PROJECT REPORT ON

"RESOURCEFUL ENERGY METER USING INTELLIGENT RETRIEVEL SYSTEM HAVING PROFICIENT UTILIZATION OF ENERGY WITH IMMEDIATE MESSAGING ALERTS AND DIMINUTION RECORD GENERATION".

Submitted to

UNIVERSITY OF MUMBAI

In Partial Requirement for the Fulfilment of the Award of

BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING

BY

ANSARI ABU ALQAMA (16EE06)

ANSARI GULFAM (16EE08)

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UNDER THE GUIDANCE OF

PROF. MOHSIN KHAN

DEPARTMENT OF ELECTRICAL ENGINEERING

Anjuman-I-Islam's Kalsekar Technical Campus, Panvel

SCHOOL OF ENGINEERING AND TECHNOLOGY

Plot No: 2, 3 Sector -16, Near Thana Naka, Khandagoan,
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CERTIFICATE

This is certify that the project entitled
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Do they, carry out a record of Bonafide work in partial fulfilment of the requirement for the award of degree of Bachelors of Engineering in Electrical at Anjuman-I-Islam's Kalsekar Technical Campus Panvel, Navi Mumbai Affiliated to University Of Mumbai. This work done during year 2019-2020, under our guidance.

Date: / /

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ABSTRACT

It is a difficult job for the electricity board officials to manually take meter readings and calculate bill as it is time consuming and requires workers. Billing consumers for energy consumption is not uniform. It is a tedious job for the electricity board official to manually go and take meter readings of big industrialists and reset their maximum demand after recording it. Even the latest energy meter is not tamper proof. Hence considering all these factors it is possible to design an energy meter that is tamper proof, supports automatic metering and billing system. Also at the same time helps in finding the energy theft in transmission lines. Considering all these features that can be done by a single energy meter it has called "RESOURCEFUL ENERGY METER".

The Resourceful energy meter will be an electronic device that will record consumption of electric energy and communicate the data collected to the electricity supplier for monitoring and billing. It typically records energy hourly or more frequently. The gathered statistics are then transmit to the supplier and corresponding billing calculation has done. Communications from the meter to the network may be wireless, or via fixed wired connections such as power line carrier (PLC). Our project uses embedded GSM technology to transmit the data from meter to the service provider.

There are many motivations to improve energy efficiency. Reducing energy use reduces energy costs and may result in a financial cost saving to consumers if the energy savings offset any additional costs of implementing an energy-efficient technology. Reducing energy use is also seen as a solution to the problem of reducing greenhouse gas emissions. According to the International Energy Agency, improved energy efficiency in buildings, industrial processes and transportation could reduce the world's energy needs in 2050 by one third, and help control global emissions of greenhouse gases. Another important solution is to remove government-led energy subsidies that promote high-energy consumption and inefficient energy use in more than half of the countries in the world.

CONTENTS

LIST OF FIGURES

LIST OF IMAGES

Chapter 1

Background

Thomas Alva Edison (1847-1931), who introduced the first electrical distribution systems for lighting using direct current, held that electricity must be sold just like gas – also used extensively for lighting at that time.

His 'electric meter' patented in 1881 (USA patent No. 251,545) used the electrochemical effect of current.

It contained an electrolytic cell, into which an accurately weighed strip of copper was place at the beginning of the billing period. The current passing through the electrolyte caused a deposition of copper. At the end of the billing period, the copper strip was weigh again, and the difference represented the amount of electricity that had passed through. The meter was calibrate so that the bills could be render in cubic feet of gas.

These meters remained in use until the end of the 19th century. There was, however, one large drawback – meter reading was difficult for the utility and impossible for the customer. Edison later added a counting mechanism to aid meter reading.

There were other electrolytic meters, like the German Siemens-Sucker hydrogen meter and the Schott & Gen. Jena mercury meter. Electrolytic meters could measure only ampere-hours and were not suitable when the voltage fluctuated.

Aron's pendulum meter, 1884

History

"The great invention of the nineteenth century was the method of invention". This maxim from the English mathematician and philosopher Alfred North Whitehead (1891-1947) perfectly applies to the history of the electricity meter, perfected through a series of inventions building on achievements and stimulating further development.

In past years, the most common type of electricity meter was the electromechanical induction watt-hour meter. The electromechanical meter operates by counting the revolutions of a non-magnetic, but electrically conductive, metal disc that is made to rotate at a speed proportional to the power passing through the meter. The number of revolutions is thus proportional to the energy usage.

From previous decade, electronic meters were widely used. Electronic meter display the energy used, on an LCD or LED display, and some can transmit readings to remote places. In addition to measuring energy used, electronic meters can also record other parameters of the load and supply such as instantaneous and maximum rate of usage demands.

Today Solid-state energy meters are being used. Solid-state energy meter has a power supply, a metering engine, a processing and communication engine (i.e. a microcontroller) and other add-on modules such as RTC, LCD display, communication ports/modules and so on.

The metering engine is given the voltage and current inputs, has a voltage reference, samplers, and quantizes followed by ADC section to yield the digitized equivalents of all the inputs. These inputs are then processed using a digital signal processor to calculate the various metering parameters such as powers, energies etc.

The processing and communication section has the responsibility of calculating the various derived quantities from the digital values generated by the metering engine. This also has the responsibility of communication using various protocols andinterface with other add-on modules connected as slaves to it.

Introduction

An electricity meter or energy meter is a device that measures the amount of electric energy consumed by a residence, business, or an electrically powered device. However, sometimes the limited functionality of these meters restricts their area of application; especially in inaccessible positions or in the area.

A possible solution is a Wireless Energy Meter (WEM) that is able to send its data via wireless communication to a PC or a remote device where monitoring and analysis of the data will be easily made.

This measurement system aimed to be use in measuring energy related quantities such as units consumed, consumed power, active load etc. of a house.

- The present system of energy metering as well as billing in India use electromechanical and somewhere digital energy meter.
- It consumes more time and labor.
- One of the prime reasons is the traditional billing system that is inaccurate.
- Many times slow, costly and lack in flexibility as well as reliability.
- Today accuracy in electricity billing is highly recommended.
- The Resourceful energy meter gives real power consumption as well as accurate billing.
- It provides real time monitoring of electricity uses.
- It is less time consuming and cost effective.

1.1 Descriptions of Device Used:

Resourceful Energy Meter that the users will be able to monitor their current power consumptions (bill) anytime from anywhere by using their mobile phone via Short Message Services (SMS). It would be a huge beneficial for the customers if they can monitor their energy meter's power consumptions (bill) on a real-time basis. Arduino UNO, main controller, was the interface between energy meter and Global System for Mobile communication (GSM) module. GSM module connect the energy meter to users' mobile phone. Real Time Clock (RTC) DS1307 was use to get the real time to count and store the usage into the EEPROM. The program developed in C language with the Arduino syntax in the Arduino IDE. The proposed system demonstrated its capability to check the current usage (bill), notify when reaching the limit, reset the usage (bill) successfully, only via accessing GSM-based mobile phone. Keywords: Energy Meter, Global System for Mobile Communication (GSM), Arduino, Short Message Services (SMS), and Real Time.

RTC is the heart of this system. All operations are done using real time clock. This meter consist of digital clock, implemented using DS1307 IC.

This document describes the design and implementation of a digital GSM based resourceful Energy Meter based on AVR microcontroller. Sending details to consumer or utility company through SMS using GSM network by the microcontroller is a distinct feature of this project.

AD7751 is used to measure the real power and convert it into frequency for further analysis.

