mini Water Pump | \$8 |
| PVC Tubing | \$8 |
| 5 Pack Piezo Buzzers | \$7 |
| TOTAL COST SO FAR | \$169 |

Table 4-3 above depicts the cost of the WLDS system parts for Winter 2017.

TABLE 4-4
TOTAL PROJECT COSTS

| <u>Item</u> | <u>Cost</u> |
|-----------------------------|-------------|
| Arduino Microcontroller(x2) | \$32 |
| Xbee Wifi Module | \$54 |
| Mini Usb Cable(x2) | \$10 |
| Linear Actuator | \$20 |
| Mini Water Pump | \$10 |
| PVC Tubing | \$8 |
| Piezo Buzzers | \$5 |
| Circuitry and Wires | \$30 |
| Water Sensor | \$10 |
| SMS System | \$50 |
| TOTAL COST | \$229 |

Table 4-4 above shows the cost breakdown of the project for Fall, Winter, and Spring Quarter.

Comparing tables 4-4 and 4-2 one will notice that the project only went over budget by 15%. The subsequent chapters include the bulk of the report which include design decisions, testing, results, and conclusions.

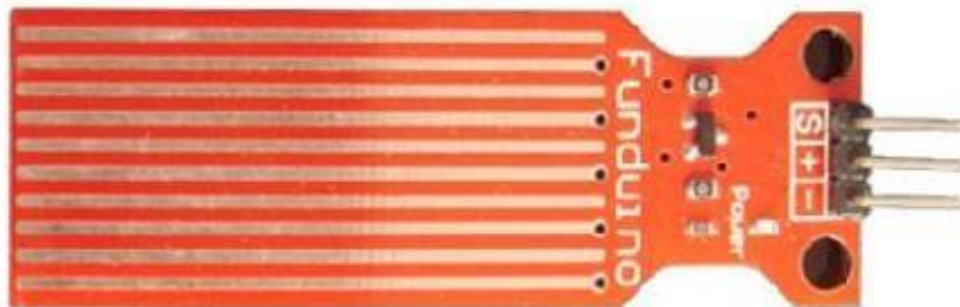
Chapter 5: System Design Decisions and Testing

Chapter 5 includes the bulk of the report and consists of the different modules for the WLDS. This includes design decisions and testing for the water sensor, XBee Wi-Fi modules, buzzer alarm, SMS alert system, and actuator control. This chapter also includes detailed explanations of each module and system schematics.

Module 1: Water Sensor

Design

The liquid level sensor, built by ALSROBOT, displays the part number RB-02S048A. Amazon or EBay sell this part for under \$2. It's very inexpensive. The sensor outputs an analog voltage proportional to the amount of liquid exposed to it. The sensor has a series of parallel wires across the board. These wires sense the liquid level that the board is exposed to. I simply connect the analog pin, represented by an S, to an analog pin on the Arduino board to read the analog value. The simplicity, cost, low power consumption and compatibility with the Arduino makes this water sensor the best decision for the project. The sensor operates on 5V and needs less than 20mA for operating power current, which means the Arduino can easily provide this (so no external power needed to power it). The liquid level sensor has 3 pins. It's very basic. Figure 5-1 below shows the pinout of the sensor [25].



- S = Signal Pin (connects to an analog pin on the arduino)**
- + = Positive Voltage (connects to +5V terminal on arduino)**
- = Ground (connects to ground terminal on arduino)**

Figure 5-1: ALSROBOT Water Sensor [25]

Two of the pins power the device, 1 connecting to the +5V of the Arduino and the other connecting to the ground terminal of the Arduino. The other pin, with an S, stands for the signal pin. This pin outputs the analog voltage signal proportionate to the amount of water on the sensor covered with liquid. This pin connects to an analog pin on the Arduino board and monitors the value.

For this circuit, the LED lights up when the liquid level of the sensor grows greater than 600.

This value meets the sensitivity specification because an analog value of 600 equates to approximately 6 droplets of water (1.5mL). After the LED worked with the Arduino for testing purposes, a buzzer alarm took its place. [25].

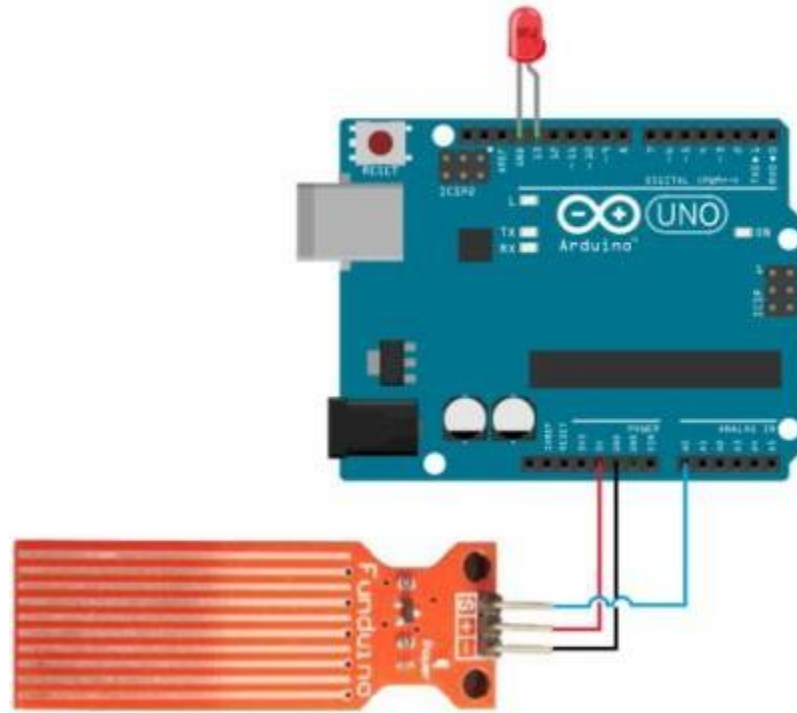


Figure 5-2: Arduino Microcontroller with Water Sensor Schematic [25]

The liquid level sensor board needs 5V of power from the 5V and GND pins on the Arduino. The signal pin (S) gets connected to an analog pin on the Arduino board. Here we connect it to analog pin A0. This allows the Arduino board to read the analog voltage value. The LED light has its anode terminal connected to digital pin D13 and its cathode.

Code

```

/*Code for Liquid Level Indicator Circuit Built with an Arduino*/

const int sensorPin= 0;           //sensor pin connected to analog pin A0
const int ledPin= 13;            //LED Pin connected to digital pin D13
int liquid_level;

void setup() {
  Serial.begin(9600);             //sets the baud rate for data transfer in bits/second
  pinMode(sensorPin, INPUT);      //the liquid level sensor input to the arduino
  pinMode(ledPin, OUTPUT);        //the LED output
}

void loop() {
  liquid_level= analogRead(sensorPin); //arduino reads the value from the liquid level sensor
}

```

```

Serial.println(liquid_level);           //prints out liquid level sensor reading for debugging
delay(2000);                            //delays 2 s

if (liquid_level >= 600){
digitalWrite(ledPin, HIGH);

Serial.println("Buzzer Buzzing!");
}
else {
digitalWrite(ledPin, LOW);
}
}

```

The commented code above explains itself for the most part. The sensorPin initialized to 0 and LED to 13. The liquid level variable holds the value of the analog value output from the sensor, serving as the sensor reading representing how much water leaks on the sensor. The setup function sets the baud rate.

The loop function repeats over and over. It reads the value from the sensorPin and stores it in the variable liquid_level. The serial monitor prints this value for debugging purposes.

The analogRead function, the most important function for the module, reads the sensor pin and outputs a value anywhere from 0 to 1023, proportional to the voltage from the sensor. If the sensor is submerged in no liquid, the Arduino registers a 0 reading. If the sensor is fully submerged in liquid, it registers a full reading of 1023. A reading of approximately 600 equates to 1.5mL of water. Thus, when the reading grows above 600, the LED/speaker turns on, indicating a leak. Otherwise, the LED and speaker turn off.

Testing Module 1:

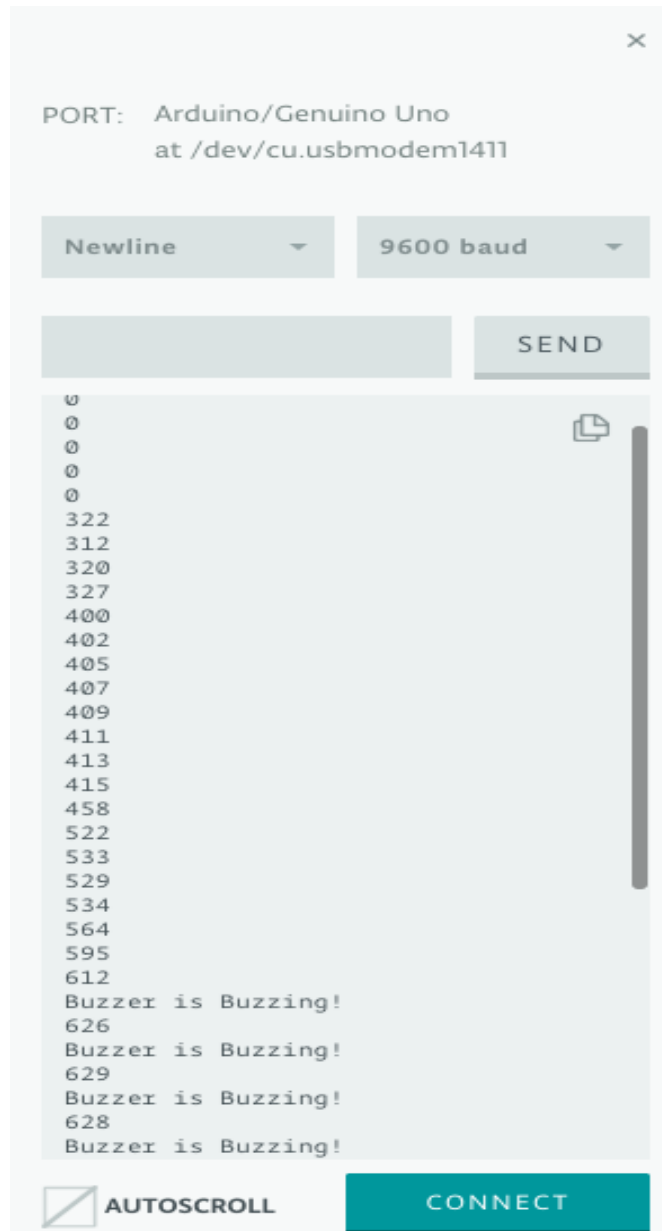


Figure 5-3: Serial Monitor Output of Water Sensor

Figure 5-3 above shows the analog values of the water sensor outputted to the serial monitor of the Arduino. A droplet of water (.25mL) was put onto the sensor using a pipette and by the 6th drop (1.5mL), the analog value reached 600, thus activating the buzzer speaker. The water sensor outputs exactly as predicted and takes water as an input, converts it to a readable voltage, and turns on a buzzer speaker when the water content rises above threshold.

Module 2: XBee Radio Communication

Design

Wi-Fi could work for my project but the power consumption is too high and the high data rate proves unnecessary. Bluetooth is useful for control but not applicable for sensor networks such as the WLDS. The XBee has a low data rate (250kbit/s), low power consumption, and is used to create mesh-type sensor networks making it the perfect fit for the WLDS. Each XBee device can communicate with one another, and through each other via a mesh network to devices out of range.

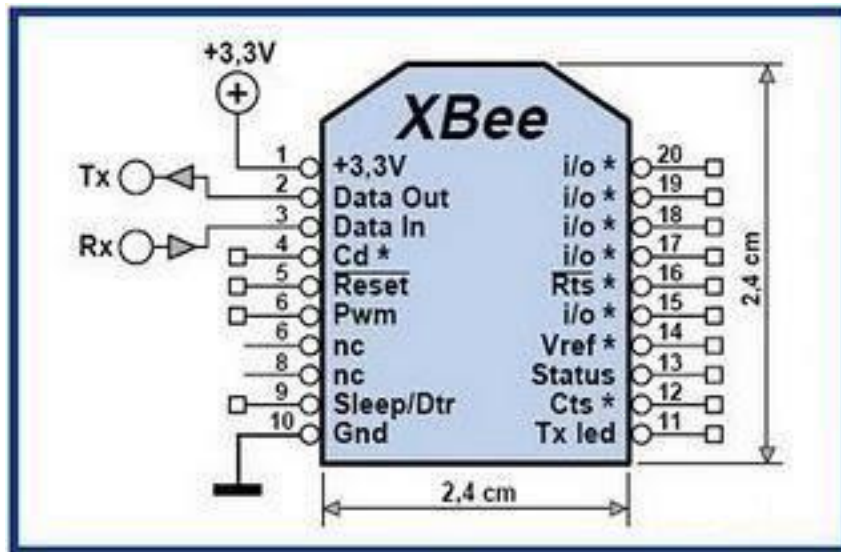


Figure 5-4: Pinout of XBee S2C [27]

The schematic above depicts the pinout of the XBee Radio Module. The main pins used for this project include the Data Out/in, Gnd, 5V, and one of the i/o pins which connects to the water sensor. The XBee, programmed through software called XTCU, allows users to directly assign the XBee parameters such as IP Address, sample rate, router/coordinator functionality.

ZigBee defines three different device types: coordinator, router, and end device.

Coordinator

ZigBee networks always have a single coordinator device. The coordinator starts the network, selecting the channel and PAN ID. It also buffers wireless data packets for sleeping and end device children and distributes addresses, allowing routers and end devices to join the network. The coordinator manages the other functions that define the network, secure it, and keep it healthy. This device cannot sleep and must constantly run.

Router

A router equates to a full-featured ZigBee node. This device can join existing networks and send, receive, and route information. Routing involves acting as a messenger for communications between other devices too far apart to convey information individually.

Can buffer wireless data packets for sleeping end device children. Can allow other routers and end devices to join the network. A router cannot sleep and may have multiple router devices in a network [27].

End device

An end device describes essentially a reduced version of a router. This device can join existing networks and send and receive information, but cannot act as messenger between any other devices. Cannot allow other devices to join the network.

XBee features Transparent Mode (AT) or Application Program Interface Mode (API). The first mode makes sure the XBees function properly and work with XCTU software and a USB cable only. In transparent mode, if I sent a packet of data saying “Hello World” from the router XBee, the coordinator XBee should receive the information and display “Hello World” on its serial monitor. API mode utilizes the XBees’ data pins, allowing interfacing with a microcontroller.

The WLDS utilizes API mode to transmit the analog data from the water sensor to a remote location via wireless communication [27].

The XBee transceivers have a 2mm pin spacing which does not interface with the standard 0.1 inch breadboard. There are several different breakout boards that bypass this spacing [27]. The various adapter boards also allow for connection through USB or serial to your computer. The breakout board used here has a UART to USB conversion circuit to connect the XBee to the computer and X-CTU software easily.

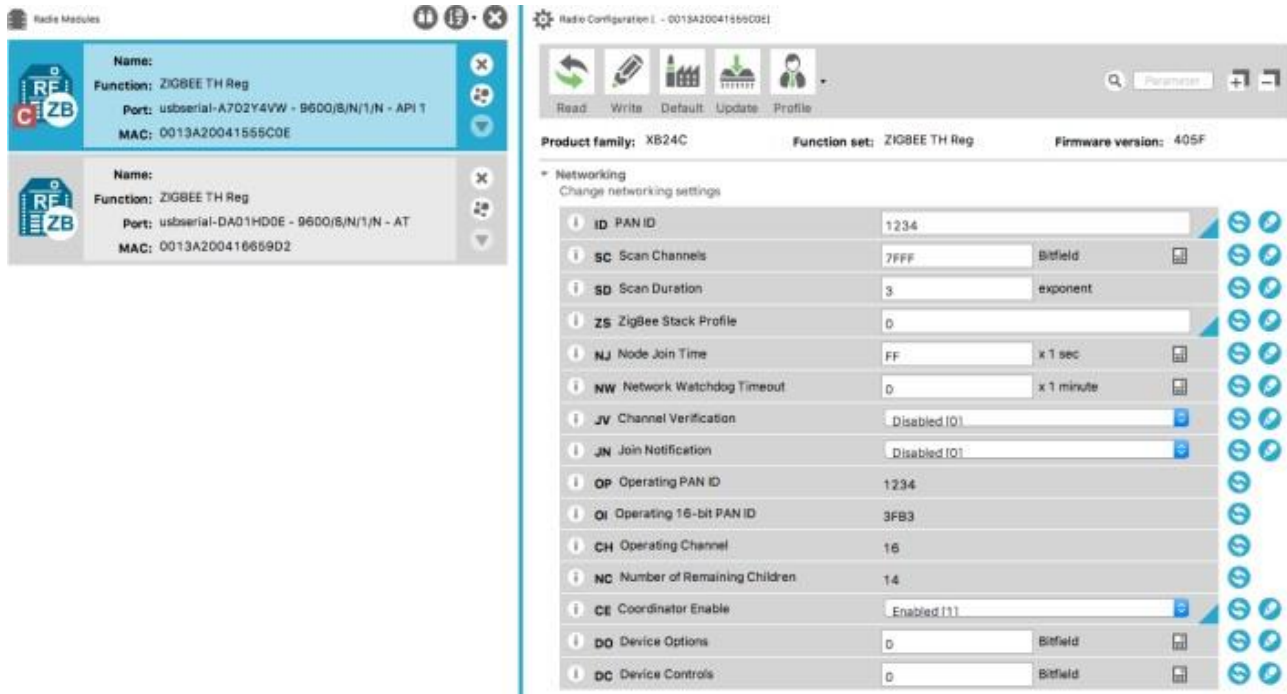


Figure 5-5: Image of XBee USB Adapter [27]

One can see from the image above that adapter has just the right number of pins to mount the XBee, solder points that make it easy to hook up the adapter to a breadboard, and most importantly a mini USB port used to connect the XBee directly to the computer to change parameters.

Testing Module 2: Connecting to and Using the XCTU Software

Figure 5-6: XCTU Software Parameters



The Figure above shows the configuration of two different XBees. Both XBees connect to the computer using the adapter shown in figure 5-5 and a USB to mini USB cable. The Xbee in the top right corner with a C by it stands for coordinator Xbee and the other with no letter stands for router Xbee. Once one Xbee initializes to the coordinator, all subsequent XBees connected automatically initialize as Routers unless changed within XCTU. Most of the Xbee parameters remain unchanged except for a few important ones.

The PAN ID allows the XBees to find one another remotely, so this number is the same for each Xbee connection. The Channel Verification (JV) equals zero for the coordinator and one for the router. This parameter makes it easier for the router to find the coordinator, maintain connection while the coordinator remains powered on, and disables connection otherwise. Baud Rate equals 9600 and Sampling Rate equals 50ms [27].

Testing Module 2: AT Communication Between Two XBees Using Serial Communication

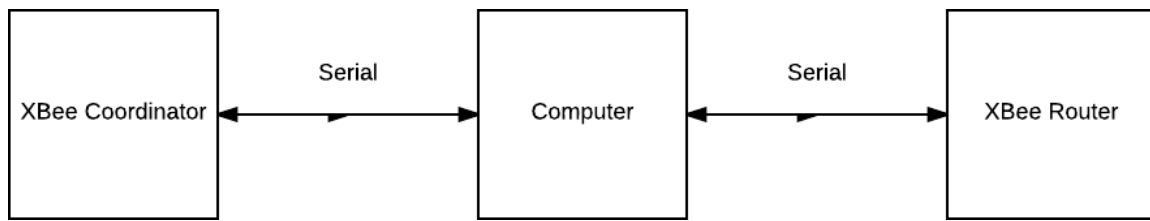


Figure 5-7: Block Diagram of XBees in Transparent Mode

The block diagram above depicts a simple connection between two XBees and a computer. The XBees use adapters to function properly with the computer via USB.