IC AD7751 is used to measure the real power consumed by consumer. The IC uses current transformer to measure the current, which is proportional to current flowing through load. A resistive network is used to sense the proportional voltage, delivered at load. Then real power is converted into frequency. This frequency is given to controller via opt coupler.

AVR ATmega32 is used for processing and controlling all external peripherals connected to the microcontroller. Microcontroller calculates the consumed energy from frequency provided by AD7751. Two timers: Timer0 and Timer1 are used.

Timer1 is used to calculate period of 15 seconds. The seconds are provide by RTC. SEM consist of GSM module sim300. This module is use to send information related to consumed energy and bill to the consumer's mobile phone and to the utility company. When a when we call to the meter, meter disconnects it and sends SMS back to the registered number along with detail information.

1.2 Overview:

In present time, Electricity is the necessary thing in the world for human life. Today every home, offices, companies, industries have electricity connection. Today we are here to discuss about next Atmega328 based project namely Resourceful Energy Meter using Atmega328 and GSM. In this project, we first recharge our electricity meter just like prepaid mobile phone and then we can use electricity in hour house or offices. This system is automated. It will disconnect the home power supply connection, if there is low or zero balance in the system. Moreover, this system will send some updates to user mobile phone like low balance alert, zero balance cut off alert and recharge alert.

1.3 Importance:

Resourceful Energy Meter is a very useful tool in todays, world and proves to be of great importance. It keeps the consumer alert about the behavior of electric supply in home.

For example when there is a low balance remaining, the GSM module sends a signal to the consumer via sim connection to the mobile. It also gives a message when the system is ready or if the system is being cutoff due to zero balance. As a result the

Consumer always has an update about the electric supply in his home, which is achieve through wireless communication, which proves to be very handy and easy way to be connected. The customer can easily recharge the electric supply from anywhere throughout the world.

Hence, this type of tool proves to be of great importance where the customer gets all the updates of electricity and accordingly he can achieve the communication to maintain the electric supply in his residence.

1.4 Features:

1) Resourceful energy meter.
2) AI (Artificial Intelligence).
3) Efficient Energy consumption.
4) Messaging alerts.
5) Record generation.
6) Wireless communication achieved.
7) Two way communication between the customer and the supplier.
8) Easy recharge of the module through anywhere in the world.
9) Notification of alert to the consumer.
10) Resourceful usage of electricity with the help of notifications.

Some other Features:

- Highly accurate.
- Real time operation.
- Fully automated.
- Live billing display facility.
- Previous units display facility.
- Get bill detail in one missed call.

Chapter 2

2. Literature Survey:

In traditional electricity billing a meter, reader goes from home to home to get the readings and write down it, manually. These readings are brought to Electricity administration office. As per the standards, utility billing is apply on the numbers of units consumed. The employee of the utility goes from home to home again and gives the bill slips of the utility to the every consumer. There are many flaws in traditional billing system. Some human error may also occur in manual billing. Analyzing the traditional billing some of the common observed errors and flaws are: It is a time consuming procedure. There is a possibility of human error and flaws while taking the manual meter reading.

There is no procedure for balanced verification of meter reading. There is always a possibility of theft and corruption. Consumer may not get the bill slip within the due date. As traditional billing contains wastage of time and resources as well, in auto billing system there is no more need of the manual meter readings and bill slips. Home energy management system (HEMS) that we developed takes plain energy management mechanism, so that it can be realized more easily. It needs user's minimal decision and activity for correct judgment. It also uses Automatic Meter reading (AMR) network based on power line communication (PLC). In order to share information with customer ZigBee module is also used. A ZigBee advance-metering infrastructure is a present one for automatic meter data collection and energy auditing and management. In the ZAMI, the system works with multiple channels and frequency hopping and coexists with potential interferers. In this method if any tariff variation is present then, the new tariff rate will be change only through reprogramming the microcontroller otherwise the previous tariff rate will be displayed on the LCD display. This may cause errors in billing. The electricity board gives no intimations to the customer regarding the status of energy consumption. There is no information about the previous month's consumption and the amount of bill paid. We are going to focus about these drawbacks and overcome in our paper.

Chapter 3

3. Software Requirements Specification:

3.1) Components Used:

1. Arduino with Atmega328 IC
2. GSM Module
3. 16x2 LCD
4. Energy Meter
5. Optocoupler 4n35
6. Resistors
7. POT
8. Connecting wires
9. Load
10. SIM card
11. Power supply
12. Mobile Phone

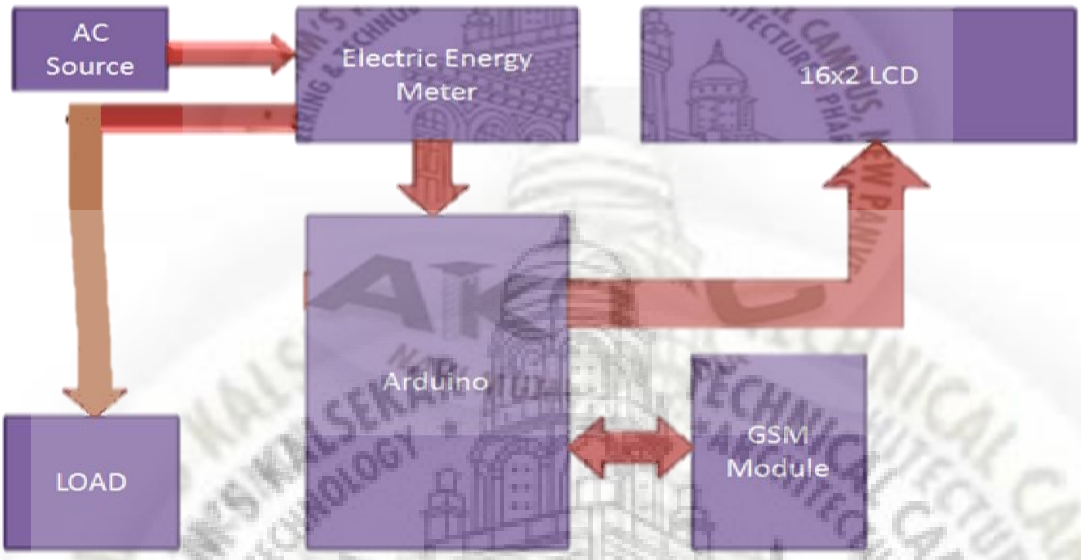
3.2) Technology Used

For Resourceful energy meter, we use the GSM module, which consists of RX and TX pins. With the help of these pins, we can achieve communication between the GSM and the energy meter. GSM has a sim card installed in which helps to send the notifications of alert to the consumer.

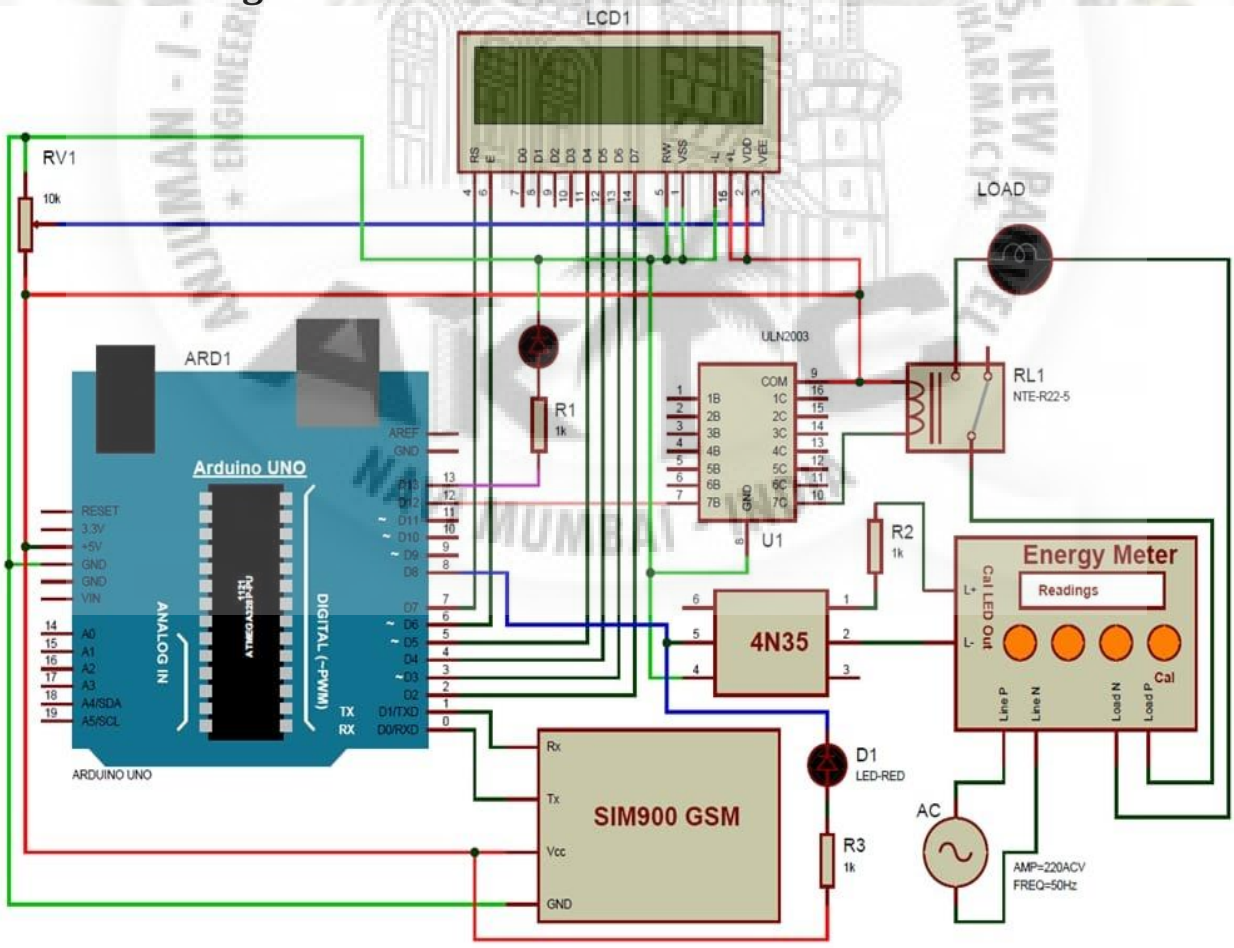
The working of GSM module depends upon the programmer setup. We have to develop programmer according to the requirement, which is suitable for the communication. Therefore, Programmed is developed and the module works accordingly.

The consumer will receive message with different intervals of times depending upon the coding done in the programmer.

3.3 Block Diagram



3.4 Circuit Diagram



Chapter 4

4. Requirement Analysis:

- GSM module
- LED (16*2) display
- Adapters
- Digital energy meter
- Bulb(12 Watt)
- IC ATMEGA 328 , relay , buzzer, capacitors, switches.
- Power supply

Chapter 5

5. System Design

5.1 Hardware Implementation:

The system requires n number of materials as mentions above in the analysis. The materials need to be connected in a way because of which we achieve the required working of the system.

First, we have a PCB upon which we connect all the required devices. These devices are connected on PCB and arranged according to the circuit diagram with the help of soldering. Soldering helps to do both the functions, to connect the devices and provide the connectivity according to the circuit diagram.

GSM module is readily available in the market, hence it is connected to the circuit through the wire and the digital meter is also connected to the power supply side of the PCB and connected to the power supply through adapter.

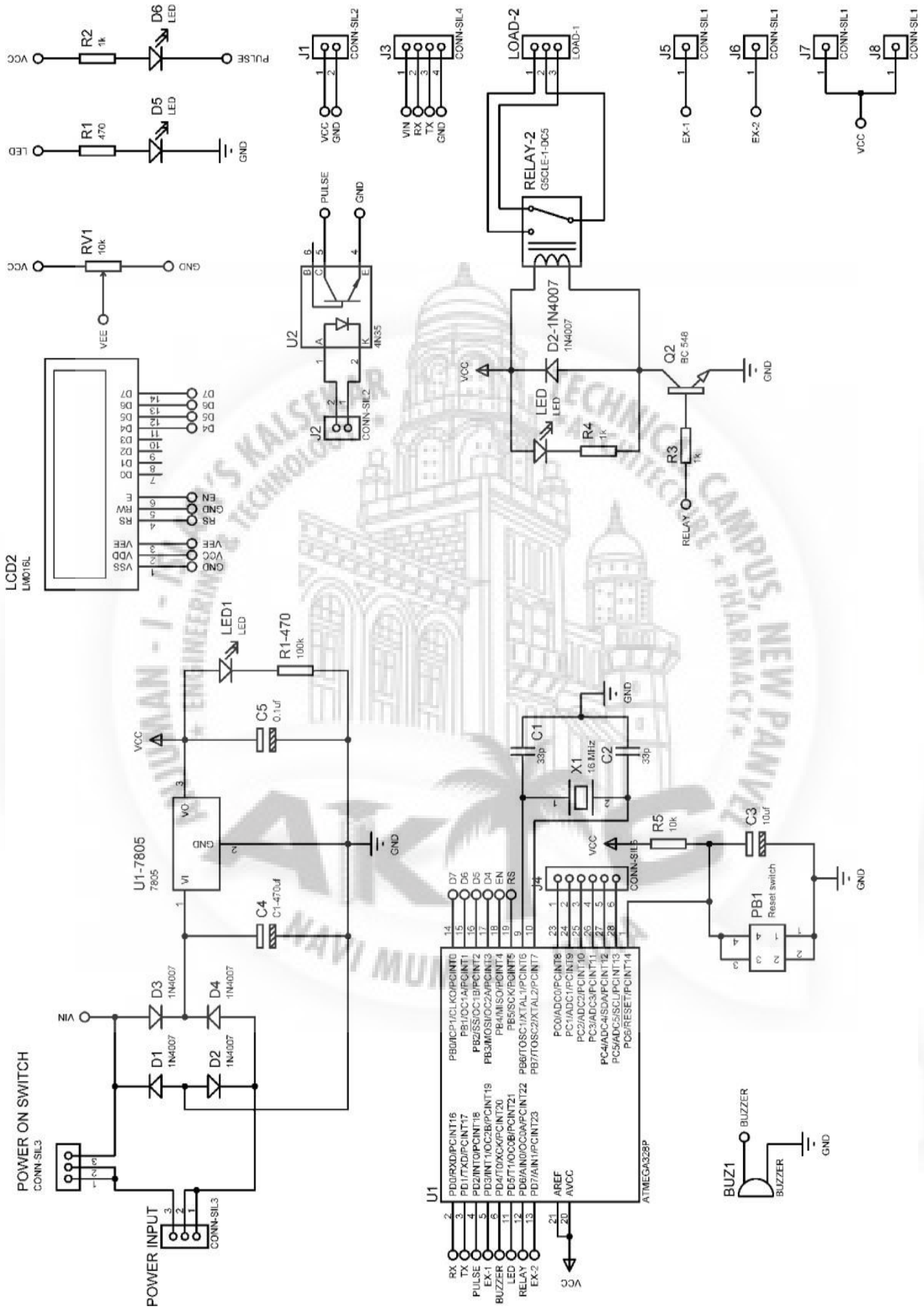
5.1.1 Printed Circuit Board:

- P.C.B. is printed circuit board, which is of insulating base with layer of thin copper-foil.
- The circuit diagram drawn on the P. C. B. with permanent marker and then it is dip in the solution of ferric chloride so that unwanted copper is remove from the P.C.B., thus leaving components interconnection on the board.
- The specification of the base material is not important to know in most of the application, but it is important to know something about copper foil which is drawn through a thin slip.
- The resistance of copper foil will have an effect on the circuit operation.
- Base material is made of lamination layer of suitable insulating material such as treated paper, fabric; or glass fibers and binding them with resin. Most commonly used base materials are formed paper bonded with epoxy resin.
- It is possible to obtain a range of thickness between 0.5 mm to 3 mm.