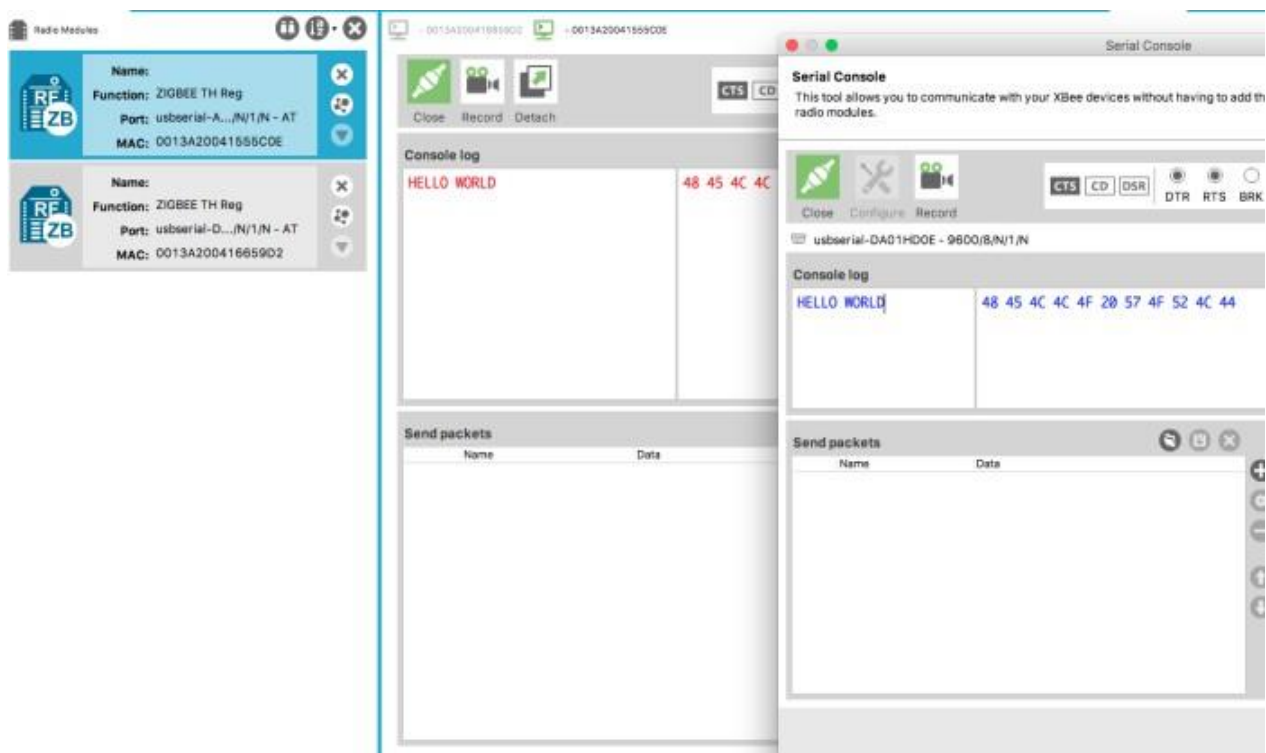


Figure 5-8: Successful Communication Between Two XBees in AT Mode

Figure 5-8 above shows the router Xbee communicating with the coordinator Xbee in AT mode. The green connection button in the image shows that the connection is open between the two XBees. In the router's serial console (BLUE) I typed HELLO WORLD and as seen above, the Coordinator processed the information wirelessly and displayed the message received from the router in red.

Testing Module 2: AT Communication Between Two XBees With Two Arduino MCU's

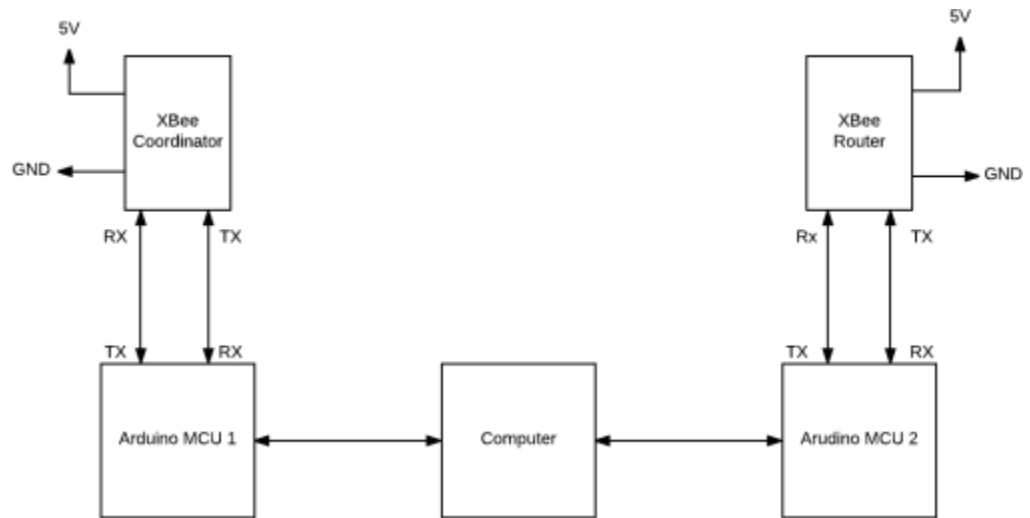


Figure 5-9: Block Diagram of Arduinos Driving XBees

Figure 5-9 shows the block diagram of two XBees in AT mode each connected to a MCU and this time the MCU connects to the computer via USB instead of the Xbee. The difference between this setup and the previous setup (Figure 5-7) is that instead of typing the message in via serial monitor and manually sending the message, this setup utilizes the Arduino MCU, crucial for the WLDS to work properly. The goal of this setup includes programming one Arduino to transmit a message and the other to receive and display the message wirelessly all through Code Composer Studio instead of XCTU software.

Code for Arduino w/XBee router

```
void setup () {  
  Serial.begin(9600);  
  
}  
void loop() {  
  Serial.println("Hello World");  
  delay(5000);  
}
```

This code simply starts the serial monitor and prints “Hello World” to the screen every 5 seconds.

Code for Arduino w/XBee Coordinator

```
void setup() {  
  Serial.begin(9600);  
}  
  
void loop() {  
  if (Serial.available()) {  
    Serial.write(Serial.read());  
  }  
}
```

The code checks if the serial monitor's availability. If available, the Coordinator XBee receives the message from the router XBee, sends it to the serial read port of the Arduino, and prints out "Hello World" wirelessly.

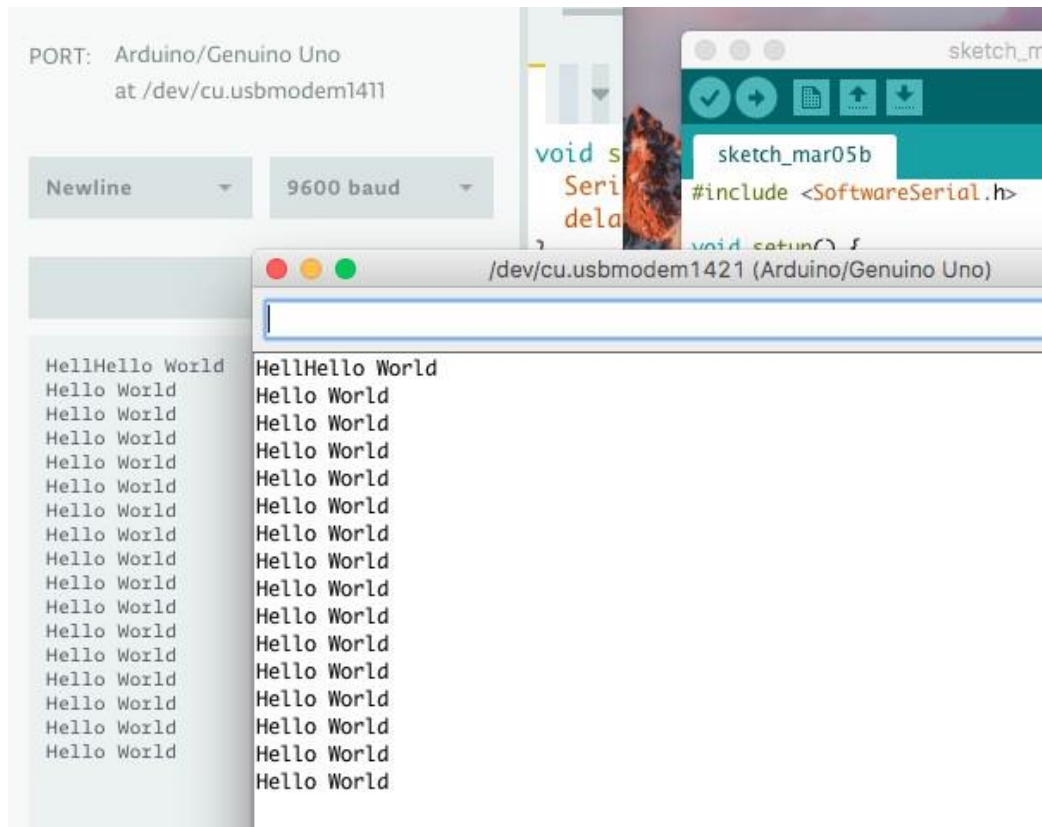


Figure 5-10: Successful Communication Between Two XBees Using Arduino MCU

The figure above shows correct communication between XBees. First, the usbmodem numbers at the top of the two serial monitors differed from one another. This means that I have two Arduinos plugged into my laptop, one running the Coordinator Code, and the other running the Router code. Usbmodem1421, the coordinator XBee, clearly receives "Hello World" from the router XBee every 5 seconds. Wireless communication is established between the two XBees using only the Arduino MCU, and now the router XBee can wirelessly transmit water sensor data to the coordinator XBee.

Testing Module 2: XBee Communication Using API Mode

API (Application Programming Interface) mode is a frame-based method for sending and receiving data to and from a radio's serial UART, an alternative to the default transparent mode [27].

The API allows the programmer the ability to:

- Change parameters without entering command mode (XBee only)
- View RSSI and source address on a packet by packet basis (XBee 802.15.4 only)
- Receive packet delivery confirmation on every transmitted packet

The WLDS needs API mode to function properly, because it allows transmitting of data frames between the water sensor, Router XBee, and Coordinator XBee. The data below shows an example of the router sending a message to the coordinator in frame form, how to read the frames explained in the following passages [27].

The data below shows the frames received by the coordinator when the router sent the message “Hello” in packet form.

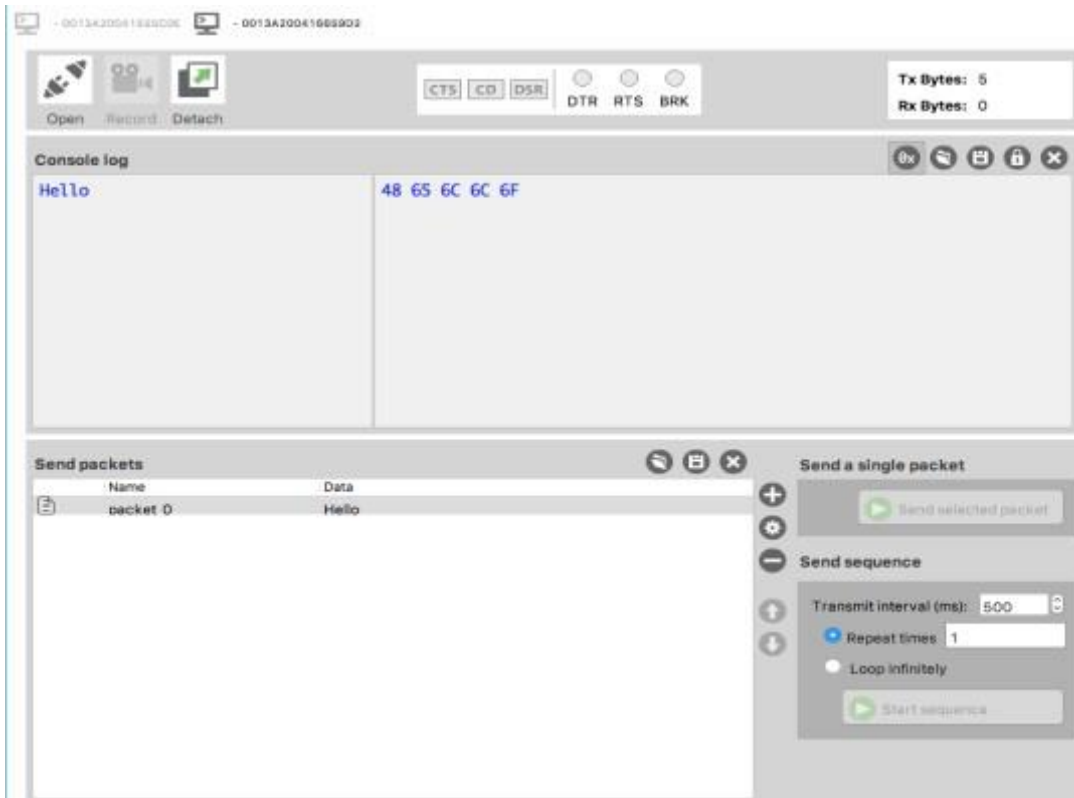


Figure 5-11: Serial Console of Router XBee

Figure 5-11 above shows a screenshot of the router XBee’s serial console. Seen above, packet zero, which translates in hex to “Hello”, transmits via mesh networking to the Coordinator XBee.

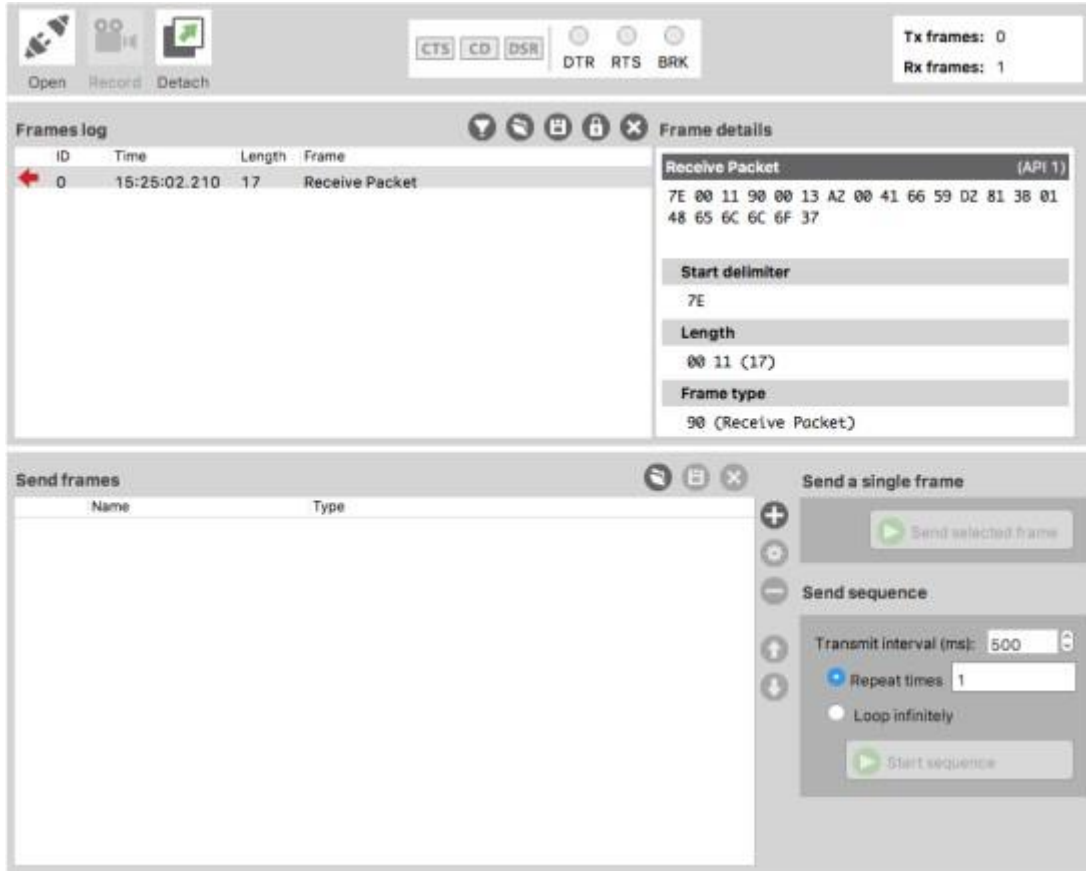


Figure 5-12: Serial Console of Coordinator XBee

As seen in the figure above, the coordinator XBee received the packet of data from the router XBee.

Receive Packet (API 1)

7E 00 11 90 00 13 A2 00 41 66 59 D2 81 3B 48 65 6C 6C 6F 37

Start delimiter: 7E

Length: 00 11 (17)

Frame type: 90 (Receive Packet)

64-bit source address: 00 13 A2 00 41 66 59 D2

16-bit source address: 81 3B

Receive options:

RF data: 48 65 6C 6C 6F

Checksum: 37

The data above represents different information received by the Coordinator from the router. Each set of Bytes represent different parameters about the XBee. For this line of Bytes, the light blue set holds the highest precedence. This set represents the ASCII characters “H,e,l,l,o” in Hex starting with byte 48 and ending with byte 6F.

Module 3: Actuator Control



Figure 5-13: 12V DC Eco-Worthy Linear Actuator [28]

The figure above shows the actuator used to stop water flow when the WLDS detects a leak. The specs include an input voltage of 12V DC, a starting current of 0.8A, and max current of 3A. The actuator has a max load of 1500N/Push, a speed of 5.7mm/s, stroke length of 4 inches and duty cycle of 25%.

Testing Module 3: Actuator Control

A 2-channel relay utilizes communication between the Arduino Uno Microcontroller and the Eco-Worthy Actuator. The relays control the direction the actuator moves. They work by using current from the input source to activate an electromagnet, which pulls a switch that allows higher currents on the opposite side of the relay to flow.



Figure 5-14: Control Relay Options [28]

On the control side of the relays a GND pin, IN pins numbered from 1 to 8 depending on the relay model, and a VCC pin exist. The relays require power to stay activated, so a stable 5V power supply works. Otherwise the Arduino has trouble powering the higher channel relay modules. On the control side of the relay, 5V power supply connects to the VCC and GND pins. Next, the IN pin connects to the corresponding Arduino pin, then the relays activate once the IN pins connect to the GND pins. On the relay side, there exist three main parts of each relay, and three screw terminals [26].

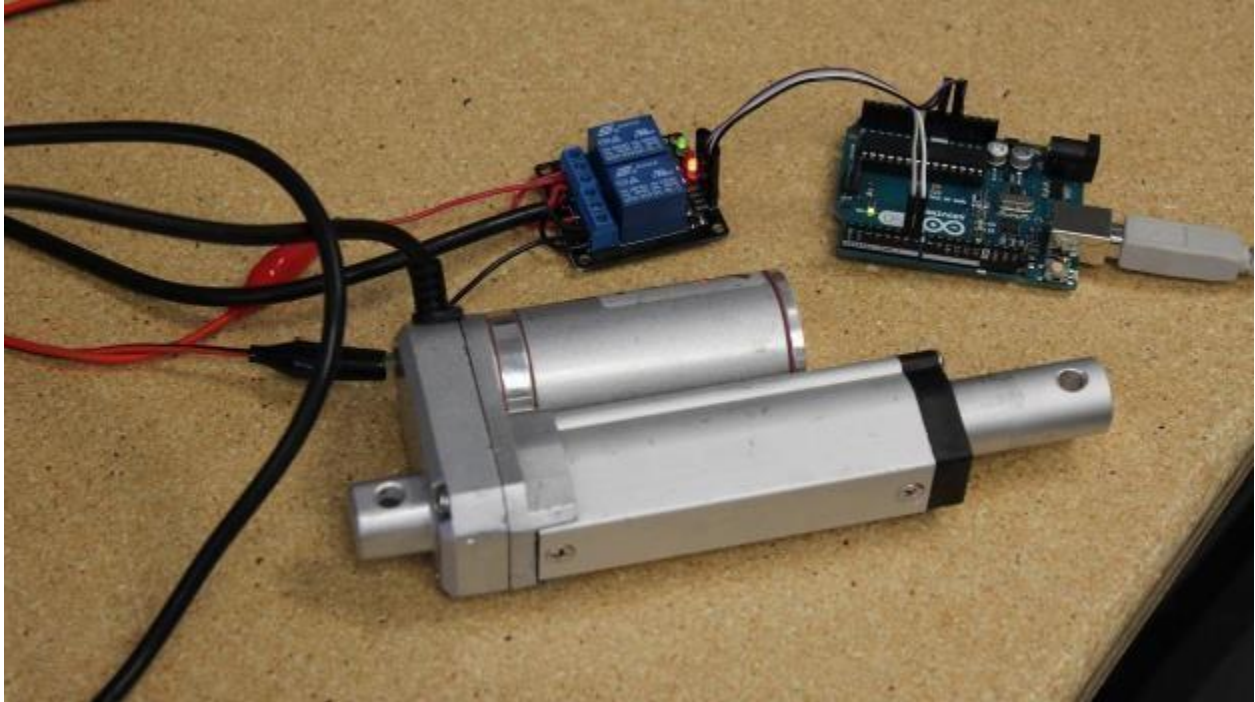


Figure 5-16: Complete Setup of Actuator Control Module [27]

Figure 5-16 above shows the complete setup of the actuator module. This tests the actuator and makes sure it functions properly. The code below controls the actuator using Arduino.

```
const int forwards = 7;
const int backwards = 6;//assign relay INx pin to arduino pin

void setup() {

pinMode(forwards, OUTPUT);//set relay as an output
pinMode(backwards, OUTPUT);//set relay as an output

}

void loop() {

digitalWrite(forwards, LOW);
digitalWrite(backwards, HIGH);           //Activate the relay one direction
delay(2000);                             // wait 2 seconds

digitalWrite(forwards, HIGH);
digitalWrite(backwards, HIGH);           //Deactivate both relays to brake the motor
delay(2000);// wait 2 seconds

digitalWrite(forwards, HIGH);
digitalWrite(backwards, LOW);           //Activate the relay the other direction
delay(2000);                             // wait 2 seconds
```

```
digitalWrite(forwards, HIGH);
digitalWrite(backwards, HIGH);           //Deactivate both relays to brake the motor
delay(2000);// wait 2 seconds

}
```

Module 4: Text Message Alert Module

GSM

GSM, an international standard for mobile telephones, stands for Global System for Mobile Communications, or also 2G.

To use GPRS for internet access, and for the Arduino to request or serve webpages, the user needs to obtain the Access Point Name (APN) and a username/password from the network operator. Among other things, GSM supports outgoing and incoming voice calls, Simple Message System (SMS or text messaging), and data communication (via GPRS) [28].

The Arduino GSM shield 2 acts like a GSM modem. From the mobile operator perspective, the Arduino GSM shield looks just like a mobile phone. From the Arduino perspective, the Arduino GSM shield 2 looks just like a modem.

GPRS

GPRS is a packet switching technology that stands for General Packet Radio Service. It can provide idealized data rates between 56-114 kbit per second. The user can also access the internet using the GSMshield. Like the Ethernet and WiFi libraries, the GSM library allows the Arduino to act as a client or server, using http calls to send and receive web pages [28].

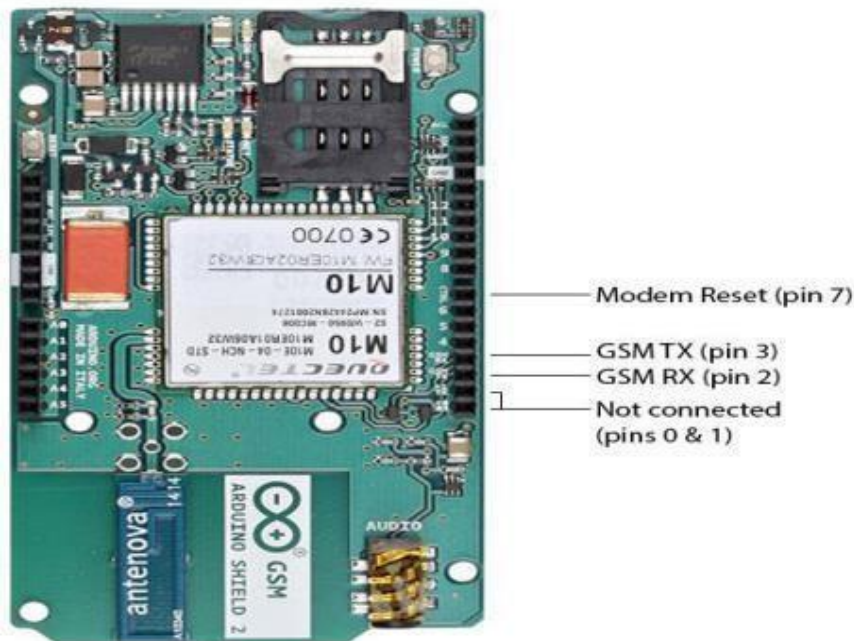


Figure 5-17: Arduino GSM Shield 2

Digital pins 2, 3 and 7 are reserved for communication between the Arduino and modem and cannot be used by one's sketches. Software Serial library handles communication between the modem and Arduino pins 2 and 3. Pin 7 is used for the modem reset. When the yellow status LED turns on, it means the modem is powered, and the user can try connecting to the network.

Testing Module 4: Modem and Network Connection

This sketch checks the modem's IMEI number. Modems have unique IME numbers, and they use the numbers to identify valid devices that can connect to a GSM network. Once the modem reads the number, the Arduino prints out the connected network carrier and the signal strength of the network over the serialport.

```
// import the GSM library
#include <GSM.h>

// PIN Number
#define PINNUMBER ""

// initialize the library instance
GSM gsmAccess(true); // include a 'true' parameter for debug enabled
GSMScanner scannerNetworks;
GSMModem modemTest;

// Save data variables
String IMEI = "";

// serial monitor result messages
String errortext = "ERROR";

void setup()
{
  // initialize serial communications
  Serial.begin(9600);
  Serial.println("GSM networks scanner");
  scannerNetworks.begin();

  // connection state
  boolean notConnected = true;

  // Start GSM shield
  // If your SIM has PIN, pass it as a parameter of begin() in quotes
  while(notConnected)
  {
    if(gsmAccess.begin(PINNUMBER)==GSM_READY)
      notConnected = false;
    else
    {
      Serial.println("Not connected");
      delay(1000);
    }
  }
}
```



```

    }
}

// get modem parameters
// IMEI, modem unique identifier
Serial.print("Modem IMEI: ");
IMEI = modemTest.getIMEI();
IMEI.replace("\n", "");
if(IMEI != NULL)
    Serial.println(IMEI);

// currently connected carrier
Serial.print("Current carrier: ");
Serial.println(scannerNetworks.getCurrentCarrier());

// returns strength and ber
// signal strength in 0-31 scale. 31 means power > 51dBm
// BER, the Bit Error Rate. 0-7 scale. 99=not detectable
Serial.print("Signal Strength: ");
Serial.print(scannerNetworks.getSignalStrength());
Serial.println(" [0-31]");
}

void loop()
{
    // scan for existing networks, displays a list of networks
    Serial.println("Scanning available networks. May take some seconds.");

    Serial.println(scannerNetworks.readNetworks());

    // currently connected carrier
    Serial.print("Current carrier: ");
    Serial.println(scannerNetworks.getCurrentCarrier());

    // returns strength and ber
    // signal strength in 0-31 scale. 31 means power > 51dBm
    // BER, the Bit Error Rate. 0-7 scale. 99=not detectable
    Serial.print("Signal Strength: ");
    Serial.print(scannerNetworks.getSignalStrength());
    Serial.println(" [0-31]");
}

```

After double checking the circuitry and the placement of the sim card, the program would still not run correctly using the Arduino GSM. I spent countless hours troubleshooting, and finally solved the problem. I figured out the sim card and code functions properly. Instead, the cell phone providers around the area (San Luis Obispo) do not support 2g anymore and the Arduinogsm shield that I had purchased only works on a 2g network. I bought a new 3G shield and everything worked perfectly.

Module 4a: New 3G Text Message Alert Module:

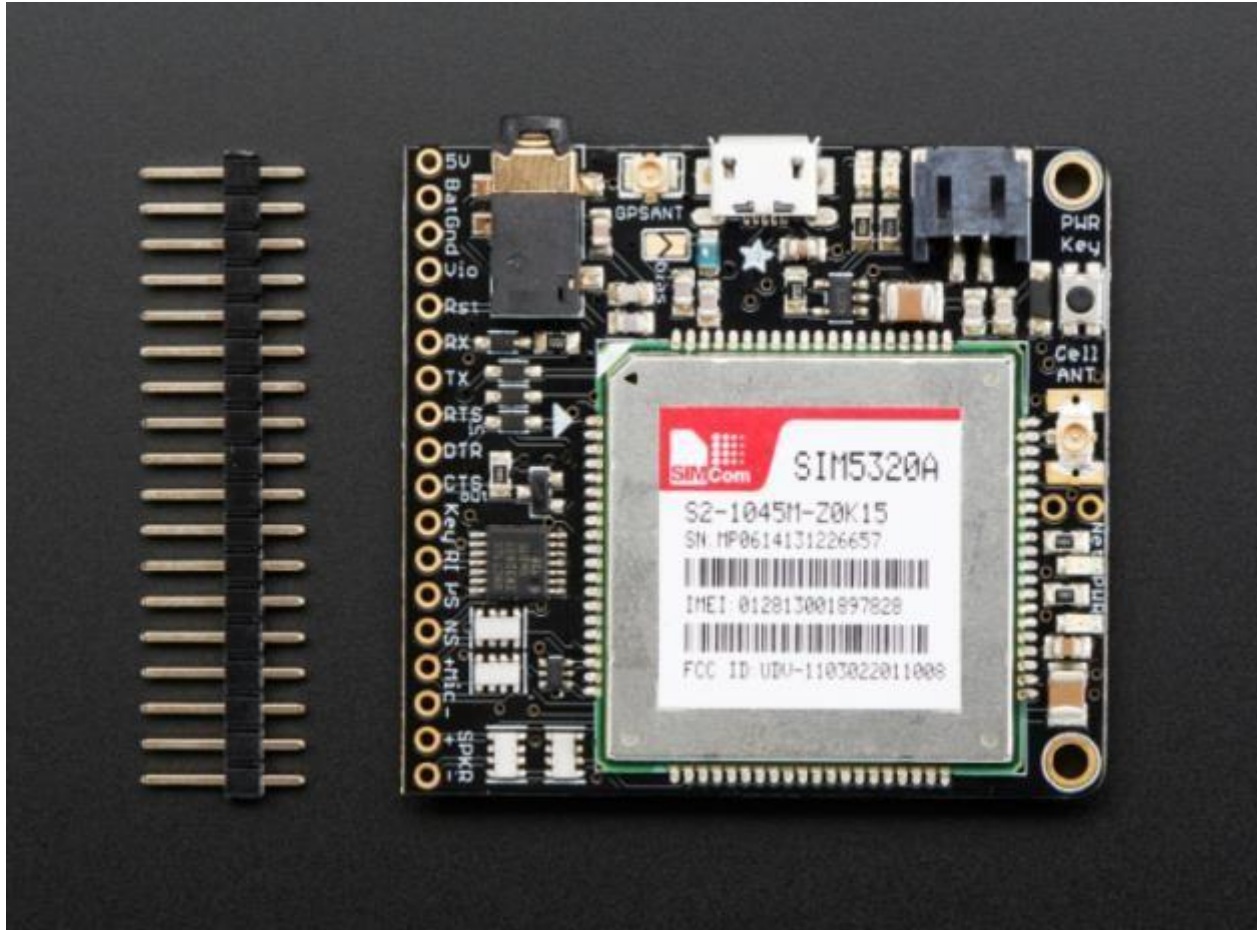


Figure 5-18: Adafruit FONA 3G [28]

The figure above shows the important pinouts of the Adafruit FONA, used to send an automated text message alert when a leak is present.

Device Specs

- Quad-band 850MHz GSM, 900MHz EGSM, 1800MHz DCS, 1900MHz PCS - connect onto any global GSM network with any 2G or 3G SIM.
- American Version dual-band UMTS/HSDPA 850/1900MHz WCDMA + HSDPA
- Fully-integrated GPS (Qualcomm PM8015 GPS) controlled and query over the same serial port
- Make and receive voice calls using a headset or an external 8Ω speaker + electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- AT command interface used with 300, 600, 1200, 4800, 9600, 19200, 38400, 57600, 115200, 230K, 461K, 961K, 3.2M, 3.7M and 4.0Mbps
- Native USB support - plug it into a computer and

On its own, this module can't do anything. It requires a microcontroller to drive it! I chose an Arduino, but any 3-5V microcontroller with a UART can send and receive commands over the RX/TX pins.

Required accessories to make FONA 3G work

- Required Lipoly Battery - 500mAh or larger. I used a 3.7V 1200mAh battery.
- 3G mini sim card. At&t GO sim cards work great.
- MicroUSB cable for charging the battery and communicating with the module over USB
- External uFL GSM Antenna - this slim one works great (or, if the designer wants to us an SMA antenna - a uFL to SMA adapter cable.)
- External Active GPS Antenna (needs a uFL to SMA adapter too)

Below are the pinouts and a description on what each one does.

- JST 2-pin - the battery input connector. It works with any Lipoly batteries, but, since the charge rate equals 500mA (and the cellular module can spike high current draw), a 500mAh or 1200mAh batteries works best.
- MicroUSB connector - the LiPoly/LiIon battery charging port.
- Headset jack - the 'standard' TRRS 3.5mm phone headset jack with stereo earphone and mono microphone
- The GSM antenna plugs in up top. To use the module for any voice or data communications as well as some SIM commands, the user needs an antenna.
- The designer can either use a uFL GSM attena like this, or use a uFL to SMA adapter and then an SMA antenna

The most important pins are broken out at the bottom of the board. All of the following fall under 3-5V input safe.

- **Vio** - THE MOST IMPORTANT PIN! The designer MUST drive with an external voltage from 3V-5V to set the logic level converter. The converter also buffers the indicator LEDs so NOTHING appears to work unless power reaches this pin! The user should set the voltage to whatever voltage the microcontroller uses for logic. A 5V micro (like Arduino) should have it set to 5V, a 3V logic micro should set it to 3V.
- **Key** – The power on/off indicator tied to the button in the top left. Tie this pin to ground for 3 to 5 seconds to turn the module on or off. It's not a level signal ("low means off, high means on") - instead the designer must pulse it for ~5 seconds to turn off/on. The module comes by default off. Tie this permanently to ground if the designer never wants the micro to turn off the FONA for power saving.
- **5V** - The USB 5V from the microUSB connector when it's in and powered. Good if the designer needs to know when the microUSB plugged in and/or want to recharge the battery from an external plug.
- **PS** - The Power Status pin. Low when the module has no power and high when the module has power. If using the Key button or pin, the designer monitors this pad to see when the modules booted up.
- **NS** – The Network Status pin. It lights up/blinks to signal the status of the module and tied to the Net LED so for more detail see the LEDs section below.
- **Reset** - Module hard reset pin. By default, it has a high pull-up (module not in reset). Toggle this pin low for 100ms to perform a hard reset.
- **RX (in) & TX (out)** - The module uses UART to send and receive commands and data. Auto-baud so whatever baud rate sent "AT" after reset or boot equals the baud rate used.
- **RTS_{in}** - The hardware flow control pin. The pin stops and starts data transfer *from* the FONA 3G

to the microcontroller

- **CTSout** - The hardware flow control pin. This pin determines when the FONA 3G's serial buffer becomes full and when to stop and start data transfer *to* the FONA 3G from the microcontroller
- **DTR** - The hardware flow control pin, used with the FONA 3G to hang up calls, control data/command mode for TCP/IP, etc.
- **RI** – The Ring Indicator, basically the 'interrupt' out pin from the module. By default, high and designer can configure RI to go low when it receives a call. The designer can also configure RI to go low when an SMS received.
- **SPK+ and -** : Used to connect an external 8 ohm speaker.
- **MIC + and -**: Used to connect an external electret microphone and to bias the mic with 2V.

LEDS

- **PWR** – Green. Lit when the module booted and running
- **NET** – Red. The designer can use this for checking the current state without sending an AT command:
 - Always on** - module running but hasn't made connection to the cellular network yet
 - 800ms on, 800ms off** - the module has contacted the cellular network and can send/receive voice and SMS
 - 200ms on, 200ms off** - Active GPRS data connectionBy watching the blinks the designer can get a visual feedback on whats going on.
- **Charging** – Orange and next to the microUSB jack. Indicates onboard charging lipo charge.
- **Done** – Green and next to the JST jack. Indicates that the battery charging finished.