5.1.1.1 Printed Circuit Board (PCB) Diagram:

The circuit diagram required for PCB making is shown as follows. The circuit diagram is made in protease software, which, helps in implementation of project stimulation.

FIGURE 5.1.1.1


R2
1k
D6
LED
PULSE
R1
470
D5
LED
LED
GND
RV1
10k
VCC
GND
VEE
J1
CONN-SIL2
VCC
GND
J3
CONN-SIL4
VIN
RX
TX
GND
LOAD-2
LOAD-1
RELAY-2
G5CLE-1-DC5
J5
CONN-SIL1
EX-1
J6
CONN-SIL1
EX-2
J7
CONN-SIL1
J8
CONN-SIL1
VCC
PULSE
GND
U2
4N35
J2
CONN-SIL2
LCD2
LM016L
D2-1N4007
1N4007
Q2
BC 548
LED
LED
R4
1K
R3
1k
RELAY
LED1
LED
R1-470
100k
C5
0.1uf
U1-7805
7805
C4
C1-470uf
C1
33p
X1
16 MHz
C2
33p
R5
10k
C3
10uf
J4
CONN-SIL6
PB1
Reset switch
D3
1N4007
D4
1N4007
D1
1N4007
D2
1N4007
VIN
POWER ON SWITCH
CONN-SIL3
POWER INPUT
CONN-SIL3
U1
ATMEGA328P
BUZ1
BUZZER
BUZZER
GND

5.1.1.2 Fabrication of PCB:

- While designing a layout, it must be noted that size of the board should be as small as possible.
- Before starting, all components should be placed properly so that an accurate measurement of space can be made.
- The component should not be mounted very close to each other or far away from one another and neither one should ignore the fact that some component reed ventilation.
- The layout is first drawn on paper then traced on copper plate, which is finalized with the pen, or permanent marker, which is efficient and clean with etching.
- The resistivity also depends on the purity of copper, which is highest for low purity of copper. The high resistance path is always undesired for soldered connections.
- The most difficult part of making an original printed circuit is the conversion from, theoretical circuit diagram into wiring layout. Without introducing cross over and undesirable effect.
- Although it is difficult operation, it provides greater amount of satisfaction because it is carried out with more care and skill.
- The board used for project has copper foil thickness in the range of 25 40 75 microns.
- The soldering quality requires 99.99% efficiency.
- It is necessary to design copper path extra large. There are two main reasons for this,
- The copper may be required to carry an extra large overall current:-
- It acts like a kind of screen or ground plane to minimize the effect of interaction.
- The first function is to connect the components together in their right sequence with minimum need for interlinking i.e. the jumpers with wire connections.

  Permanent connection of mechanical parts may be done by using welding, soldering,

and gluing. Their essence is introduction of liquid phase between the parts to be connected (molten base metal in welding, molten solder in soldering, glue in gluing). The liquid wets the parts, gets in intimate interfacial contact with them arising intermolecular attractive forces. Then the liquid solidifies keeping the parts connected.

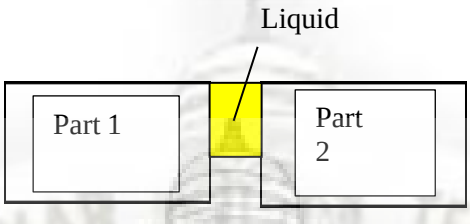


FIGURE 5.1.1.2

Soldering is a process by which the parts are joined using material (solder) with lower melting point than melting points of materials of joined parts. Welding is perform by melting of materials of joined parts. Glues are liquid materials that solidify as the result of chemical reaction or evaporation of solvent.

5.1.1.3 Thermal conductivity of PCB materials:

Material	Thermal conductivity, W/(m· K)
FR4	0.25
LTCC	2.5…4
HTCC	16…30 (Al_2O_3)
	180 (AlN)
	260 (BeO)
Copper	401

Table 5.1.1.3

- For soldering of any joints first the terminal to be solder are clean to remove oxide film or dirt on it. If required flux is applied on the points to be soldered.
- Now the joint to be solder is heat with the help of soldering iron. Heat applied should be such that when solder wire is touched to joint, it must melt quickly.
- The joint and the soldering iron are held such that molten solder should flow smoothly over the joint.
- When joint is completely covered with molten solder, the soldering iron is remove.