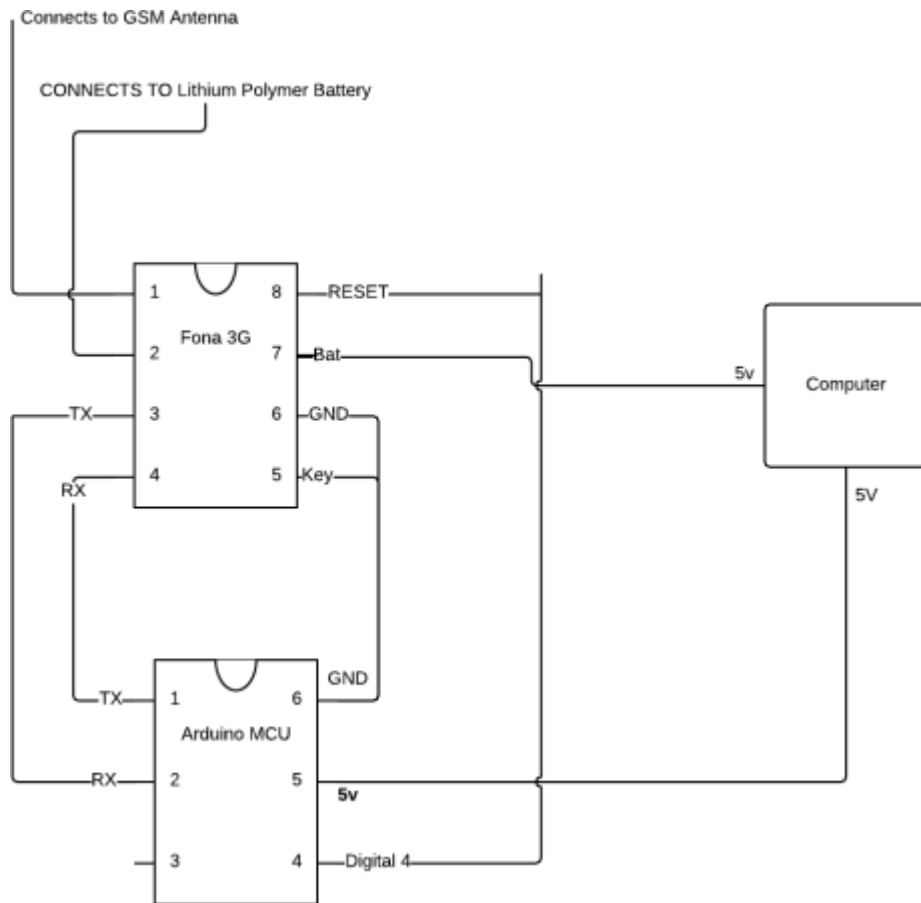


Figure 5-19: Arduino and GSM Shield Schematic

The figure above is the schematic of the Arduino, FONA GSM, and computer tied together.
Wiring with Arduino Microcontroller

- **Vio** connects to **5V**
- **GND** connects to **GND**
- **Key** connects to **GND** (always on)
- **RX** connects to digital **2**
- **TX** connects to digital **3**
- **RST** connects to digital **4**

```
#include "Adafruit_FONA.h"
```

```
#define FONA_RX 2
```

```
#define FONA_TX 3
```

```

#define FONA_RST 4

// a large buffer for replies
char replybuffer[255];

// We default to using software serial. If the coder wants to use hardware serial
// (because softserial isnt supported) comment out the following three lines
// and uncomment the HardwareSerial line
#include <SoftwareSerial.h>
SoftwareSerial fonaSS = SoftwareSerial(FONA_TX, FONA_RX);
SoftwareSerial *fonaSerial = &fonaSS;

//
// HardwareSerial *fonaSerial = &Serial1;

Adafruit_FONA fona = Adafruit_FONA(FONA_RST);

uint8_t readline(char *buff, uint8_t maxbuff, uint16_t timeout = 0);

void setup() {
  while (!Serial);

  Serial.begin(115200);
  Serial.println(F("FONA SMS caller ID test"));
  Serial.println(F("Initializing... (May take 3 seconds)"));

  // make it slow so its easy to read!
  fonaSerial->begin(4800);
  if (! fona.begin(*fonaSerial)) {
    Serial.println(F("Couldn't find FONA"));
    while(1);
  }
  Serial.println(F("FONA OK"));

  // Print SIM card IMEI number.
  char imei[16] = {0}; // MUST use a 16 character buffer for IMEI!
  uint8_t imeiLen = fona.getIMEI(imei);
  if (imeiLen > 0) {
    Serial.print("SIM card IMEI: "); Serial.println(imei);
  }

  Serial.println("FONA Ready");
}

char fonaInBuffer[64]; //for notifications from the FONA

void loop() {

  char* bufPtr = fonaInBuffer; //handy buffer pointer

```



```

if (fona.available()) //any data available from the FONA?
{
  int slot = 0; //The slot number of the SMS
  int charCount = 0;
  //Read the notification into fonaInBuffer
  do {
    *bufPtr = fona.read();
    Serial.write(*bufPtr);
    delay(1);
  } while ((*bufPtr++ != '\n') && (fona.available()) && (++charCount < (sizeof(fonaInBuffer)-1)));

  //Add a terminal NULL to the notification string
  *bufPtr = 0;

  //Scan the notification string for an SMS received notification.
  // If it's an SMS message, we'll get the slot number in 'slot'
  if (1 == sscanf(fonaInBuffer, "+CMTI: \"SM\",%d", &slot)) {
    Serial.print("slot: "); Serial.println(slot);

    char callerIDbuffer[32]; //we'll store the SMS sender number in here

    // Retrieve SMS sender address/phone number.
    if (! fona.getSMSSender(slot, callerIDbuffer, 31)) {
      Serial.println("Didn't find SMS message in slot!");
    }
    Serial.print(F("FROM: ")); Serial.println(callerIDbuffer);

    //Send back an automatic response
    Serial.println("Sending reponse...");
    if (!fona.sendSMS(callerIDbuffer, "Hey, I got your text!")) {
      Serial.println(F("Failed"));
    } else {
      Serial.println(F("Sent!"));
    }
  }

  // delete the original msg after processed
  // otherwise, fill up all the slots
  // SMS anymore not received anymore
  if (fona.deleteSMS(slot)) {
    Serial.println(F("OK!"));
  } else {
    Serial.println(F("Couldn't delete"));
  }
}
}
}

```

The code above checks to see if the Fona can receive and send a text. After getting the Arduino and Fona to work together correctly, the next step was to put all the modules together and get a working system, shown in detail below.

Complete System:

The WLDS includes two main modules: Module 1 and Module 2. Module 1, the bulk of the system, consists of the water sensor, sms alert, buzzer alarm, and xbee router. Module 2 consists of the actuator, relay module, and xbee coordinator.

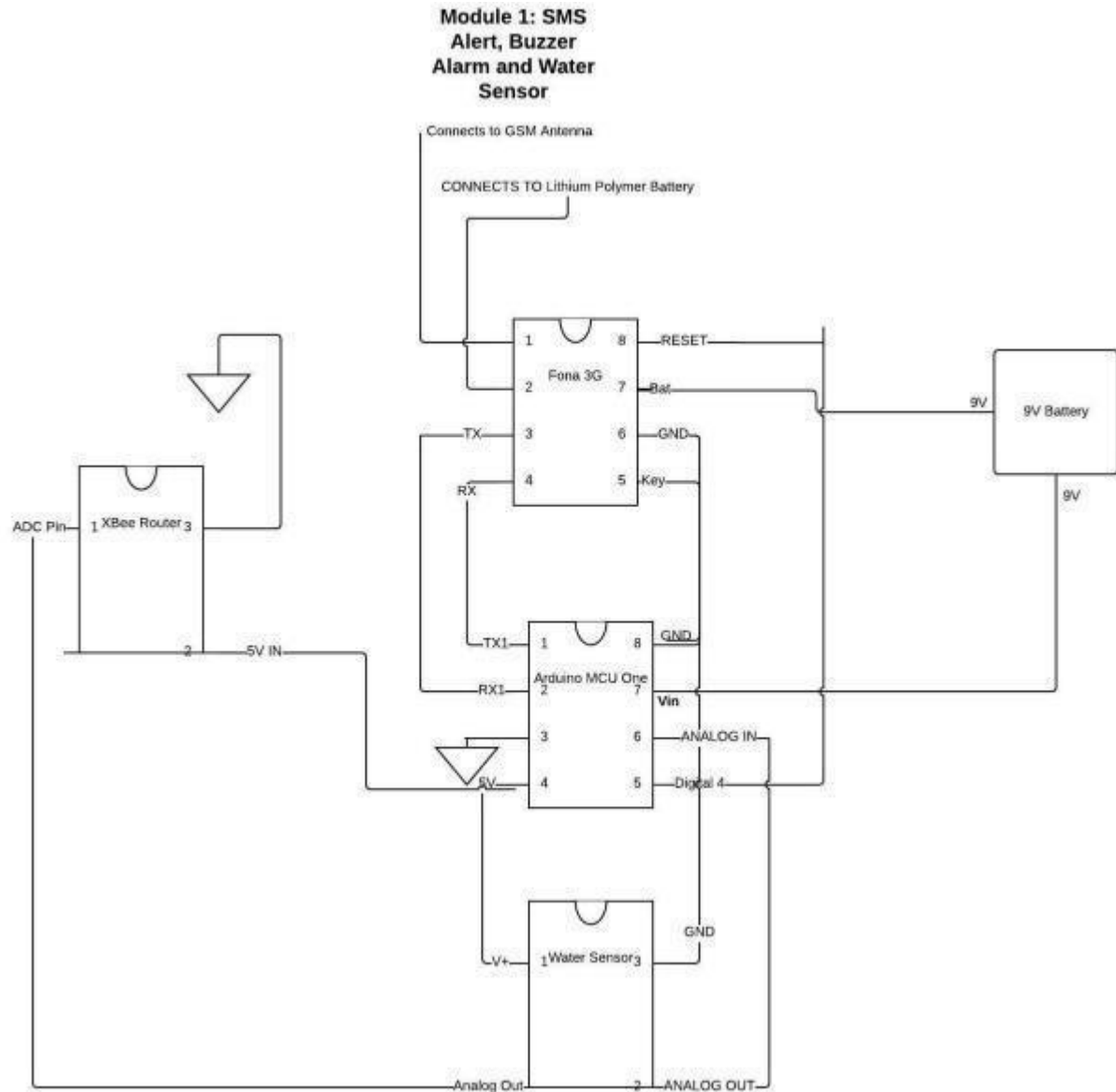


Figure 5-20: SMS, Buzzer, XBee, and Water Sensor Network

All the components in Module 1 can run off the 9V battery, but the Fona 3G requires extra amperage to run properly via the external LiPoly Battery. The water sensor continuously monitors for water at a certain sensitivity between its conducting wires. When the sensor reaches that certain sensitivity, the Arduino sends a signal over to the Fona through serial interface,

which then sends a text using its 3G capabilities to the user, thus notifying the user that he/she has a leak and should return home shortly. The XBee Router also takes in the analog data from the sensor and sends it via mesh networking to the XBee Coordinator, part of Module 2 described below.

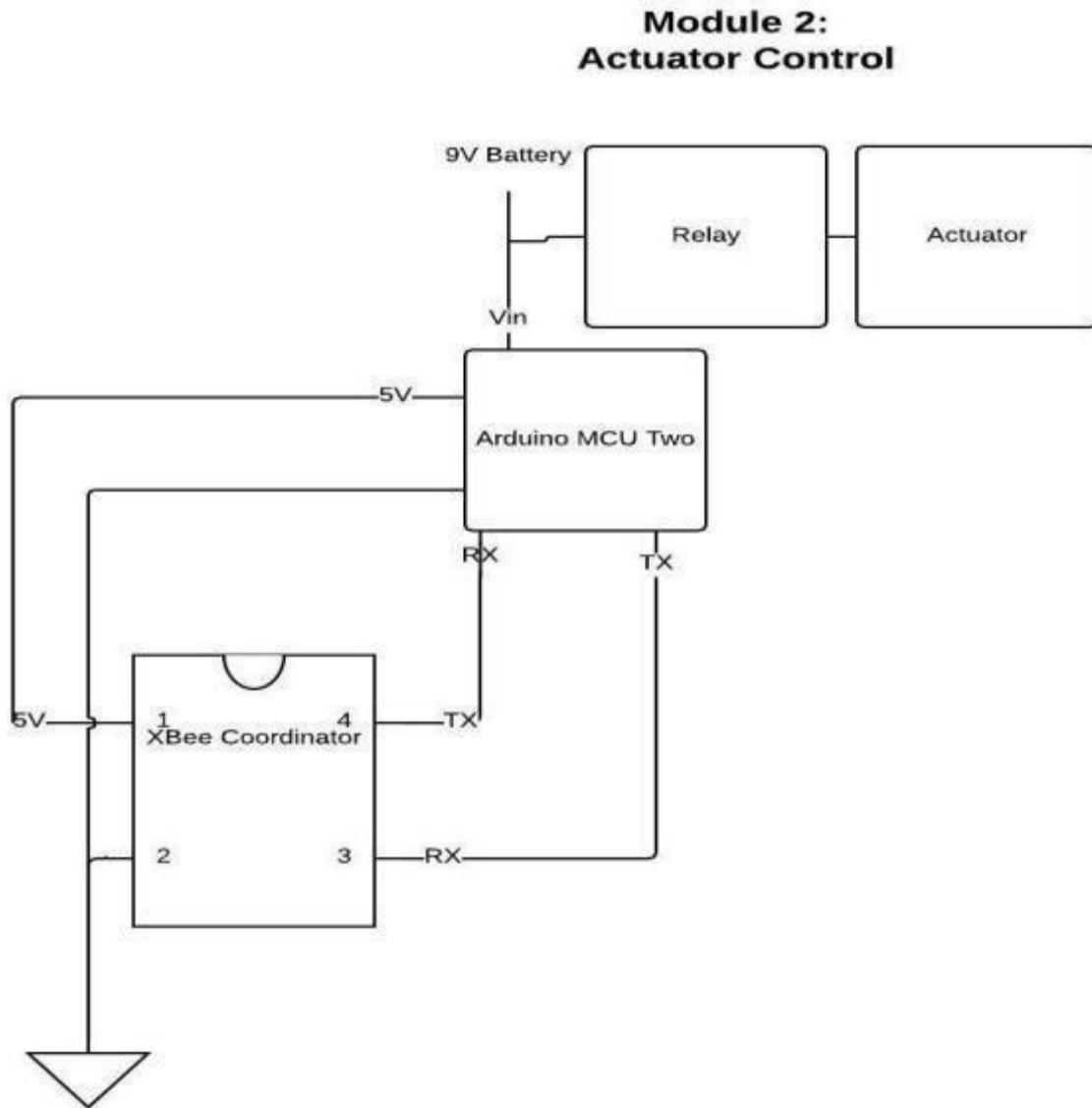


Figure 5-21: Actuator Control

The figure above describes Module 2 of the WLDS. After Module 1 detects a leak, the XBee coordinator receives this data and processes the data via the Arduino MCU. When the sensor detects water, the Arduino sends a signal to the relay activating the actuator and shutting off the main power. Once the sensor detects no water, the actuator retracts inward simulating turning the water back on.

CODE FOR MODULE 1:

```
#include "Adafruit_FONA.h"

#define FONA_RX 9
#define FONA_TX 8
#define FONA_RST 4
#define FONA_RI 7

#define alarmPin A4 . // defines the input pin from the FONA

#define notifyPhoneA "16144609437" // tel number to notify goes here
const int buzzer = 13;
const int threshold = 300; // threshold value for alarm state

char replybuffer[255]; // large buffer for replies

// these variables change:
int sensorValue = 600; // variable to store the value read from the sensor pin
int var = 0;

#include <SoftwareSerial.h>
SoftwareSerial fonaSS = SoftwareSerial(FONA_TX, FONA_RX);
SoftwareSerial *fonaSerial = &fonaSS;

Adafruit_FONA fona = Adafruit_FONA(FONA_RST);

void setup() {
  pinMode(FONA_RI, INPUT);

  pinMode(buzzer, OUTPUT);
  pinMode(FONA_RST, OUTPUT);
  digitalWrite(FONA_RST, LOW);
  delay(100);
  digitalWrite(FONA_RST, HIGH);

  while (!Serial);

  Serial.begin(115200);
  Serial.println(F("FONA SMS Alarm Notification v1"));
  Serial.println(F("Initializing. ..(May take 3 seconds)"));

  fonaSerial->begin(4800);
  if (! fona.begin(*fonaSerial)) {
    Serial.println(F("Couldn't find FONA"));
    while (1);
  }
}
```

```

}
Serial.println(F("FONA OK"));

while (1) {
  uint8_t n = fona.getNetworkStatus();
  Serial.print(F("Network status "));
  Serial.print(n);
  Serial.print(F(": "));
  if (n == 0) Serial.println(F("Not registered"));
  if (n == 1) Serial.println(F("Registered (home)"));
  if (n == 2) Serial.println(F("Not registered (searching)"));
  if (n == 3) Serial.println(F("Denied"));
  if (n == 4) Serial.println(F("Unknown"));
  if (n == 5) Serial.println(F("Registered roaming"));

  if (n == 1) break;

  delay(500);
}

Serial.println("FONA operational and notification system ready");
digitalWrite(buzzer, HIGH);
delay(1000);
digitalWrite(buzzer, LOW);
}

// put your main code here, to run repeatedly:

void loop() {
  // read the sensor and store it in the variable sensorValue:
  int sensorValue = analogRead(A4);

  if (sensorValue > 36) { // if the sensor reading equals less than threshold
    var = 1;
  } else {
    var = 2;
  }
}

switch (var) {
  case 1:
    Serial.println(sensorValue); // displays sensor reading during alarming status
    Serial.println("ALARM DETECTED!"); // displays that alarm detected
    Serial.println("Sending first notification...");
    Serial.println(notifyPhoneA);
    digitalWrite(buzzer, HIGH);
    fona.sendSMS(notifyPhoneA, "Dear Ryan, hurry home your house has a leak! Shutting off

```

```

the main water pump");
    delay(5000); // delay to check for alarm reset

    break;

case 2:
    Serial.println("System armed - not alarming"); // displays armed status
    Serial.println(sensorValue);
    digitalWrite(buzzer, LOW); // displays sensor reading during armed status
    delay(3000); // delay to rerun program if alarm not sounding
    break;
}

}

```

CODE FOR MODULE 2:

```

const int forwards = 6;
const int backwards = 5; // assign relay INx pin to arduino pin
void setup(){

Serial.begin(9600);
pinMode(forwards, OUTPUT); // set relay as an output
pinMode(backwards, OUTPUT); // set relay as an output

}

void loop()
{
if (Serial.available() >= 21) { // Make sure the frame all there
if (Serial.read() == 0x7E) { // 7E = the start byte
for (int i = 1; i < 19; i++) { // Skip ahead to the analog data
byte discardByte = Serial.read();
}
int analogMSB = Serial.read(); // Read the first analog byte data
int analogLSB = Serial.read(); // Read the second byte
int analogReading = (analogLSB + (analogMSB * 256));
Serial.print(analogReading);
}

}

if(analogReading > 36) {
digitalWrite(forwards, HIGH);
digitalWrite(backwards, LOW); // Activate the relay one direction, they must differ to move the motor
delay(2000); // wait 2 seconds\
}
}

```



```
else{
digitalWrite(forwards, LOW);
digitalWrite(backwards, HIGH);//Activate the relay the other direction, they must differ to move the
motor
delay(2000);// wait 2 seconds
}

}
```

Chapter 6: Conclusions and Recommendations

The main goal of this project is to provide an autonomous system that prevents excessive water damage within a household. After working on this project, I better understand the difficulties people face when trying to create a product from scratch. The WLDS detects a water leak anywhere the user chooses to put it and alerts the user with a text message, in case of house vacancy. The WLDS differentiates itself from many products on the market today, because when leakage occurs, not only does it alert the user with an alarm and text message, but it also powers an actuator installed at the main water pump which shuts off the main water preventing further leakage. This project is more proof of theory than application, because of time and money constraints. This means that I only created one sensor network and created communication between the sensor and actuator, but if I had more time, the creation of multiple around the house would increase the product efficiency. In addition, incorporating the actuator into the piping creates a better water shutoff network because it doesn't shut off all the water in the house, instead, just where leakage occurs. All the specifications listed in Table 2-1 are met besides the price constraints. The prices of the components used in the project totaled \$229, coming in 15% over budget. The final product met all performance requirements after testing, using water to simulate a leak. However, future improvements on the WLDS can still be made. Color coding the sensors would make it even more clear which one goes where. This implementation would make the installation process much easier for the customer by reducing the chances of incorrect installation. Water resistant packaging seems crucial to the product working correctly and meeting NFPA safety standards. Also, the XBee ADC pin can only reach 1.2V total, and the water sensor I used went up to 5V, so I spent too long troubleshooting this problem, before I realized the pin of the XBee malfunctioned instead of something wrong with my connections. To prevent this, incorporating a different Wi-Fi module into the system, or utilizing a simple voltage divider both fix the problem. Finally, the Arduino includes a low-power mode not utilized in this project. By changing the inputs of the sensors to interrupts, one could leave the microcontroller in low-power mode until it needs to perform an action. This could dramatically reduce its power usage.