5.1.1.4 PCB Layout:

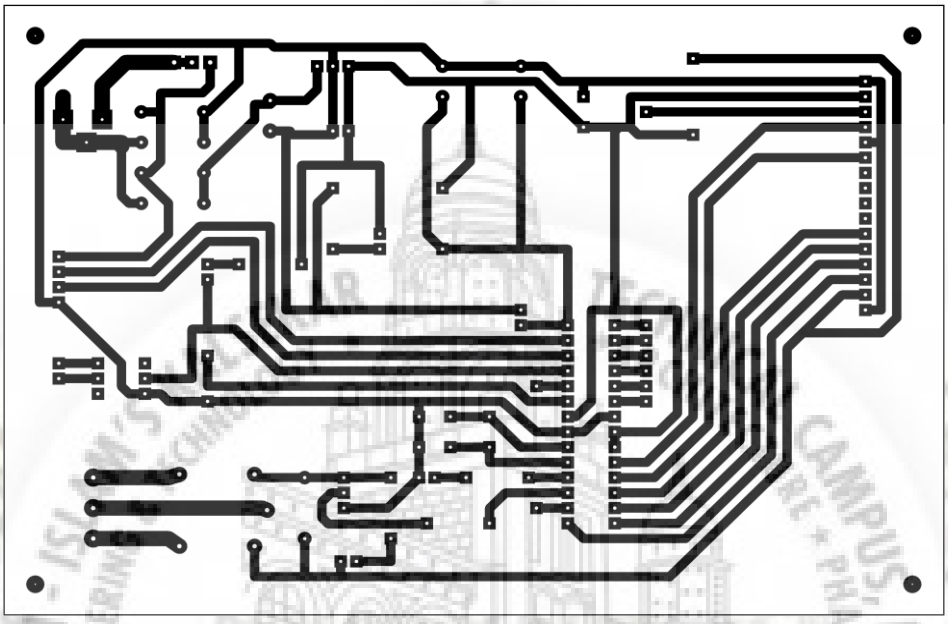


FIGURE 5.1.1.4

5.1.1.5 Components layout:

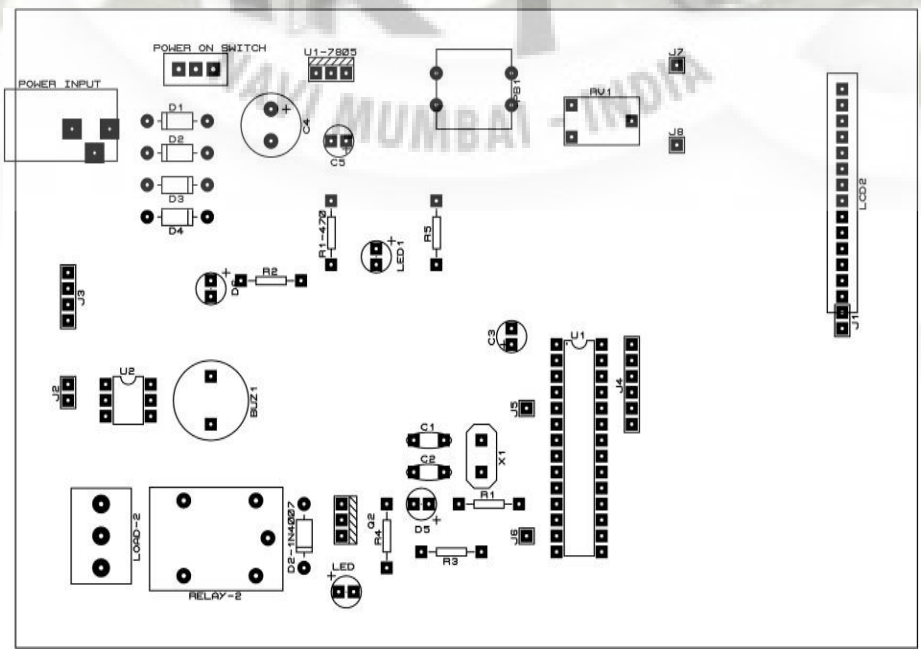


FIGURE 5.1.1.5

5.1.2 LCD:

LCD is use in the system to monitor the balance of the energy meter and the units consumed by the consumer. It is 16*2 type of LCD, which displays the required data to the consumer. It is readily available in the market and very cheap. Different types of LCD are available. LCD is connected in the PCB with help of a stand and fixed by a soldering iron.

FIGURE 5.1.2

5.1.2.1 LCD module:

LCD module is as shown in the figure which is a 16*2 type module used to show the required data to the consumer.

Any type of data including alphabets or numbers etc, can be displayed here.

5.1.2.2 Features:

- Operating Voltage is 4.7V to 5.3V.
- Current consumption is 1mA without backlight.
- Alphanumeric LCD display module, meaning can display alphabets and numbers.
- Consists of two rows and each row can print 16 characters.
- Each character is built by a 5×8 pixel box.
- Can work on both 8-bit and 4-bit mode.
- It can also display any custom generated characters.

5.1.2.3 PIN diagram

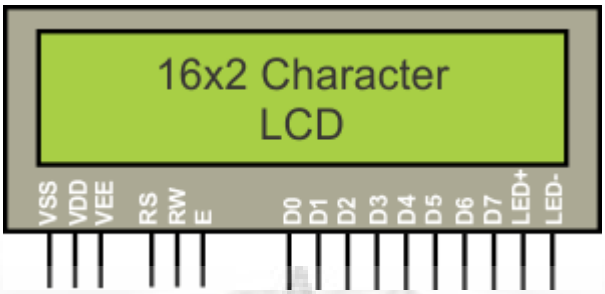


FIGURE 5.1.2.3

5.1.2.4 LCD pin diagram description:

Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL

5.1.2.5 Technical Data:

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day-to-day life, at either PCO's or calculators. The appearance and the pinouts have already been visualized above now let us get a bit technical.

16*2 LCD is name so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD. Therefore, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dot.

Now, we know that each character has (5×8=40) 40 Pixels and for 32 Characters we will have (32×40) 1280 Pixels. Further, the LCD should also be instructed about the Position of the Pixels. Hence, it will be a hectic task to handle everything with the help of MCU; hence, an interface IC like HD44780 is use, which is mount on the backside of the LCD Module itself. The function of this IC is to get the commands and data from the MCU and process them to display meaningful information onto our LCD Screen.

5.1.3 PIC Microcontroller Atmega 328

5.1.3.1 Description:

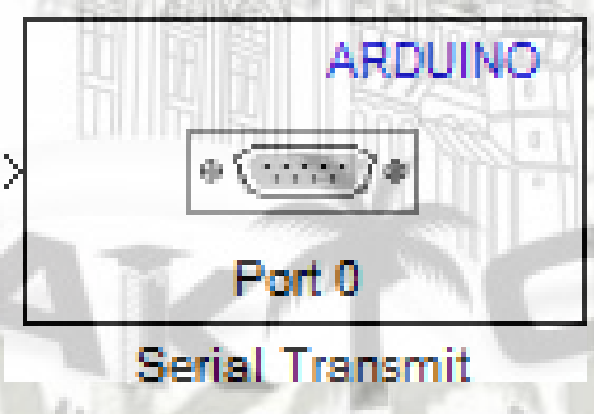


FIGURE 5.1.3.1

Send buffered data to the specified serial port. For more information, see Use Serial Communications with Atmega328 Hardware. The Atmega328 hardware has one serial port device, serial port 0, connected to the digital pins marked TX 1and RX 0. If you set the **Port number** parameter to zero, this block transmits over the digital pin marked TX 1.

The block input accepts vector or scalar uint8 data. To convert a data source to uint8, use a Data Type Conversion block.

During simulations without the hardware, this block does nothing. If you use this block in models with the Standard Servo Read, Standard Servo Write, and Continuous Servo Write blocks, use longer sample times to avoid overruns.

5.1.3.2 PIN diagram Atmega 328:

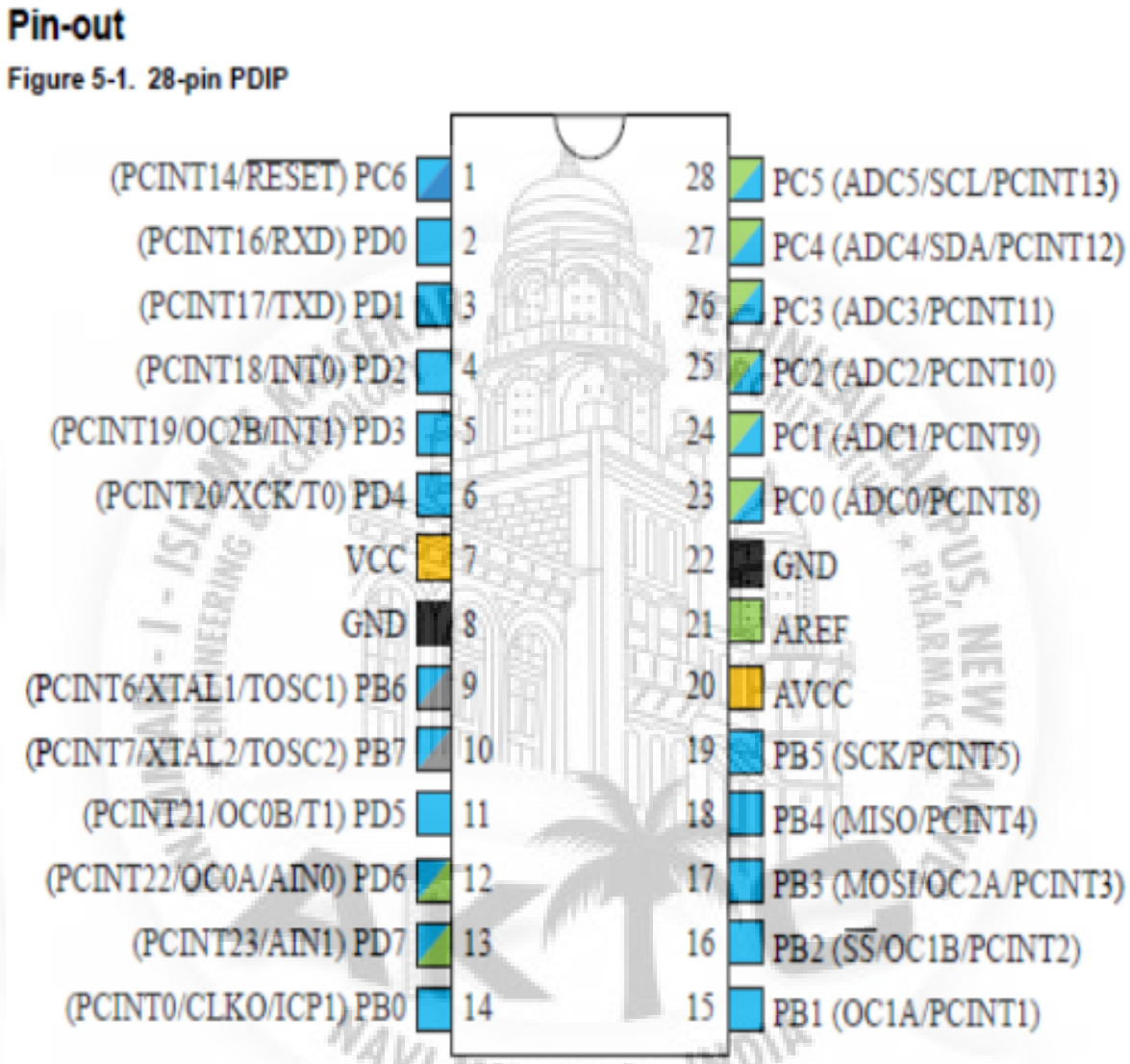


FIGURE 5.1.3.2

5.1.3.3 Ports of Atmega 328:

You can use serial port 0 to communicate with other devices that have serial ports, or to communicate with a computer over the USB port. Each serial port supports one Serial Transmit and one Serial Receive block, one block per pin.To know pin mapping for the supported Atmega328 hardware.

➢ Transmit Serial Data:

To transmit data through a serial port or USB port on the Atmega328 hardware:

1. Add the Serial Transmit block to your model.
2. Connect a data source to the block input on the Serial Transmit block. If the data type is not uint8, use a Data Type Conversion block to convert it to uint8.
3. In the Atmega328 Serial Transmit block, select a **Port number**.
4. Click the Tools menu in the model, and select Run on Target **Hardware**>**Options**. In the Configuration Parameters dialog that opens, on the Run on Target Hardware pane, set the baud rate for the serial port you selected in the Atmega328 Serial Transmit block.
5. Connect the appropriate digital transmit pin to the hardware that receives the data.
6. Run the model, as described in Run Model on Atmega328 Hardware.
7. If your model uses the Atmega328 USB port (Serial port 0) to transmit data to a device.

➢ Port Number:

- Enter the number of the serial port.
- Click **View pin map** to open the Atmega328 Pin Mapping table.
- To know about the fixed ports and the allocated pins for the block, see Pin Mapping on Atmega328 Blocks.
- You can assign a Serial Transmit block and a Serial Receive block to the same serial port.
- Do not assign multiple Serial Transmit blocks to the same serial port.
- Do not assign the pin numbers used by the serial port to other blocks within the model.
- Serial port 0 is connect to the USB port through a converter. Do not use both serial port 0 and the USB port at the same time. For example, do not use serial port 0 if you intend to use External mode, because External mode requires the USB port.

➢ Receive Serial Data:

To receive data through a serial port or USB port on the Atmega328 hardware:

1. Add the Serial Receive block to your model.
2. On the Atmega328 Serial Receive block, connect the **Data** block output to a block that uses the data.
3. Open the Atmega328 Serial Receive block and specify the **Port number**.
4. Click the **Tools** menu in the model, and select **Run on Target Hardware**>**Options**. In the Configuration Parameters dialog that opens, on the Run on Target Hardware pane, set the baud rate for the serial port you selected in the Atmega328 Serial Receive block.
5. Connect the digital receive pin to the hardware that transmits the data.
6. Run the model, as described in.

Get one byte of data per sample period from the receive buffer of the specified serial port. For more information, see Use Serial Communications with Atmega328 Hardware.

The Serial Receive block has two outputs, **Data** and **Status**.

When data is available:

- The **Data** block output emits data from the serial receive buffer.
- The **Status** block output emits one.

When data is not available:

- The **Data** block output emits 255.
- The **Status** block output emits zero.

The **Data** block output emits uint8 values. The **Status** block output emits into values. You can use the Status block output to determine whether a value of 255emitted by the **Data** port is data, or an indication that no data was received.

During simulations without the hardware, this block emits zeroes.

5.1.3.4 Programming Input and Output:

The Atmega328 can be programmed using Arduino software, which uses Java or C++. The programming used in the project is to measure the analog value of sensors, and to correspondingly provide the digital code. The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and derives from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development.

It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is capable of compiling and uploading programs to the board with a single click. A program or code written for Atmega328 is called a sketch. Atmega328 programs are written in C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a runnable cyclic executive program:

- setup(): a function run once at the start of a program that can initialize settings
- loop(): a function called repeatedly until the board powers off

5.1.4 Power Supply:

Power supply is given to the system with the help of adapter, which is connected to the pcb which makes the digital meter and also the GSM module ON. After the circuit is on the system starts its functioning according to the programming done. The power supply specification is general (230V/50Hz). This power supply is AC but the circuit operates on DC thus there is a full wave bridge rectifier on the power supply output followed by the capacitor which converts the AC signal into a pure DC signal.

5.1.5 GSM module

5.1.5.1 Introduction:

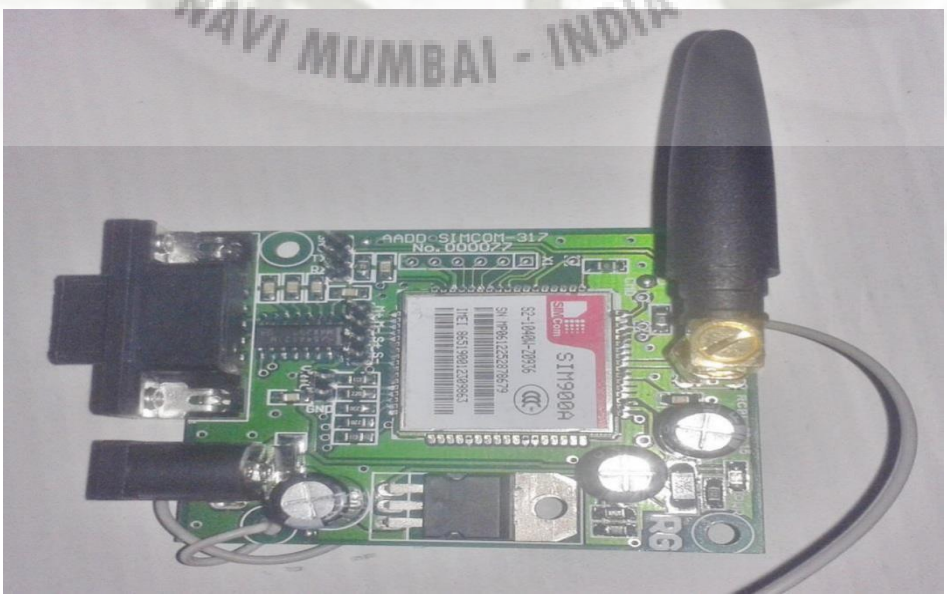


FIGURE 5.1.5.1

SIM900 designed by using single-chip processor integrating AMR926EJ-S core

Quad - band GSM/GPRS module in small.