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Appendix A: Senior Project Analysis

Project Title: Water Leak Detection System

• Summary of Functional Requirements

The Water Leak Detection System WLDS has a couple of main components. The water sensors, the microcontroller, and the DC Motor. The Motor runs off line voltages between ~80-264 VAC. The sensors are battery powered as well as the microcontroller. A user installs the motor directly into the main water pump and places the microcontroller/water sensor system around the house where they feel a water reservoir needs monitoring. With no further actions necessary, the WLDS monitors the water reservoir for any leaks present and alerts the user when it finds one.

Responding to the found leak, the motor shuts off the main water pump preventing any further leakage.

• Primary Constraints

There exist both monetary and location-based constraints associated with this project. The WLDS must function in various countries such as the U.S. which uses 110V or Indonesia which uses 220V. One must also keep in mind the various wall outlet types [3]. Making the system easy to install and independent of the users' water system offers yet another challenge. This may require designing protection circuitry in case a user makes a mistake during installation. The water sensors must also meet NEMA standards.

Building a non-intrusive actuator system is also a challenge. Non-intrusive systems exist, but they sell for a much greater price than intrusive systems, which indicates greater implementation difficulty. If this fails, I plan to relax my spec to an intrusive system. The power consumption of the WLDS also presents difficulty. The actuator operates off the electrical mains, but has a backup battery as well. The backup battery must last for at least 30 days, which sets a limit on the power consumption of the water sensor. I attempted to solve this problem firstly by optimizing the system to use a minimal amount of power. Because that didn't meet the specification, I moved onto a more expensive battery. The microcontroller deactivates the water pump if the water sensor detects 20mL or more water leakage. ¼ mL of water equals approximately a drop of water from a faucet, so 20mL of water ensures no false alarm [9]. The actuator and water sensor used to deactivate the water pump is small and light enough for any user to carry and install. The actuator can obtain power from a wall socket which negates the need for additional power [4]. The water sensor features battery powered hardware, allowing maximum mobility so that it may run for at least 30 hours. Ideally, installation only requires mounting the water sensor, installing the actuator into the water pump, and plugging in the motor to the nearest residential power outlet. Table 2-1 summarizes detailed marketing requirements as well as the engineering specifications of the proposed WLDS.

• **Economic Impact**

As with all products, there exist many economic impacts likely to result following the implementation of this project. Many companies benefit from the need for goods and services associated with the project such as shipping, raw materials, parts, manufacturing, and labor. Almost every aspect of the creation of the WLDS requires labor in some shape or form making it an important aspect [20]. Local banks also benefit from the additional purchase made by the businesses and the product user. It saves water districts money that they can then allocate to other conservation efforts. The most significant economic impact, however, is the reduced water waste, stepping closer towards sustainable usage of the Earth's natural resources [20].

Users benefit from the WLDS through using an effective and efficient water leak detector and low power consumption. With an effective control system in place, a water leak becomes detected and terminated resulting in less money used for repairs and replacements. Beside the initial investment of buying the product, there exist no upkeep costs beyond its use of power except for repair costs if broken down. This becomes increasingly likely throughout the product's lifetime until a replacement becomes necessary. Users have the option of replacing the water sensors, the only replaceable part, in case they alone fail. The WLDS requires the user to already have a compatible water pump to use with the control box. The user of the WLDS, someone who seeks autonomous control of their home water system, pays low overall costs for the affordable product. Not including design or testing cost estimates, the estimated sum of parts totals \$100[4]-[7]. The project takes an estimated 150 hours of development time ending around April of 2017.

• **If manufactured on a commercial basis**

The estimated fixed costs total \$9150 to design, and development a prototype followed by an estimated \$100 per unit plus labor likely meaning \$200 per unit. If each unit sells for \$250, a positive profit margin would emerge after 185 units sold assuming inefficient manufacturing. Assembling this product through lean manufacturing practices on a production line would result in much lower production costs. However, this also results in a higher initial investment to create a manufacturing line. If it costs an estimated \$50,000 to create a manufacturing line that reduced production costs to roughly \$100 and the selling price remained \$250, it would require 334 units sold to make profit. However, factories can produce at much faster rates when they use manufacturing lines [21]. If 500 units sell per year, the device makes \$75,000 yearly profit.

• **Environmental Impacts**

The materials that make up the WLDS include electronics composed of metals mined out of the earth. Sometimes, these mining operations impact ecosystems quite seriously due to the overall destruction of the surrounding environment. The manufacturing process uses harsh chemicals, which if not disposed of properly, seep into water supplies contaminating drinking water for humans and animals alike [2]. Like all other electronics, the WLDS consumes power which puts pressure on power generation plants to produce more energy. This requires burning more fossil fuels resulting in more greenhouse gasses emitted into the atmosphere. Greenhouse gasses also

accumulate from the increased vehicle presence caused by the need to transport the WLDS. The atmosphere warms as the gasses accumulate leading to the degradation of various ecosystems reliant on very specific temperatures such as aquatic ecosystems [2]. Once the lifetime of the product has elapsed, the users must properly recycle the waste so it does not decompose quickly and release toxic chemicals. Often, this waste ends up in developing countries negatively affecting both the people and animals living there [9].

However, the WLDS makes its users more aware of their water usage and decreases overall usage. If the WLDS does indeed reduce its customers' water usage, its benefits may outweigh its costs. Assuming it reduces each user's water consumption by only 2%, 1 million installations, and an average household water usage of 360 gallons per day [23], we save 7.2 million gallons of water per day. These savings exceed the water costs to operate a large fabrication house of 4.8 million gallons per day [22]. Increased water savings can also save energy, and outweigh the energy cost of manufacturing the Smart Water Meter since much of our energy goes toward transporting and treating water.

• **Manufacturability**

The WLDS serves as an easy-to-use control box requiring no user input beyond initial installation of the water sensors and motor. As a result, users likely struggle when attempting to fix malfunctions, and when they occur, instead buy a new unit. While this benefits profit, it also leads to less sustainability as more units require more resources. The WLDS must last a long period necessitating a quality build. With no regular maintenance required, the unit requires very little upkeep associated with the product aside from power costs. The product could potentially include easily replaceable internal parts as an upgrade, but this would drive up manufacturing costs. Also, the implementation of the electronics within the WLDS requires the use of rare earth metals. Users can help sustain this resource if they disable the components and recycle them correctly. However, this often does not happen resulting in aggressive unsustainable consumption of resources. The modular design of the WLDS allows the individual manufacturing of the modules. The circuitry likely requires the longest manufacturing time due to its small size and precision design. The other components such as the microprocessor and water sensors come pre-made and ready to integrate into the assembly. Installation of the WLDS consists of placing the water sensors, connecting the motor to the water pump, and supplying power from a nearby wall outlet.

• **Sustainability**

The WLDS strives to find leaks before any serious damage occurs to the user's house. The system needs minimal maintenance for the sensors used to monitor leakage [7]. The system only requires connection to residential wall socket voltages to perform its functions. Potential improvements, the incorporation of a solar panel to reduce energy usage would make the product greener for the environment. However, the implementation of a solar panel would require a battery to store the resulting charge. The batteries contain chemicals such as sulfuric acid which can harm the environment. The WLDS could also potentially benefit from a wind generated power source depending on average weather conditions of the region.

• Ethical Considerations

Regarding the Institute of Electrical and Electronics Engineers (IEEE) code of ethics, the WLDS upholds ethical principles as an ethical device. The designers of said product accept no bribery and discriminate against no persons based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression. Designers perform research when deciding all price estimates and completion time estimates to ensure they honestly reflect likely end costs. Designers make the completed product with the welfare of the public in mind by including warning labels to help prevent incorrect usage. If unforeseen or unintended conflicts arise resulting from the production or use of the device, responsible parties must take steps to remedy said conflicts. While the designers of the project have intention to uphold the IEEE code of ethics, the power to do so may lie with different people. If a governing body purchased the WLDS in bulk and distributed them as they see fit, discrimination may become an issue. This applies to the acceptance of bribes and setting fair prices as well.

From a utilitarian perspective, the WLDS could be either beneficial or harmful, depending on the consumers who utilize it. An individual user utilizing this device gains happiness by not having to constantly monitor his/her water system. This allows for optimal water monitoring, so the user can enjoy daily activities without worrying about water leaks. If someone only introduces a few devices into a community, those without the WLDS have greater chances of severe water damage. This could lead to unhappiness. However, if all members of a community used the WLDS then all members would benefit equally and the average happiness of the community would rise. With initial successes, the governing body of the area may decide to include the device as part of the water utility spreading the technology for others to benefit from resulting in even more happiness. According to the utilitarian ethical framework, the WLDS has overall utility, which makes it an ethically justified project. Several arguments exist for the good it provides. Saving water (and thereby energy) has utility, because California is currently in a drought and water usage needs reducing [23]. This also contributes to sustainability, proving very useful in the long term. In addition, the revenue generated by the project creates jobs and the money saved by using the product reduces financial strain on households [20]. Both provide good for many people.

Several ethical dilemmas exist as well. Inevitably, the manufacturing process introduces new social and political inequities or sustains old ones. The labor involved in manufacturing typically is not paid well and goes to the person who accepts the least amount of money for it. Inequity created by unfair treatment of workers, however, diminishes when the product switches to manufacturing by a responsible company in the US. This costs more, but minimizes the social and political inequities associated with my project. Overall, the good the product provides outweighs the negative possibilities, assuming it is manufactured responsibly by a company that treats its workers fairly.

• **Health and Safety Impacts**

The use of the WLDS helps users protect their property. Having a water leak detection system helps maintain public health and safety. In addition, the autonomous nature of the WLDS allows people living with physical disabilities or ailments to forgo the arduous work associated with periodically fixing their water reservoirs or losing possessions due to water damage. Not all aspects of the WLDS benefit people's health. The electronics inside the WLDS require a manufacturing process reliant on harsh chemicals. This is dangerous to the labor force if work sites do not take proper precautions. As stated in section 5, these chemicals can sometimes leak into water supplies, making anyone who uses the water for drinking ill. In addition, the manufacturing setting generally resents a danger for workers due to the large machinery often present. The motor runs on high voltages which can deliver painful and dangerous shock if irresponsibly tampered with. Because the setting of the system necessitates placement outdoors and near bodies of water, the device has an increased chance of becoming wet and, therefore, higher chance of electric shock to the user. This same high voltage concerns during testing because wrong wire placement can result in electric shock nearby people and damage to surrounding components. Also, any metals the water sensors contain may rust and compromise the safety of the water [7].

• **Social and Political Impacts**

The WLDS relies on a water system where a reservoir supplies water and needs a pump to move it to a residential storage tank. In countries like Indonesia, the government supplies the supplied water [2]. If they feel like this product gives users an unfair advantage over others with regarding water access, lawmakers may introduce new legislation. Those with expendable money can afford this product giving them an advantage over those who cannot afford the product. This further solidifies the relationship between money and power. The user benefits directly from a well working water system making him/her the main stakeholder. Both water districts and households are most likely to utilize the product, making them the main stakeholders. The WLDS has several indirect stakeholders as well though, primarily the manufacturing workers as well as plumbers. The WLDS has a net positive effect on plumbers, for whom it would create jobs. It has a net negative effect on manufacturing workers since it creates inequities, but those are minimized by selecting a responsible manufacturer. Other stakeholders may include any investors who expect a return of profit. This could potentially cause issues if investors only contribute if they can influence specific changes made to the product. Despite negative concerns, the implementation of the WLDS would introduce technology into a community simplifying otherwise difficult aspects of everyday activities, especially for the physically handicapped. If the governing body in an area decided to purchase the WLDS for all residential buildings in an area, it would help solve the issues of inequality and promote a sense progress in the community. Other stakeholders include companies working to manufacture the WLDS. With sufficient demand, the WLDS supplies opportunity for manufacturers to make money and create jobs.

• Developmental Comments

The design of the project system has necessitated the research of power electronics, specifically converters between AC and DC voltage and DC to DC step-down [4]. The circuit designs required sensitivity analysis Monte Carlo simulations. The software chosen, LTspice, warranted research and practice in how to perform the desired analysis. This project required knowledge of new tools such as Gantt charts which helped establish a clear schedule of expected milestones related to the project. Other research conducted includes information on conditions in countries like Indonesia, existing patents related to the WLDS, datasheets for potential components, and worldwide wall-socket voltages. I also learned about adding new information flows to a system and how they can change its behavior from the Donella Meadows article [24]. This motivated my project to introduce real-time data in units that make sense to humans in the household water consumption system. Adding this information hopefully affects everyday choices that add up to a huge amount of wasted water and energy.



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&

**RESEARCH AND DEVELOPMENT CELL
SENGUNTHAR ENGINEERING COLLEGE**

A PROJECT REPORT

DESIGN AND DEVELOPMENT OF A SMART THREAD MILL BIKE

Submitted by

Mr.P.Jagadeeswaran

Assistant Professor

Department of Mechanical Engineering

Sengunthar Engineering College

Tiruchengode

Ref: SEC/MECH/SEED/2020-21/ 1

25.11.2020

To
The Chairman
Research and Development Cell
Sengunthar Engineering College
Tiruchengode-637211

Respected Sir,

Sub: Submission of Research Project Scheme (2020-2021) proposal – Reg.

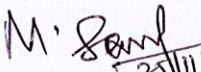
Greetings from Mechanical Department, Sengunthar Engineering College!

We are happy to submit our Research Project Scheme (2020-2021) proposal "**Design and development of a smart thread mill bike**" under the guidance of Mr. P.Jagadeeswaran, Assistant Professor, Department of Mechanical Engineering. Here with we have enclosed with Research Project Scheme (2020-2021) proposal form for your kind perusal.

We are expecting your kind consideration towards this proposal.

Thanking You

Your's faithfully,


(HoD/Mech) 25/11/2020


Encl:

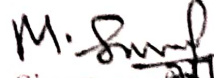
1. Research Project Scheme (2020-2021) proposal.

| RESEARCH PROJECTS SCHEME (2020-2021) - PROPOSAL | | |
|---|---|---|
| 1 | Name of the Principle Investigator | : P.Jagadeeswaran, M.E., |
| | Department / Designation | : Mechanical Engineering / Assistant Professor |
| | Institutional Address | : Sengunthar engineering college (Autonomous), Tiruchengode-637205, Namakkal (Dt) |
| | Phone No. & Mobile No. | : 04288-255716 (College) , 99420-47775 (Guide) |
| 2 | Project Title | : DESIGN & DEVELOPMENT OF A SMART THREAD MILL BIKE |
| 3 | Sector in which your Project proposal is to be Considered | : Engineering and Technology |
| 4 | Project Details | : Separate sheet to be attached |
| 5 | Has a similar project been carried out in your college / elsewhere? If so furnish details of the previous project and highlight the improvements suggested in the present one | : No, We are implementing new innovative project. |

CERTIFICATE

This is to certify that Mr./Miss. Mr.P.Jagadeeswaran, Assistant Professor, Department of Mechanical Engineering, is a bonafide of our college and it is also certified that utilization certificate and final report along with seminar paper will be sent to the Research and Development Council after completion of the project by the end of December 2021.


Signature of the Principle Investigator


Signature of the MOD

PROJECT DETAILS

DESIGN & DEVELOPMENT OF A SMART THREAD MILL BIKE

INTRODUCTION

A Treadmill is a device generally for walking or running while staying in the same place. Treadmills were introduced before the development of powered machines, to harness the power of animals or humans to do work, often a type of mill that was operated by a person or animal treading steps of a tread wheel to grind grain. In later times, treadmills were used as punishment devices for people sentenced to hard labour in prisons. The terms treadmill and tread wheel were used interchangeably for the power and punishment mechanisms.

OBJECTIVE

- The solar powered health cycle is totally new gateway in transportation.
- The solar powered electrical assistance it take a very minimal effort to walk than "a walk in park".
- By this the rise in pollution can be greatly minimized and also make people exercise while they travelling to various destinations.
- It is totally work on the non conventional energy source. • It has also played a predominant role in global warming and also took up some part in fuel less transportation method.

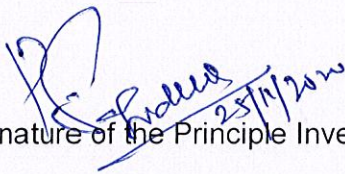
METHODOLOGY

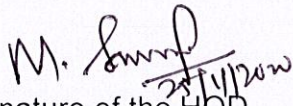
The research described in this thesis will attempt to solve the problems detailed in the previous points. To meet these ends, the following goals have been set:

- Identification of the problem
- Literature Survey
- Material Selection for Parts of treadmill
- Design of Parts & Selection of bearings
- Fabrication process
- To select the length & diameter of the shaft, forces applied on the components of the cycle which are moving and stationary.
- Assembly of unit
- Finalizing the project.
- Process parameters: Metal cutting, Sawing, Welding, Drilling

BUDGET

| PROJECT BUDGET | | | |
|--|--------------------------|----------|------------------------|
| S.NO | NAME OF THE COMPONENT | QUANTITY | PRICE OF THE COMPONENT |
| 1 | Frame | 1 | 2000.00 |
| 2 | Battery | 1 | 2500.00 |
| 3 | Handle | 1 | 500.00 |
| 4 | Chain sprocket | 1 | 1500.00 |
| 5 | Conveyor belt and roller | 1 | 1500.00 |
| 6 | wire and switch | 2 | 500.00 |
| 7 | Wheels and rim | 2 | 2000.00 |
| 8 | Implementation | | 2000.00 |
| 9 | Testing | | 1000.00 |
| 10 | Conveyance | | 1000.00 |
| TOTAL PROJECT BUDGET (A) | | | Rs.14500.00 |
| In kind Donation(B) By our college | | | |
| | Battery | 1 | 2500.00 |
| In kind Donation Subtotal (B) | | | 2500.00 |
| Required Amount for the project(A-B) | | | Rs.12,000.00 |


Signature of the Principle Investigator


Signature of the HOD

PROJECT EVALUATION REPORT

| | |
|---|---|
| Name of the Investigator | P. JAGADEESWARAN |
| Name of the Co-Investigator | - |
| Name of the Department | Mechanical Engineering |
| Title of project | Design and development of a smart tread mill bike |
| Recommendation of the evaluation committee (Recommended/Revision/Not Recommended) | Recommended |
| Financial allocation recommended | Rs.12,000.00 |

| Sl. No. | Head | Amount in INR |
|---------|--|---------------|
| 1 | Equipment/Component (Frame, Handle, Chain sprocket, Conveyor belt and roller, Wire and Switch, Wheels and Rim,etc..) | 8000.00 |
| 2 | Implementation of tread mill bike by assembling parts like roller, rim, wheels. Welding and grinding process etc., | 2000.00 |
| 3 | Testing of tread mill bike on road condition | 1000.00 |
| 4 | Travel Expenses | 1000.00 |
| | Total | 12,000.00 |

Evaluation Committee Members

1. Dr.C.Venkatesh - Principal
2. Dr.B.Sujatha - Dean (Academics)
3. Dr.P.Rameshkumar - Dean (R&D)
4. Dr.P.Ponmurugan - Head (R&D)

- 
20/03/2021

- 
20/03/2021

- 
20/03/21

- 
20/3/21

DESIGN AND DEVELOPMENT OF A SMART TREAD MILL BIKE

| Sl. No. | Head | Components /Description |
|---------|---------------------|---|
| 1 | Equipment/Component | <ol style="list-style-type: none">1. Frame,2. Handle,3. Chain and sprocket,4. Conveyor belt and roller5. Wheels,6. Rim7. Wire and Switch. etc.. |
| 2 | Implementation | <ol style="list-style-type: none">1. Assembling parts like Frame. Handle, Chain and sprocket, Conveyor belt, roller, rim, and wheels.etc.,2. Welding and grinding process to assemble the product. |
| 3 | Testing | <ol style="list-style-type: none">1. Testing the tread mill bike in on road condition |
| 4 | Travel Expenses. | <ol style="list-style-type: none">1. Purchase the raw material |



SENGUNTHAR ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)

Recognized Under Section 2(f) & 12(B) of the UGC Act, 1956

NAAC Accredited with 'A' Grade

TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU



RESEARCH & DEVELOPEMENT CELL

Submitted to Correspondent sir Approval

Ref: SEC/R&D/2020-2021/R/001

Date: 22.03.2021

Sir,

Sub: Requisition for permission to grant SEED money -Reg

The Research& Development cell of our college had selected the following projects to grant SEED money to implement the proposals submitted. The principal investigator has asked to carry out their work as mentioned in their report.

| Sl.No | Title of the Project | Name of the Principal Investigator | Amount |
|--------------|--|------------------------------------|------------------|
| 1 | Flood geo-morphological survey and mapping of surface water potential and degradation study for tameradarani river stretch using remote sensing and gif techniques | DR.M.SEENIRAJAN | 12000.00 |
| 2 | LICENSE ELIGIBILITY MEASUREMENT SYSTEM | Mr.K.ASHOK KUMAR | 12000.00 |
| 3 | RFID BASED BUS MONITORING SYSTEM FOR INSTITUTION USING IOT | Dr.P. RAMESH KUMAR | 12000.00 |
| 4 | DETECTION OF WATER LEAKAGE IN PUBLIC DISTRIBUTION SYSTEM | Dr.K.UMADEVI | 13000.00 |
| 5 | DESIGN AND DEVELOPMENT OF SMARK THREAD MILL BIKE | Mr. P.JAGADEESWARAN | 12000.00 |
| Total | | | 61,000.00 |

Dean(R&D)
22/3/21

Principal i/c
22/3/21

Correspondent
22-03-2021

VOUCHER

No.