GPRS Enabled

AT Command: AT means ATTANTION. This command is use to control GSM module. There are some commands for calling and messaging that we have used in this project for sending message.

For testing GSM Module we used AT command. After receiving AT Command GSM Module, respond with OK. It means GSM module is working fine.

ATE0→ For echo off

AT+CMNI=2, 2,0,0,0 <ENTER>→ Auto opened message Receiving. (No need to open message)

ATD<Mobile Number>; <ENTER>→ making a call (ATD+919610126059;\r\n)

AT+CMGF=1 <ENTER>→ Selecting Text mode AT+CMGS="Mobile Number" <ENTER> → Assigning recipient's mobile number

>>Now we can write our message

>>After writing message

Ctrl + Z → send message command (26 in decimal). ENTER=0x0d in HEX

Working:

when we power up the system then it will read previous values of rupees stored in EEPROM and restores them to variables then check the available balance with the predefine value and take action according to them like if available balance is greater than 15 rupees then Atmega328 turned On the electricity of connection of home or office by using relay. In addition, if balance is less than 15 rupees then Atmega328 send message to user phone of low balance alert and requesting to recharge soon. In addition, if balance is less than 5 rupees then Arduino turned off the electricity

connection of home and send a SMS to user phone for connection cut alert and requesting recharge soon.

Now when we need to recharge our system we have to send a SMS using our cellphone

to the system with some prefix like #45*.

System receives this message, extract recharge amount, and update balance of system. Moreover, system again turned on the connection of house or office.

Calculation:

Before proceeding calculation first, we have to keep in mind the pulse rate of energy meter. There are two pulse rate of energy meter first is 1600 imp/kwh and second is 3200 imp/kwh. So here, we are using 3200 imp/kwh pulse rate energy meter.

5.1.5.2 Applications

Access control devices:

Now access control devices can communicate with servers and security staff through SMS messaging. "Complete log of transaction is available at the head office Server instantly without any wiring involved and device can instantly alert security personnel on their mobile phone in case of any problem. Ion able is introducing this technology in all Fingerprint /Access control and time attendance products. You can achieve high security any reliability.

Transaction terminals:

'1" machines, P2S terminals can use SMS messaging to confirm transactions from central servers. The main benefit is that central server can be anywhere in the world. Today you need local servers in every city with multiple telephone lines. 0ou save huge infrastructure costs as well as per transaction cost.

Supply Chain Management:

Today S"M re3uire huge infrastructure with leased lines, networking devices, data center, work stations and still

You have large downtimes and high costs. 0ou can do all this at a fraction of the cost with GSM M&M technology.

5.1.5.3 Features

- Improved spectrum efficiency.
- International roaming.
- Compatibility with integrated services digital network (ISDN).
- Support for new services.
- Phonebook management.
- Fixed dialing number (FDN).
- Real time clock with alarm management.
- High-quality speech.

5.2 Software implementation

5.2.1 Proteus software:

Proteus is a Design Suite also known as Virtual System Modeling (VSM) offering the ability to simulate micro-controller code and circuits.

So if you are willing to design hardware and software this is a great tool to start with, In this case Proteus ISIS is for simulation from the schematic form of the hardware and

the micro-controller code. It is possible to develop and test designs before a physical prototype is constructed.

I think that says it all about what Proteus is and it is for (can be used for more things).

Proteus ISIS combines ease of use with powerful editing tools as a very high degree of control over the drawing appearance, in terms of line widths, fill styles, fonts, etc... It is capable of supporting schematic capture for simulation.

As for Proteus ARES is for PCB designs to make your own devices using the PCB layout tools and provides a powerful, integrated and easy to use suite of tools for professional PCB Design.

5.2.2 Source Code:

The below mentioned code is the code used in the GSM module to run the programmer The code was design in order to get the required out put in a sequence.