Date : 28.3.21

To: Mr. P. Jagadeeswaran.

| Particulars | Rate | | Nos. | Amount | |
|-------------------------------|------|----|------|--------|----|
| | Rs. | P. | | Rs. | P. |
| Implementing seed money | | | | 12,000 | 00 |
| Total Expenditure | | | | | |
| (-) Advance Paid on..... | | | | | |
| Balance to be refunded / paid | | | | - | |

Received / Refunded Rs. : Twelve thousand only.

| PREPARED | CERTIFIED | PASSED |
|-----------|------------|--------|
| Staff I/C | Supervisor | A.O. |

P. Jagadeeswaran
Signature 28/3/21

PRINCIPAL

*To
OR*

28.3.21
TRUST


**Sengunthar Engineering College
(Autonomous)
Tiruchengode**

UTILISATION CERTIFICATE - (2020-2021)

Name of the Scheme under which the amount was sanctioned under the Research promotion scheme of Sengunthar Charitable Trust

| Sl. No | SCT Sanction Order/Letter No. & Date under which the amount was sanctioned | Amount (Rs.) | Remarks |
|--------|---|--|---|
| 1. | SEC/R&D/2020-21/003 dated 10.12.2021 | Rs 12,000 (Rupees Twelve Thousand Only) | Certified that out of Grant-in-Aid of Rs 12,000 (Rupees Twelve Thousand Only) sanctioned by the SCT during the financial year Rs. 12,000 has been utilized for the purpose for which it was sanctioned and the balance of Rs. 0 remained unutilized at the end of the year. |

Certified that I have satisfied myself that the conditions on which the amount was sanctioned have been duly fulfilled and that I have exercised the following checks to see that the money was actually utilized for the purpose for which it was sanctioned.


Signature of the Principal investigator


Signature of Head of the Institute

Place: Tiruchengode

Date: 10/12/2021

FORMAT FOR RECEIPT AND PAYMENT ACCOUNT

| Sl. No. | Receipt | Amount (Rs.) | Sl. No. | Payments | Amount (Rs.) |
|---------|--------------------|--------------|---------|-----------------|--------------|
| 1 | To Opening Balance | 12000 | 1 | Components | 8000 |
| | | | 2 | Implementations | 2000 |
| | | | 3 | Testing | 1000 |
| | | | 4 | Conveyance | 1000 |
| | | | | Closing Balance | 0 |
| | Grant Total | 12000 | | Grant Total | 12000 |


Signature of the Principal investigator


Signature of Head of the Institute

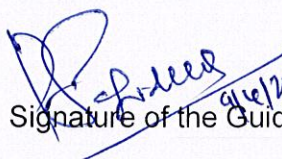
Place: Tiruchengode

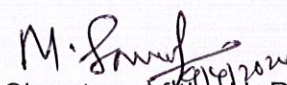
Date: 10/12/2021

SENGUNTHAR ENGINEERING COLLEGE
DEPARTMENT OF MECHANICAL ENGINEERING
STATEMENT OF ACCOUNT

Design and development of a smart thread mill bike

| S.NO | NAME OF THE COMPONENT | CREDIT (Rs) | DEBIT(Rs) |
|---------------------------------------|--------------------------|---------------------|--------------|
| 1 | Frame | | 2000.00 |
| 2 | Handle | | 500.00 |
| 3 | Chain sprocket | | 1500.00 |
| 4 | Conveyor belt and roller | | 1500.00 |
| 5 | wire and switch | | 500.00 |
| 6 | Wheels and rim | | 2000.00 |
| 7 | Implementation | | 2000.00 |
| 8 | Testing | | 1000.00 |
| 9 | Conveyance | | 1000.00 |
| Total | | | Rs.12,000.00 |
| SCT- Seed Money/Grand Received | | Rs.12,000.00 | |
| Balance | | | Nil |


Signature of the Guide


Signature of the HoD

ABSTRACT

Although millions of people use the bicycle every day, the design of the modern bicycle is still largely traditional, and comparatively little research work has been carried out to determine the design which is most effective physiologically. New modifications have generally been tested on the racing track where, however, many uncontrollable factors may influence the result. From both the practical and physiological point of view it is important to determine the energy output when riding different types of bicycles for a given distance at a certain speed. In our work modification of treadmill is done to better fit the requirements of users. Treadmill bike is designed for those humans who love to run outside. Treadmill equipped on bike frame and formulates a big innovation named a smart treadmill bike. This bike runs perfectly on human momentum. As the rider walks on the treadmill, the belt butts up against the rear wheel propelling the bike forward. Treadmill bike is designed for runners as the ideal treadmill device, this device combines the best exercise running and cycling to deliver a low-impact, high performance workout outdoors. We believe it is the ideal device for healthy runners. It delivers an exercise experience that is closer to running than anything else available today.

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LIST OF ABBREVIATION

| S.No | SHORTENING | FULL FORM |
|-------------|-------------------|-------------------------------|
| 1 | mm | Millimeter |
| 2 | Kg | Kilogram |
| 3 | rpm | Revolutions per minutes |
| 4 | AC | Alternative Current |
| 5 | DC | Direct Current |
| 6 | PLC | Programmable Logic Controller |
| 7 | Cc | Chain Clearance Diameter |

CHAPTER 1

INTRODUCTION

The treadmill bike is completely a new way of movement completely designed for runners. Typically using a treadmill basically is similar to running, hiking or walking. Think about the last time you were riding a bike over some kind of obstacles such as train tracks, potholes, speed bumps. Possibilities are you stood up on the pedals to improve your balance when crossing the obstacle. Basically, the treadmill bike will provide the rider a well-balanced position the entire time. It is a combination of amalgamation of different components upgrading your walking speed to a much higher pace. Since it uses no fuel it a very conventional option for people in their busy schedule to take care of their health completely. People with a busy schedule will also be able to take care of their health and physical fitness. Above all, it is not a conventional treadmill to make use of only in closed rooms, person using treadmill bicycle can roam on roads also. This project overcomes the drawback of the conventional treadmill which is stationary which in fact does not provide the jogger to get exposed to the natural atmosphere. So this proposed methodology provides an ultimate solution by making use of wheels and making the treadmill bicycle a walking cycle.

CHAPTER 2

LITERATURE REVIEW

Kale R.D.etal.,(2004) Treadmill bicycle is exclusively advanced way of moving. This paper deals with conversion of conventional bicycle into walking bicycle. This project work to better fitness of user. This project desired for humans who love to run outside. When users walking on bicycle he push treadmill belt backward due to it bicycle is propel in forward direction. With electric assist it takes no more effort to walks rather than walk on the track. The dynamo is connected to rear wheel. By using accessories like gear, braking system and electronic devices we can accelerate regulate as well as decelerate speed of bicycle. Our project contributes to make environment pollution .Our aim to make vehicle that is faster than walking and easy to ride than bicycle

KirtishBondre,etal.,(2007) This paper deals with conversion of a conventional bicycle into treadmill bicycle. In this bicycle the frame of the bicycle is completely modified and the treadmill is placed in between the two wheels, on which user will walk. As the user walks or runs on the treadmill the belt moves to the rear. At the rear roller RPM Sensor is attached to the roller from where Sensor will sense the speed of the roller and accordingly it will send signal to motor. The motion of motor is transmitted to the front wheel by which we can get the motion of wheel and bicycle runs.

EsakkiMuthuS,et al.,(2008) This paper deals with conversion of a conventional tricycle into treadmill bicycle. In this tricycle the frame of the bicycle is completely modified and the treadmill is placed in between the two wheels, on which user will walk. As the user walks or runs on the treadmill the belt moves to the rear. The mechanism used in this walking cycle is versatile of its kind in which, the cycling pedals are replaced with a treadmill belt. This treadmill belt drives the cycle forward by introducing free wheels and shafts mechanism. The prototype design requires a treadmill belt, shafts, the frame of treadmill, the free

wheels, gears, chain-drive and gear-chain .The platform on which the treadmill belt is placed is fabricated. All the links are made up of normal MS (mild steel) including the head which has a direct contact with the treadmill belt.

PankajGawhade,et al.,(2010) In this project we study the treadmill exercise outdoor and their effect on health. One of the most popular types of home as well as outdoor exercise equipment is the treadmill bicycle, which provides a straightforward, efficient aerobic workout. For many, treadmills are a good choice to begin a new exercise routine because walking is well tolerated by most individuals regardless of fitness level and for most back conditions. As strength and endurance are developed, the treadmill bicycle can be used for jogging or for interval training. The modern challenge faced with the global energy situation is the growing energy demand and the strong dependence on unsustainable fossil fuels. Another concurrent issue is the adverse health and socio-economic implications of adult obesity. Human Power Generation, which uses metabolized human energy to generate electrical power, could potentially address both these challenges. The treadmill, one of the most popular exercise machines, presently consumes large amounts of energy while dissipating a majority as heat. A heavy duty rechargeable battery pack was used to store the generated energy and additional components to measure the generated power were included. The power generating potential of the generator was determined for varying belt speeds and angles of inclination

Prof. P. R. Gajbhiye,et al.,(2014)Exercise is inevitable to keep health in good status. In this project we study the treadmill exercise outdoor and their effect on health. Also we enlisted the advantages and disadvantages of treadmill cycle exercise. One of the most popular types of home as well as outdoor exercise equipment is the treadmill cycle, which provides a straightforward, efficient aerobic workout. For many, treadmills are a good choice to begin a new exercise routine because walking is well tolerated by most individuals regardless of fitness level and for most back conditions. As strength and

endurance are developed, the treadmill bicycle can be used for jogging or for interval training. The modern challenge faced with the global energy situation is the growing energy demand and the strong dependence on unsustainable fossil fuels. Another concurrent issue is the adverse health and socio-economic implications of adult obesity. Human Power Generation, which uses metabolized human energy to generate electrical power, could potentially address both these challenges. The treadmill, one of the most popular exercise machines, presently consumes large amounts of energy while dissipating a majority as heat. The purpose of this thesis project was to design and develop a human powered treadmill generator and determine its power generation potential. A heavy duty rechargeable battery pack was used to store the generated energy and additional components to measure the generated power were included. The power generating potential of the generator was determined for varying belt speeds and angles of inclination, and compared with the American College of Sports Medicine (ACSM) metabolic walking and running prediction equations to determine efficiency. The generator was able to deliver 140W peak power for a short period of time. Regression equations related the power generated to the belt speed, covering values ranging from an average 10.8 ± 0.36 W at 1.83 ± 0.045 m/s to 90.3 ± 3.04 W at 2.38 ± 0.054 m/s. The angle of inclination did not have a significant impact on energy generation. The max average efficiency obtained for the system in this study was $37.9 \pm 2.63\%$, assuming 25% gait efficiency. Possible applications for this concept include energy saving equipment in a gym, low-cost, simple to operate, and low maintenance solutions for developing nations, and as a tool to educate energy conservation. Also, the need for exercise in space with low gravity makes the treadmill generator a possible source for secondary power in future extraterrestrial environments.

CHAPTER 3

MAJOR COMPONENTS

- SPROCKET
- CONVEYOR ROLLER
- CONVEYOR BELT
- WHEEL
- SHAFT

- DC MOTOR
- BATTERY
- BALL BEARING
- METAL FRAME

3.1 SPROCKET

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles.

Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations, a second gear is placed and the power is recovered by attaching shafts or hubs to this gear. Though drive chains are often simple oval loops, they can also go around corners by placing more than two gears along the chain; gears that do not put power into the system or transmit it out are generally known as idler-wheels. By varying the diameter of input and output gears with respect to each other, the gear ratio can be altered.

Roller Chain Definition

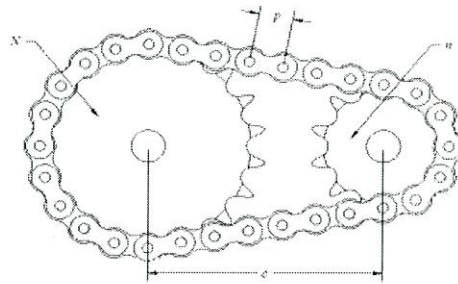


Figure 3.1: Roller Chain

For example, when the bicycle pedals' gear rotate once, it causes the gear that drives the wheels to rotate more than one revolution.

3.1.1 Characteristics

- High axial stiffness
- Low bending stiffness
- High efficiency
- Relatively cheap

SPECIFICATION OF AXLE

Table 3.1

| | |
|-----------------------------------|-----------------|
| Material | Mild Steel |
| Shape | Cylindrical rod |
| Length | 50mm |
| Diameter | 13mm |
| Inner diameter of supporting axle | 15 mm |
| Outer diameter of supporting axle | 17mm |
| Length | 30mm |
| Thickness | 3mm |

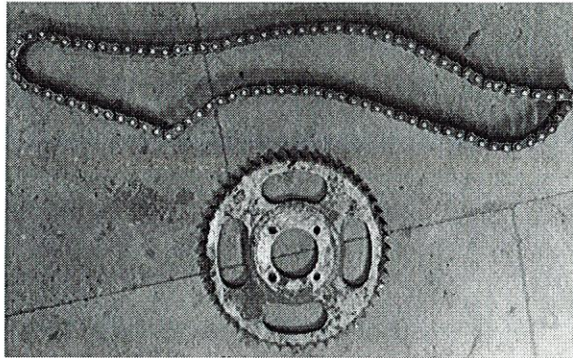


Figure 3.2:Chain Sprocket

CHAIN SPROCKET

Table3.2

| | |
|----------|---------------------------------------|
| Material | High Carbon Steel |
| Pitch | 12.7mm |
| Width | 30mm |
| Teeth | 16 |
| Balls | High carbon high chromium steel balls |

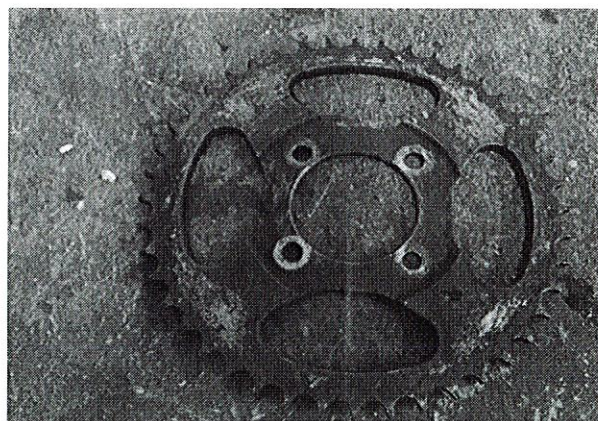


Figure 3.3 sprocket

3.1.2 Chain drive design calculation

- Chain must contain even integer number of links
- Hence cannot pick an arbitrary centre distance and chain pitch
- Nearest chain lengths (in pitches) for a contemplated centre distance, C_c , are calculated by empirical formulae like (for a two sprocket system)

$L = N_1 + N_2/2 + 2C_c/p + (N_2 - N_1)^2/4\pi^2 C_c$ Where, N_1, N_2 - Number of teeth

P - Chain pitch

3.2 CONVEYOR ROLLER

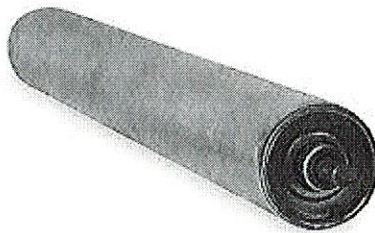


Figure 3.4: Conveyor Roller

Material : Mild steel.

Outer diameter: 35mm.

Inner diameter: 15mm

A line shaft roller conveyor or line-shaft conveyor is, as its name suggests, powered by a shaft beneath rollers. These conveyors are suitable for light applications up to 50 kg such as cardboard boxes and tote boxes.

A single shaft runs below the rollers running the length of the conveyor. On the shaft are a series of spools, one spool for each roller. An elastic polyurethane o-ring belt runs from a spool on the powered shaft to each roller.

When the shaft is powered, the o-ring belt acts as a chain between the spool and the roller making the roller rotate. The rotation of the rollers pushes the product along the conveyor. The shaft is usually driven by an electrical motor that is generally controlled by an electronic PLC (programmable logic controller). The PLC electronically controls how specific sections of the conveyor system interact with the products being conveyed. Advantages of this conveyor are quiet operation, easy installation, moderate maintenance and low expense. Line-shaft conveyors are also extremely safe for people to work around because the elastic belts can stretch and not injure fingers should any get caught underneath them. Moreover, the spools will slip and allow the rollers to stop moving if clothing, hands or hair gets caught in them. In addition, since the spools are slightly loose on the shaft, they act like clutches that slip when products are required to accumulate (stop moving and bump up against each other. i.e. queue up). With the exception of soft bottomed containers like cement bags, these conveyors can be utilized for almost all applications.

A disadvantage of the roller lineshaft conveyor is that it can only be used to convey products that span at least three rollers, but rollers can be as small as 17mm in diameter and as close together as 18.5mm. For items shorter than 74mm, the conveyor belt system is generally used as an alternative option. A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, Many kinds of conveying systems are available and are used according to the various needs of different industries. There are chain conveyors (floor and overhead) as well. Chain conveyors consist of enclosed tracks, I-Beam, towline, power & free, and hand pushed trolleys. A conveyor system is often the lifeline to a company's ability to effectively move its

product in a timely fashion. The steps that a company can take to ensure that it performs at peak capacity, include regular inspections and system audits, close monitoring of motors and reducers, keeping key parts in stock, and proper training of personnel. Increasing the service life of a conveyor system involves: choosing the right conveyor type, the right system design and paying attention to regular maintenance practices.

3.3 CONVEYOR BELT

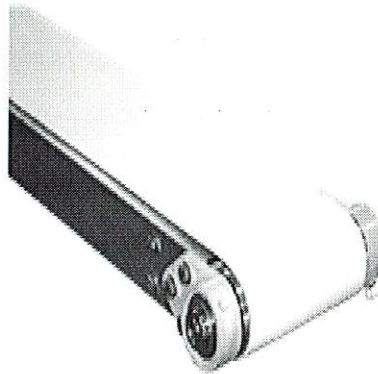


Figure 3.5:Conveyor Belt

Material:Cloth Width:25cm

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium the conveyor belt that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory

and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more. Conveyors are durable and reliable components used in automated distribution and warehousing. In combination with computer-controlled pallet handling equipment this allows for more efficient retail, wholesale, and manufacturing distribution. It is considered a labor saving system that allows large volumes to move rapidly through a process, allowing companies to ship or receive higher volumes with smaller storage space and with less labor expense.

Rubber conveyor belts are commonly used to convey items with irregular bottom surfaces, small items that would fall in between rollers (e.g. a sushi conveyor bar), or bags of product that would sag between rollers. Belt conveyors are generally fairly similar in construction consisting of a metal frame with rollers at either end of a flat metal bed. The belt is looped around each of the rollers and when one of the rollers is powered (by an electrical motor) the belting slides across the solid metal frame bed, moving the product. In heavy use applications the beds which the belting is pulled over are replaced with rollers. The rollers allow weight to be conveyed as they reduce the amount of friction generated from the heavier loading on the belting.

3.4 WHEEL

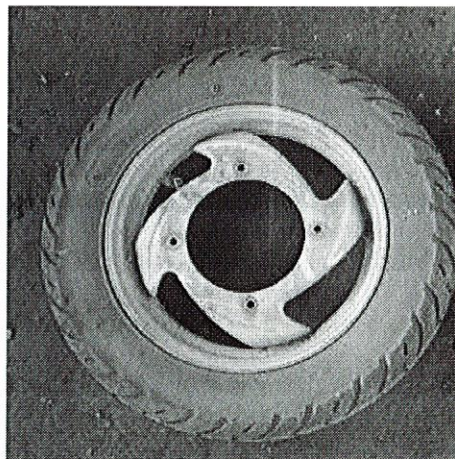


Figure 3.6: Wheel

3.4.1 Etymology and spelling

Historically, the spelling was “tire” and is of French origin, which comes from the word *tire*, to pull. The reason for this naming is that originally “tire” referred to iron hoops or thick wires bound to carriage wheels. In French blacksmithing the word for a drawn iron rod is a *tirer*, or pull. The same word was often used for any metal drawing or rolling process. In an article in the *London Magazine/Intelligencer* of 1853 “The Utility of Broad Wheels,” it explains that the common practice was to bend two rods, called “tires,” into hoops and bind them to the wheel, but it is preferable to use an iron band, called a “broad wheel” rather than the rods, because as the rods wear they bite into the wheel. Another early mention of a tire in English is in *The Scots Magazine*, Volume 15 By James Boswell (1753). Another origin of “tire” is provided by Online Etymology Dictionary, essentially that the word is a short form of “attire,” and that a wheel with a tire is a dressed wheel. Some other etymologists may share this view. The spelling *tyre* does not appear until the 1840s when the English began shrink fitting railway car wheels with malleable iron. Nevertheless, traditional publishers continued using *tire*. The *Times* newspaper in Britain was still using *tire* as late as 1905. The spelling *tyre*, however, began to be commonly used in the 19th century for pneumatic tires in the UK. The 1911 *Encyclopaedia* states that “[t]he spelling 'tyre' is not now accepted by the best English authorities, and is unrecognized in the US”, while Fowler’s *Modern English Usage* of 1926 says that “there is nothing to be said for 'tyre', which is etymologically wrong, as well as needlessly divergent from our own [sc. British] older & the present American usage”. However, over the course of the 20th century *tyre* became established as spelling.

3.5 SHAFT



Figure3.7: Shaft

Specifications

Shaft diameter: 12mm

Material: mild steel

Length:26 inch

Shaft

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. The shaft is generally acted upon by bending moment, torsion and axial force. Design of shaft primarily involves in determining stresses at critical point in the shaft that is arising due to aforementioned loading. Other two similar forms of a shaft are axle and spindle. Axle is a non-rotating member used for supporting rotating wheels etc. and do not transmit any torque. Spindle is simply defined as a short shaft. However, design method remains the same for axle and spindle as that for a shaft. Standard sizes of Shafts Typical sizes of solid shaft that are available in the market are, Up to 25 mm 0.5 mm increments 25 to 50 mm 1.0 mm increments 50 to 100 mm 2.0 mm increments 100 to 200 mm 5.0 mm increments Material for Shafts The ferrous, non-ferrous materials and non

metals are used as shaft material depending on the application. Some of the common ferrous materials used for shaft are discussed below. Hot-rolled plain carbon steel. These materials are least expensive. Since it is hot rolled, scaling is always present on the surface and machining is required to make the surface smooth.

Since it is cold drawn it has got its inherent characteristics of smooth bright finish. Amount of machining therefore is minimal. Better yield strength is also obtained. This is widely used for general purpose transmission shaft.

3.6 DC MOTOR

DC motor is an electrical machine that utilizes electric power resulting in mechanical power output. Normally the motor output is a rotational motion of the shaft. The input may be direct current supply or alternating supply. But in case of DC motor direct current is used. The mechanism of dc motor is like a bar wound with wire is placed in between 2 magnets having North and South Pole. When it is provided with electric supply the wire becomes energized resulting in rotational motion which leads to rotational output. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC with AC motors possible in many applications possible in many applications.

3.6.1 Specification

DC motor I (12v, 3 Amp, 17.18 kg-cm, 200 rpm)

DC motor II (12v, 1Amp, 3.88 kg-cm,)

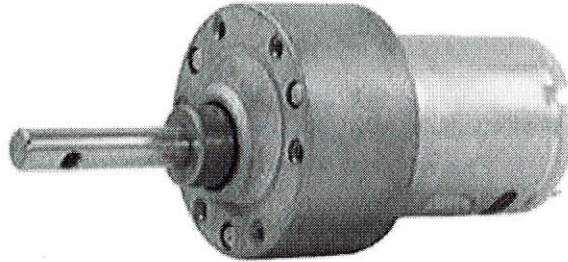


Figure 3.8: DC motor

In this work, gear DC motor is used. A DC motor is not the same as a "gear motor". A "gear motor" may be an AC or DC motor coupled with a gearbox or transmission. A gear motor adds mechanical gears to alter the speed/torque of the motor for an application. Usually such an addition is to reduce speed and increase torque. Geared DC motors can be defined as an extension of DC motor. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

3.7 BATTERY

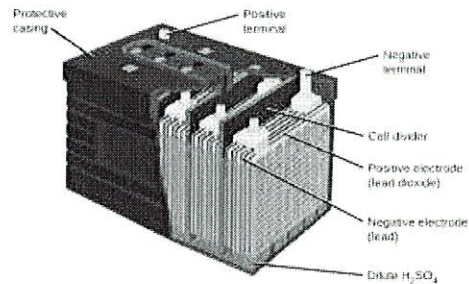


Figure 3.9: Battery

Battery is use for storing the energy produced from the dynamo. The battery used is a lead-acid type and has a capacity of 12v; 2.5A.the most inexpensive secondary cell is the lead acid cell and is widely used for commercial purposes. A lead acid cell when ready for use contains two plates immersed in a dilute sulphuric acid (H₂SO₄) of specific gravity about 1.28.the positive plate (anode) is of Lead –peroxide (PbO₂) which has chocolate brown colour and the negative plate (cathode) is leading (Pb) which is of grey colour. When the cell supplies current to a system (discharging), the chemical activity that creates lead sulphate (PbSO₄) on both the plates with water being created in the electrolyte. After a certain amount of energy has been withdrawn from the cell, both plates are transformed into the same material and the specific gravity of the electrolyte (H₂SO₄) is lowered. The cell is then said to be discharged.

3.7.1 Battery Calculation

To find the current

$$\text{Watt} = 18 \text{ W}$$

$$\text{Volt} = 12 \text{ V}$$

$$P = V * I$$

$$18 = 12 * I$$

$$I = 18/12$$

$$= 1.5 \text{ Amps}$$

BATTERY USAGE WITH 1.5 AMPS

BAH / I

8/1.5 = 5.3 hrs

3.8BALL BEARING

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least three races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other. Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls.

3.8.1 SPECIFICATION

INNER DIA :12mm

OUTER DIA : 37mm

3.8.2 HISTORY

Although bearings had been developed since ancient times, the first modern recorded patent on ball bearings was awarded to Philip Vaughan, a Welsh inventor and ironmaster who created the first design for a ball bearing in Carmarthen in 1794. His was the first modern ball-bearing design, with the ball running along a groove in the axle assembly.

Jules Suriray, a Parisian bicycle mechanic, designed the first radial style ball bearing in 1869, which was then fitted to the winning bicycle ridden by James Moore in the world's first bicycle road race, Paris-Rouen, in November 1869.

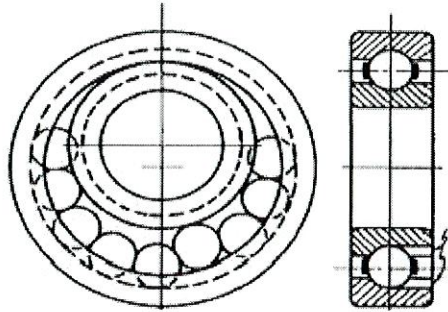


Figure 3.10:Ball Bearing

3.9METAL FRAME

The metal frame is generally made of mild steelbars for machining, suitable for lightly stressed components including studs, bolts, gears and shafts. It can be case-hardened to improve wear resistance. They are available in bright rounds, squares and flats, and hot rolled rounds

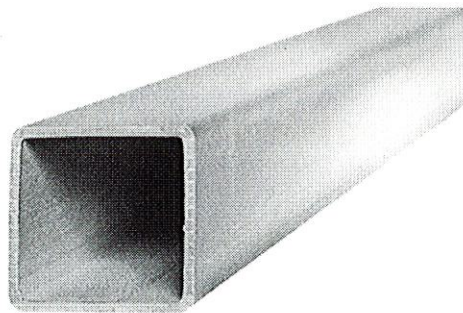


Figure 3.11 Metal Frame

Suitable machining allowances should therefore be added when ordering. It does not contain any additions for enhancing mechanical or machining properties. Bright drawn mild steel is an improved quality material, free of scale, and has been cold worked (drawn or rolled) to size. It is produced to close dimensional tolerances. Straightness and flatness are better than black steel. It is more suitable for repetition precision machining. Bright drawn steel has more consistent hardness, and increased tensile strength. Bright steel can also be obtained in precision turned or ground form if desired.

3.9.1 MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

CHAPTER 4

CONSTRUCTION

The frame setup with the combination of bicycle powered by a thread mill is created with the help of square tubes and channels by a metal joining process called welding. Two wheels are mounted at the front and rear end portion of the frame for motion of vehicle. Next to the handle bar number of rollers are placed parallel to each other and they are coupled with a belt, there by activating the rollers one by one through the input motion. The last roller is coupled to a crank wheel and the rotation is transferred from it to sprocket by means of chain drive, sprocket is couple to the rear wheel with flywheel.

CHAPTER 5

WORKING PRINCIPLE

The fabrication of the treadmill traveler is very advantageous because of its simple construction and easy working principle. To say in a one line, this machine follows the action of the user. That is, when the driver walks forward, the machine moves forward and when he walks backward, the machine moves backward. A treadmill setup is made so that the operator can walk on the belt. A handle is placed in the front for the controlling of the vehicle. The rollers above which the conveyor belt (treadmill belt), held in tension are coupled to the wheels of the machine, usually rear wheels. The rollers are connected by a suitable arrangement for efficient transmission of motion thus having minimal losses during the transmission of motion. The frame of the machine is designed in such a way that it is balanced and the operator doesn't put any effort in balancing the machine. Now when the operator walks forward, the conveyor belt moves in one direction which makes the wheels of the machine to rotate so that the machine moves front. When he walks backwards, the motion direction of the belt is reversed and thus the vehicle moves backwards.

CHAPTER 6
MATERIAL USED

Table 6.1

| S.No | DESCRIPTION | QUANTITY | MATERIAL |
|-------------|--------------------|-------------------|--------------------|
| 1 | FRAME | AS PER REQUIRMENT | MILD STEEL |
| 2 | SHAFT | AS PER REQUIRMENT | MILD STEEL |
| 3 | BEARING | 16 Nos | STAINLESS STEEL |
| 4 | CHAIN DRIVE | 1Nos | STAINLESS STEEL |
| 5 | WHEEL | 3Nos | RUBBER |
| 6 | CONVEYOR BELT | 1Nos | CLOTH |
| 7 | CONVEYOR ROLLER | 8Nos | MILD STEEL |
| 8 | DC MOTOR | 1Nos | ELECTRICAL |
| 9 | BATTERY | 2Nos | ELECTRICAL |

CHAPTER 7

COST ESTIMATION

Table 7.1

| S.No | DISCRIPTION | COST |
|------|------------------|-------|
| 1 | FRAME | 2000 |
| 2 | SHAFT | 800 |
| 3 | BEARING | 1600 |
| 4 | CHAIN DRIVE | 1800 |
| 5 | WHEEL | 2400 |
| 6 | CONVEYOR BELT | 500 |
| 7 | CON VEYOR ROLLER | 700 |
| 8 | D C MOTOR | 2200 |
| 9 | BATTERY | 2000 |
| | TOTAL | 14000 |

LABOUR COST

LATHE, DRILLING, WELDING, GRINDING, POWER HACKSAW, GAS CUTTING:

Cost = 1000/-

TOTAL COST

$$\begin{aligned}\text{Total cost} &= \text{Material Cost} + \text{Labour cost} \\ &= \text{Rs}14000 + 1000\end{aligned}$$

Total cost for this project = Rs15000

CHAPTER 8

APPLICATION

- It can be used as an indoor locomotive device infrastructure with large roof span i.e. malls, warehouse, open markets, large office spaces, etc.
- By using such product pedestrian cops can save themselves from getting exhausted.
- Pedestrians in large campuses can benefit from this product the same way.
- Can replace cycle as an energy efficient vehicle for those who cannot drive a cycle.

CHAPTER 9

ADVANTAGES

- Treadmill bicycle helps in maintaining proper physique. Physical fitness is of utmost importance in day to day life. People often get bored while exercising in a closed room such as gym. By using treadmill bicycle one can exercise outdoors in fresh air.
- People often use vehicle for travelling over short distance. This causes unnecessary wastage of fuel. Due to use of treadmill bicycle over short distance a large amount of fuel can be saved.
- One can also exercise while travelling over short distance.
- Treadmill bicycle does not require any fuel. Therefore it does not emit any pollutants. So it is an eco-friendly vehicle.

CHAPTER 10
2D LAYOUTS OF MODEL

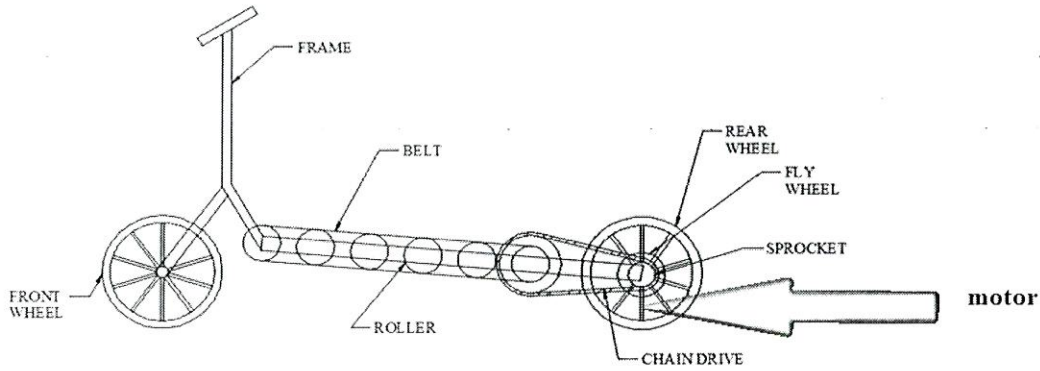


Figure 10.1 Model 2D Diagram

CHAPTER 11

CONCLUSION

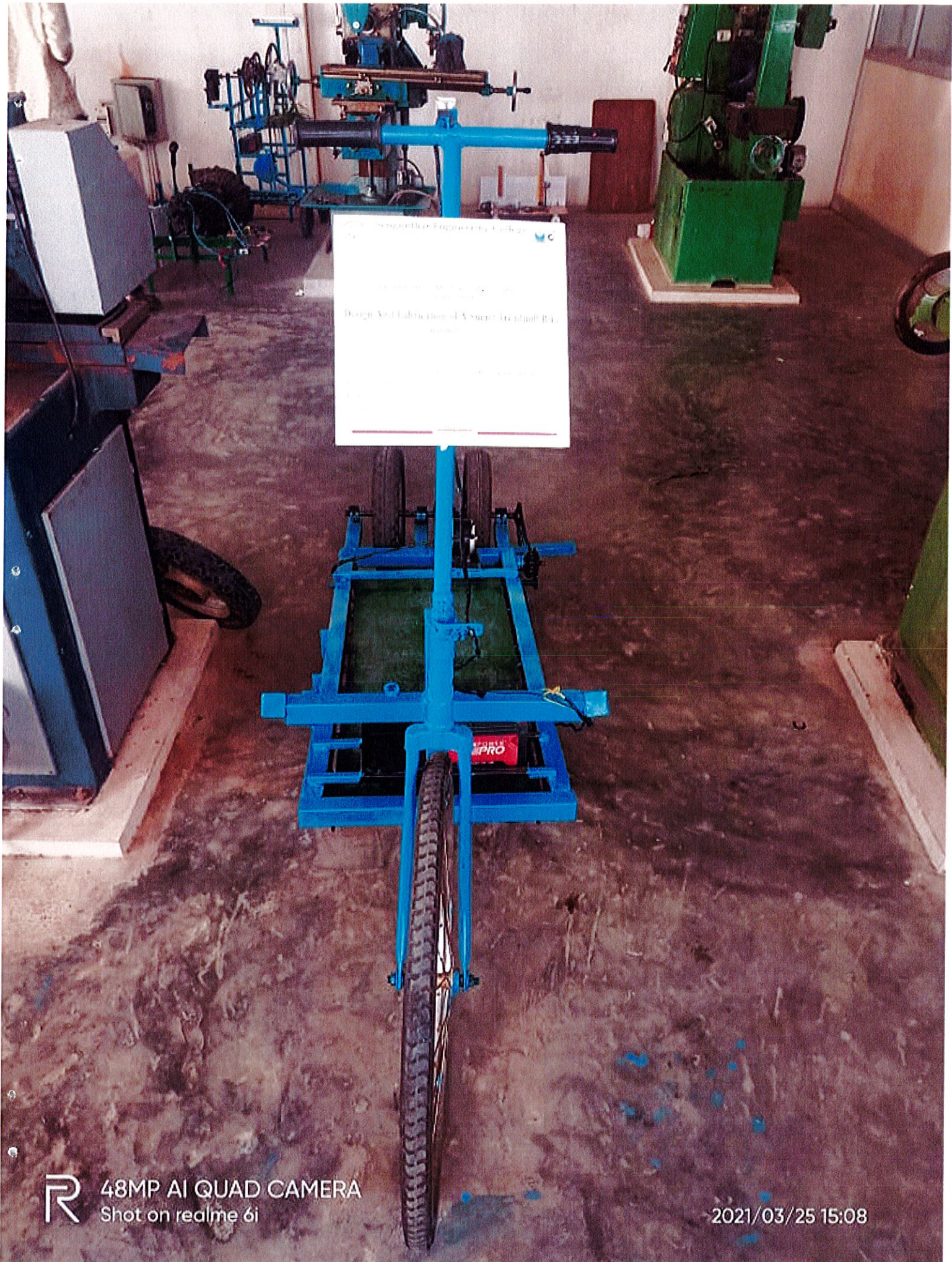
We have described a new way of travelling as well as exercise with the help of a new model of bike which is combination of treadmill and bicycle. It can be used in place of regular bike at cheaper cost and without use of fuel. The treadmill bicycle will prove to be a future vehicle as no fuel is used for travelling through this and it is pollution free. The treadmill which is used for walking helps to keep us fit as exercise is also one of the important tasks for a person to be fit and healthy for day to day life. Treadmill bicycle is cheaper than the normal bike which also makes it efficient and economic.

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A SMART TREADMILL BIKE

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ABSTRACT:

This project work modifies a treadmill to better fit the requirements of users. Treadmill bike is designed for those humans who love to run outside. Treadmill equipped on bike frame and formulates a big innovation named 'TREADMILL BIKE'. This bike has electronic parts and runs perfectly on human momentum. As the rider walks on the treadmill, the belt butts up against the rear wheel propelling the bike forward. Treadmill bike is designed for runners as the ideal treadmill device, this device combines the best exercise running and cycling to deliver a low-impact, high performance workout outdoors. We believe it is the ideal device for healthy runners. It delivers an exercise experience that is closer to running than anything else available today.

Key Words: Treadmill, Walking.

I. INTRODUCTION

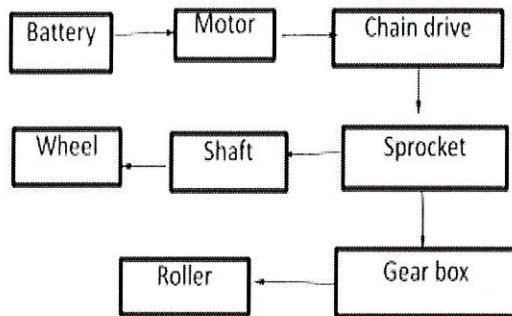
The treadmill bike is completely a new way of movement completely designed for runners. Typically using a treadmill basically is similar to running, hiking or walking. Think about the last time you were riding a bike over some kind of obstacles such as train tracks, potholes, speed bumps. Possibilities are you stood up on the pedals to improve your balance when crossing the obstacle. Basically, the treadmill bike will provide the rider a well-balanced position the entire time. It is a combination of amalgamation of DC motor with different components upgrading your walking speed to a much higher pace. Since it uses no fuel it a very conventional option for people in their busy schedule to take care of their health completely. People with a busy schedule will also be able to take care of their health and physical fitness. Above all, it is not a conventional treadmill to make use of only in closed rooms, person using treadmill bike can roam on roads also. This project overcomes the drawback of the conventional treadmill which is stationary which in fact does not provide the jogger to get exposed to the natural atmosphere. So this proposed methodology provides an ultimate solution by making use of wheels and making the treadmill bike a walking cycle. The major elements in our project are as listed below.

II. LITERATURE SURVEY

[Kirtishbondre,2016]¹ explains about the "Physical activity," "exercise," and "physical describe different concepts This fitness are three different terms that paper are confused with one another, and the terms gives definitions to distinguish them. Any bodily movement produced by skeletal muscles that result in energy expenditure is known as Physical activity. The energy expenditure is measured in kilocalories. In daily life physical activity can be categorized into occupational, sports, conditioning, household, or other activities. It is a

set of attributes that are either health or skill-related. The degree to which people have these attributes can be measured with specific tests.

III. BLOCK DIAGRAM



IV. COMPONENTS

a. The Treadmill



Fig.1 Frame

There are majorly two different types of treadmills having steel frames and newer and premium treadmills with Mild steel frames. Mild steel frames will hold up better if you are preparing on keeping your treadmill for several years or if you are near to the weight capacity of the treadmill. The treadmill rails (also known as bars or grips) should be used for providing stability when you are starting or stopping the treadmill or if your treadmill is well equipped with a grip heart monitor, this is where you will take your heart rate measurements. Rails are not meant to be held the complete time that you are using the treadmill, so be sure that they are in a convenient but also out of the way location.

b. Walking Belt

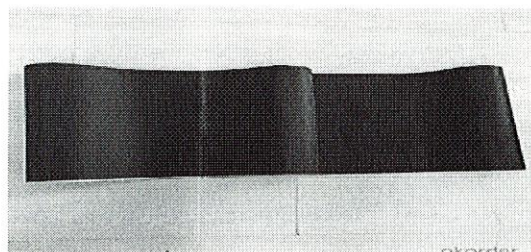


Fig.2 Belt

Specification:

Material : Cloth

Width : 25 cm

The walking surface of a treadmill comprises of the thin moving belt and a rigid plate held between the two surfaces of that belt so as to provide support when the transverse load of footfalls is applied. The treadmill belt size is an important characteristic in your treadmill if you are preparing for running or jogging on your treadmill. If you are planning on walking, the belt size is not of much importance. Standard belts run with size 19" wide by 47" long. Although this appears like a good width and length, you must note that the belt goes onto a deck, which includes part of the frame and your console. Again, if you are preparing on only walking on your treadmill, this size is ok. However, if you try on running you will want a wider and longer belt, since we have a capability to sway a bit while we run.

c. Rollers



Fig.3 Roller

Bike rollers are a type of bike trainer that make it feasible to ride a bike indoors without moving forward. However, dissimilar to other types of bike trainers, rollers do not confine to the bike frame, and the rider must balance him or herself on the rollers while training. Bike rollers normally comprise of three cylinders, drums, or "rollers" (two for the rear wheel and one for the front wheel), on top of which the bike runs. A belt joins one of the rear rollers to the front roller, causing the front wheel of the bike to spin when the bike is pedaled. The spacing of bike rollers can normally be adjusted to match the bike's wheelbase. Generally, the front roller is adapted to be slightly ahead of the hub of the front wheel.

d. Bearing

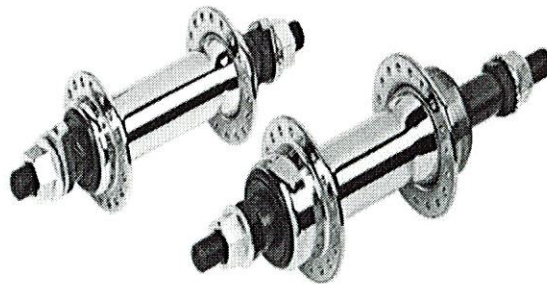


Fig.4 Bearing

Specification:

Inner Dia : 12mm

Outer Dia : 37mm

A bearing is machine element which holds another moving machine element. The moving machine element called as a journal. Bearing allows a relative motion between the contact surfaces of the members while

transferring the load. A certain amount of power is wasted in removing frictional resistance. So as to reduce frictional resistance and wear and to carry away the heat generated, a lubricant may be utilized.

V. WORKING PRINCIPLE

When we walk or run on the walking surface it gives rotation to rear wheel of bike and treadmill bike is moving forward. The walking surface of a treadmill consists of the thin moving belt and a rigid plate placed between the two surfaces of that belt in order to provide backing when the transverse load of footfalls is applied. The original and unmodified treadmill used a sheet of 0.75 inches pressed particle board as a support plate. This was attached to the frame of the treadmill at four points with wood screws placed near the four corners of the sheet. While resting on the rails in a lowered position, the plate received vertical support from small metal risers at the mounting points and from two rubber pads placed under the longest edge of the surface midway between the hard mounting points. According to the manual provided with the treadmill, the design intent behind this flexible multi-point mounting system was to reduce the overall stiffness of the plate by providing less support than that provided by direct attachment to two solid rails. In actual practice, the thickness and stiffness of the particle board surface were more than required to remove all discernable deflection from the system. Users were unable to distinguish the difference in stiffness when additional Mild steel supports were inserted between the sheet and the rails, in order to remove the compliant effect of the rubber supports.

We concluded that modifications would be necessary to achieve an ideally compliant walking surface capable of reducing the impact forces related with walking and running.

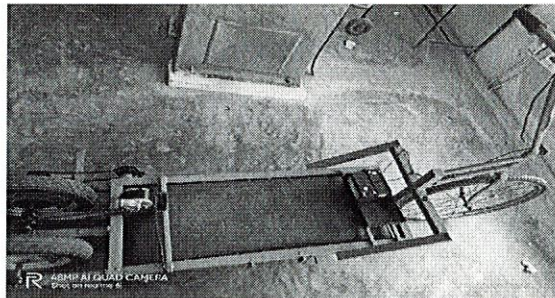


Fig.5 Treadmill Bike

VI. COST ESTIMATION

| S.No | Description | Cost (Rs.) |
|------|--------------------------|------------|
| 1 | Frame | 2000.00 |
| 2 | Shaft | 800.00 |
| 3 | Bearing | 1600.00 |
| 4 | Chain drive | 1800.00 |
| 5 | Dc motor | 2200.00 |
| 6 | Battery | 2000.00 |
| 7 | Conveyor belt and roller | 1200.00 |
| 8 | Total (Rs.) | 14,000.00 |

VII. RESULTS AND DISCUSSION

- We have described a new way of travelling as well as exercise with the help of a new model of bike which is combination of treadmill bike.
- It can be used in place of regular bike at cheaper cost and without use of fuel.
- Treadmill bicycle is cheaper than the normal bike which also makes it efficient and economic.

VIII. CONCLUSIONS

This system can be efficiently used anywhere whether it is outdoor or indoor. This utilizes highly fuel-saving technology which is a major requirement of this era. In the future, it can be used as an indoor locomotive device infrastructure with large roof span i.e. malls, warehouse, open markets, large office spaces, etc. By using such product pedestrian cops can protect themselves from getting exhausted. Pedestrians in large campuses can take benefit from this product the same way. We can replace cycle as an energy efficient vehicle for those who cannot drive a cycle.

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A SMART TREADMILL BIKE

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Key Words: *Treadmill, Walking.*

I. INTRODUCTION

The treadmill bike is completely a new way of movement completely designed for runners. Typically using a treadmill basically is similar to running, hiking or walking. Think about the last time you were riding a bike over some kind of obstacles such as train tracks, potholes, speed bumps. Possibilities are you stood up on the pedals to improve your balance when crossing the obstacle. Basically, the treadmill bike will provide the rider a well-balanced position the entire time. It is a combination of amalgamation of DC motor with different components upgrading your walking speed to a much higher pace. Since it uses no fuel it a very conventional option for people in their busy schedule to take care of their health completely. People with a busy schedule will also be able to take care of their health and physical fitness. Above all, it is not a conventional treadmill to make use of only in closed rooms, person using treadmill bike can roam on roads also. This project overcomes the drawback of the conventional treadmill which is stationary which in fact does not provide the jogger to get exposed to the natural atmosphere. So this proposed methodology provides an ultimate solution by making use of wheels and making the treadmill bike a walking cycle. The major elements in our project are as listed below.

II. LITERATURE SURVEY

[Kirtishbondre,2016]¹ explains about the "Physical activity," "exercise," and "physical describe different concepts This fitness are three different terms that paper are confused with one another, and the terms gives definitions to distinguish them. Any bodily movement produced by skeletal muscles that result in energy expenditure is known as Physical activity. The energy expenditure is measured in kilocalories. In daily life physical activity can be categorized into occupational, sports, conditioning, household, or other activities. It is a

The walking surface of a treadmill comprises of the thin moving belt and a rigid plate held between the two surfaces of that belt so as to provide support when the transverse load of footfalls is applied. The treadmill belt size is an important characteristic in your treadmill if you are preparing for running or jogging on your treadmill. If you are planning on walking, the belt size is not of much importance. Standard belts run with size 19" wide by 47" long. Although this appears like a good width and length, you must note that the belt goes onto a deck, which includes part of the frame and your console. Again, if you are preparing on only walking on your treadmill, this size is ok. However, if you try on running you will want a wider and longer belt, since we have a capability to sway a bit while we run.

c. Rollers

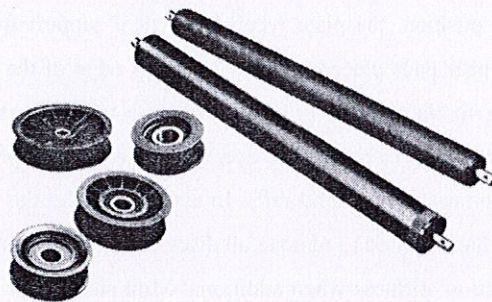


Fig.3 Roller

Bike rollers are a type of bike trainer that make it feasible to ride a bike indoors without moving forward. However, dissimilar to other types of bike trainers, rollers do not confine to the bike frame, and the rider must balance him or herself on the rollers while training. Bike rollers normally comprise of three cylinders, drums, or "rollers" (two for the rear wheel and one for the front wheel), on top of which the bike runs. A belt joins one of the rear rollers to the front roller, causing the front wheel of the bike to spin when the bike is pedaled. The spacing of bike rollers can normally be adjusted to match the bike's wheelbase. Generally, the front roller is adapted to be slightly ahead of the hub of the front wheel.

d. Bearing

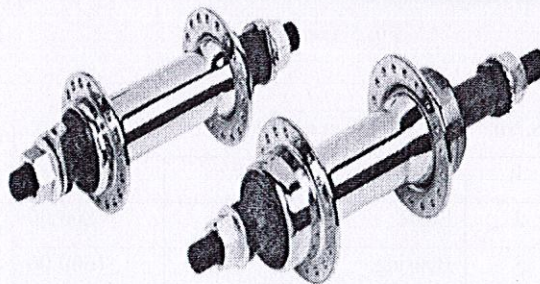


Fig.4 Bearing

Specification:

Inner Dia : 12mm

Outer Dia : 37mm

A bearing is machine element which holds another moving machine element. The moving machine element called as a journal. Bearing allows a relative motion between the contact surfaces of the members while

VII. RESULTS AND DISCUSSION

- We have described a new way of travelling as well as exercise with the help of a new model of bike which is combination of treadmill bike.
- It can be used in place of regular bike at cheaper cost and without use of fuel.
- Treadmill bicycle is cheaper than the normal bike which also makes it efficient and economic.

VIII. CONCLUSIONS

This system can be efficiently used anywhere whether it is outdoor or indoor. This utilizes highly fuel-saving technology which is a major requirement of this era. In the future, it can be used as an indoor locomotive device infrastructure with large roof span i.e. malls, warehouse, open markets, large office spaces, etc. By using such product pedestrian cops can protect themselves from getting exhausted. Pedestrians in large campuses can take benefit from this product the same way. We can replace cycle as an energy efficient vehicle for those who cannot drive a cycle.

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A SMART TREADMILL BIKE

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ABSTRACT:

This project work modifies a treadmill to better fit the requirements of users. Treadmill bike is designed for those humans who love to run outside. Treadmill equipped on bike frame and formulates a big innovation named 'TREADMILL BIKE'. This bike has electronic parts and runs perfectly on human momentum. As the rider walks on the treadmill, the belt butts up against the rear wheel propelling the bike forward. Treadmill bike is designed for runners as the ideal treadmill device, this device combines the best exercise running and cycling to deliver a low-impact, high performance workout outdoors. We believe it is the ideal device for healthy runners. It delivers an exercise experience that is closer to running than anything else available today.

Key Words: Treadmill, Walking.

I. INTRODUCTION

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treadmill bike a walking cycle. The major elements in our project are as listed below.

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wheel of the bike to spin when the bike is pedaled. The spacing of bike rollers can normally be adjusted to match the bike's wheelbase. Generally, the front roller is adapted to be slightly ahead of the hub of the front wheel.

d. Bearing

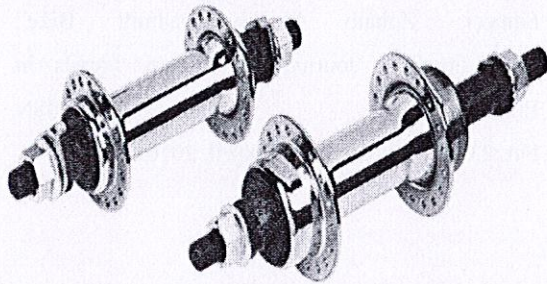


Fig.4 Bearing

Specification:

Inner Dia:12mm

Outer Dia:37mm

A bearing is machine element which holds another moving machine element. The moving machine element called as a journal. Bearing allows a relative motion between the contact surfaces of the members while transferring the load. A certain amount of power is wasted in removing frictional resistance. So as to reduce frictional resistance and wear and to carry away the heat generated, a lubricant may be utilized.

V. WORKING PRINCIPLE

When we walk or run on the walking surface it gives rotation to rear wheel of bike and treadmill bike is moving forward. The walking surface of a treadmill consists of the thin moving belt and a rigid plate placed between the two surfaces of that belt in order to provide backing when the transverse load of footfalls is applied. The original and unmodified treadmill used a sheet of 0.75 inches pressed particle board as a support plate. This was attached to the frame of the treadmill at

four points with wood screws placed near the four corners of the sheet. While resting on the rails in a lowered position, the plate received vertical support from small metal risers at the mounting points and from two rubber pads placed under the longest edge of the surface midway between the hard mounting points. According to the manual provided with the treadmill, the design intent behind this flexible multi-point mounting system was to reduce the overall stiffness of the plate by providing less support than that provided by direct attachment to twosolid rails. In actual practice, the thickness and stiffness of the particle board surface were more than required to remove all discernable deflection from the system. Users were unable to distinguish the difference in stiffness when additional Mild steel supports were inserted between the sheet and the rails, in order to remove the compliant effect of the rubber supports.

We concluded that modifications would be necessary to achieve an ideally compliant walking surface capable of reducing the impact forces related with walking and running.

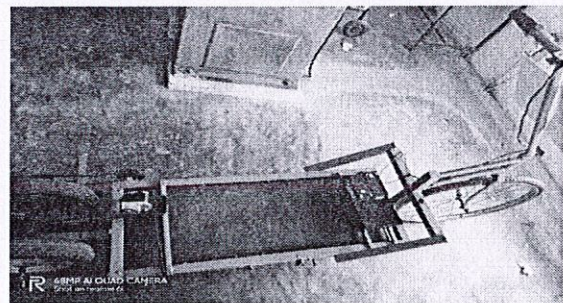


Fig.5 Treadmill Bike

VI. COST ESTIMATION

| S.No | Description | Cost (Rs.) |
|------|-------------|------------|
| 1 | Frame | 2000.00 |
| 2 | Shaft | 800.00 |
| 3 | Bearing | 1600.00 |
| 4 | Chain drive | 1800.00 |
| 5 | Dc motor | 2200.00 |
| 6 | Battery | 2000.00 |