This code also helps in displaying message from the LCD monitor and beeps from the buzzer etc. all other parts to perform their functions on their time.

```
#include<EEPROM.h> #include
<LiquidCrystal.h>

#define led         5

#define buzzer      4

#define pulsein     2

#define relay       6

unsigned int pusle_count      = 0;

unsigned int rupees           = 0;

unsigned int temp             = 0;

unsigned int i                = 0;

unsigned int x                = 0;

unsigned int k                = 0;

float units                   = 0;

float watt_factor             = 0.3125;

char flag1                    = 0;

char flag2                    = 0;

char rec                      = '0';

char str[200];

String bal                    = "";

String number                 = "+919594384778";

LiquidCrystal lcd(13, 12, 11, 10, 9, 8)
void setup()
  {
  Serial.begin(9600);
  lcd.begin(16,2);
```

```
pinMode(led    ,    OUTPUT);
pinMode(buzzer  ,  OUTPUT);
pinMode(pulsein  ,  INPUT  );
pinMode(relay , OUTPUT);

digitalWrite(pulsein, HIGH);

lcd.clear();
lcd.setCursor(0,0);  lcd.print("
Prepaid Energy ");
lcd.setCursor(0,1);

lcd.print("Meter");
beep();
delay(2000);

lcd.clear();
lcd.setCursor(0,0);
lcd.print("GSM Initilizing ");

gsm_init();

lcd.clear();
lcd.setCursor(0,0);  lcd.print("
            System Ready   ");

Serial.println("AT+CNMI=2,2,0,0,0");
Serial.println("AT+CMGF=1");
delay(200);
Serial.print("AT+CMGS=\"");
delay(200);
Serial.print(number);
delay(200);
Serial.println("\"");
delay(200);
Serial.print("System  Ready");
delay(200);  Serial.write(26);
delay(1000);

digitalWrite(led,  LOW);
lcd.clear();
beep();
beep();
beep();
// EEPROM.write(1,0);
// rupees = EEPROM.read(1);
}

void loop()
{
while(Serial.available())
{
char  ch  =  (char)Serial.read();
str[i++] = ch;
if(ch == '*')
{
temp  =  1;  lcd.clear();
lcd.setCursor(0,0);
lcd.print("Message       Received");
delay(500);
beep();


while(Serial.available())
{
char ch = (char)Serial.read();
}
break;}}
```

```
rupees   =   EEPROM.read(1);
units     =     rupees/5.0;
lcd.setCursor(0,0);
lcd.print("Units       :");
lcd.print(units);
lcd.print("           ");
lcd.setCursor(0,1);
if(rupees < 15)
{

}
else
{
  lcd.print("Balance     :");
}
lcd.print(rupees);
lcd.print("         ");
read_pulse();
check_status(); if(temp
== 1)
{
  decode_message();
  send_confirmation_sms();
}
}

void gsm_init()
{
boolean  at_flag  =  1;
while(at_flag)
{
Serial.println("AT");
delay(100);
while(Serial.available()>0)
{
 if(Serial.find("OK"))
{
at_flag = 0;
    }
}
delay(100);
}

boolean  echo_flag  =  1;
while(echo_flag)
{
Serial.println("ATE0");
delay(100);
while(Serial.available()>0)
{
if(Serial.find("OK"))
echo_flag = 0;
}
delay(100);
}

boolean net_flag =
1; while(net_flag)
{
Serial.println("AT+CPIN?");
delay(100);
while(Serial.available()>0)
{
if(Serial.find("+CPIN: READY"))
net_flag = 0;
```

```
delay(100);}
boolean text_mode_flag = 1; while(text_mode_flag)
{
Serial.println("AT+CSMP=17,167,0,0");
delay(100); while(Serial.available()>0)
{

   text_mode_flag = 0;
}
delay(100);
}

while(Serial.available()>0)
{
rec = Serial.read();
}
}

void read_pulse()
{
if(!digitalRead(pulsein))
{
digitalWrite(led, HIGH);
//count++;
//units=watt_factor*count/1000;
if(units < 1)
{

}
else
{
units--;
}
rupees=units*5;
EEPROM.write(1,rupees);
while(!digitalRead(pulsein)){
}
digitalWrite(led,LOW);
// delay(2000);}}
void check_status()
 {
 if(rupees > 15)
 {
digitalWrite(relay,   HIGH);
flag1 = 0;
flag2 = 0;
}
Serial.println("Energy Meter Balance Alert:");
delay(200);
Serial.print("Low Balance: ");
delay(200);
Serial.print(rupees);
delay(200);
 Serial.println(" Rs remaining.");
 delay(200);

 Serial.println("Please recharge your energy meter soon.\n\nThank you");
 delay(200);
 Serial.write(26);
 lcd.clear();
 lcd.print("   Message Sent   ");
 delay(1000);
 flag1=1;
 }
 if(rupees<5 && flag2==0)
 {
```

```
digitalWrite(relay,   LOW);
beep();
beep();
lcd.clear();
lcd.print("Light  Cut  Due  to");
lcd.setCursor(0,1);  lcd.print("
             Low   Balance   ");
delay(2000);
lcd.clear();
lcd.print("Please   Recharge");
lcd.setCursor(0,1);
lcd.print("UR  Energy  Meter  ");
Serial.println("AT+CMGF=1");
delay(200);
Serial.print("AT+CMGS=\"");
delay(200);
Serial.print(number);
delay(200);
Serial.println("\"");
delay(200);
Serial.println("Energy  Meter  Balance  Alert:\nLight  cut  due  to  low
Balance\nPlease recharge your energy meter soon.\n\nThank you");
delay(200);
Serial.write(26);
lcd.clear();
lcd.print("   Message Sent   ");
delay(1000);
flag2 = 1;
}
}

void decode_message()
{
x = 0, k = 0, temp =
0; while(x < i)
  {
 if(str[x] == '#')
   {
 x++;
 bal = ""; do
     {
 bal += str[x++];
        }while(str[x]     !=
   '*');     goto here;
   }
   x++;
}
here: x = x;
//bal += '\0';
}

void send_confirmation_sms()
{
int  recharge_amount  =  bal.toInt();
rupees += recharge_amount;
EEPROM.write(1, rupees)
```

```
rupees = EEPROM.read(1);
lcd.clear();
lcd.print("  Energy Meter  ");
lcd.setCursor(0,1);
lcd.print("Recharged:");
lcd.print(bal);
Serial.println("AT+CMGF=1");
delay(200);
Serial.print("AT+CMGS=\"");
delay(200);
Serial.print(number);
delay(200);
Serial.println("\"");
delay(200);
Serial.print("Energy Meter Balance Alert:\nYour energy meter has been
recharged with: ");
delay(200);
Serial.print(bal);
delay(200);
Serial.println(" Rs");
delay(200);
Serial.print("Total Balance is: ");
delay(200);
Serial.print(rupees);
delay(200);
Serial.println(" Rs");
delay(200);
Serial.println("Elctricity has been connected.\n\nThank you");
delay(200);
Serial.write(26);
temp = 0;
i = 0;
x = 0;
k = 0;
memset(str,0, sizeof str);
delay(1000);
lcd.clear();
lcd.print("  Message Sent  ");
delay(1000);
}

void beep()
{
  digitalWrite(led,
HIGH);
digitalWrite(buzzer,
HIGH);        delay(150);
digitalWrite(led,   LOW);
digitalWrite(buzzer,
LOW); delay(150);}
```

Chapter 6

6. System testing

6.1 Test Cases and Test Results:

Test ID	Test Case Title	Test Condition	System Behavior	Expected Result
T01	Power supply testing	Switch on or off	System is ON and OFF	System should working according to switch
T02	Receiving and transmitting	GSM signal	System gets the message through GSM	Receiving and transmitting should be achieved
T03	Notification to mobile	Balance remaining	Mobile receives a notification	GSM should send alert notification

Chapter 7

7. Project Planning:

- The Resourceful Energy Meter proves to be very helpful in keeping the consumer alert as nowadays there is a lot more usage of energy
- It helps in reducing the energy wastage
- We can use this type of energy meters in bungalows, residences, flats, or buildings or in big industrial areas
- This energy meter can be modified more and an app can be developed where the customer can keep an eye on the analysis of usage of energy day by day
- The apps may help to reduce the wastage of energy and hence reduce the energy bills which can then be termed as a SMART USAGE of energy.

Chapter 8

8. Implementation:

On the application level the RESOURCEFUL ENERGY METER can be implemented on the energy meter section of the consumer . This may be done by the electric suppliers side. And all we need is to provide a sim card at the meter end to recharge our ENERGY METER time to time.

Chapter 9

9. Meter

IMAGE CAPTION 1

9.1 PCB

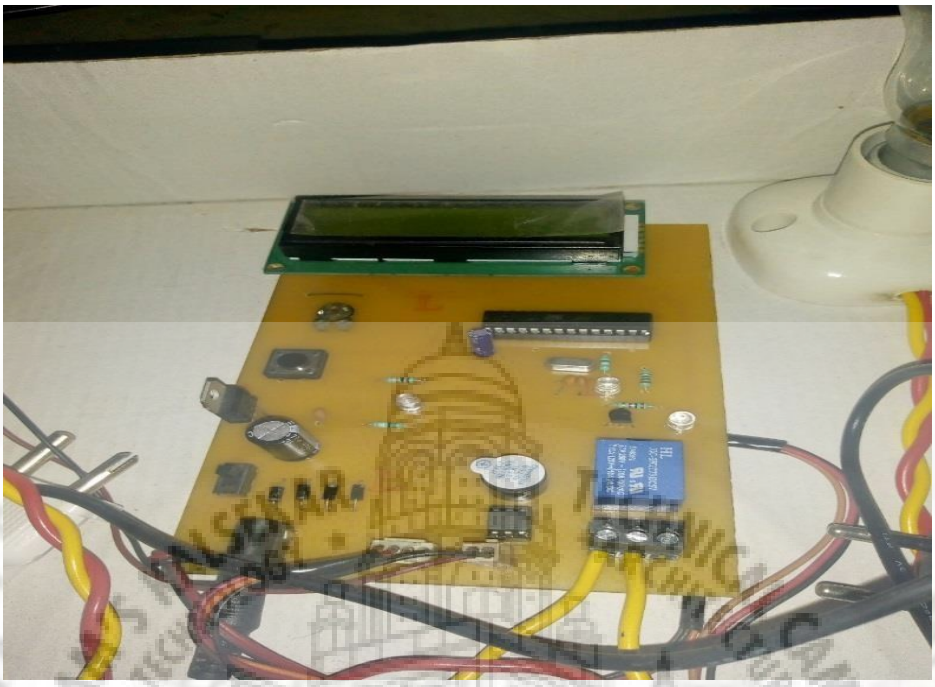


IMAGE CAPTION 2

9.2 GSM module

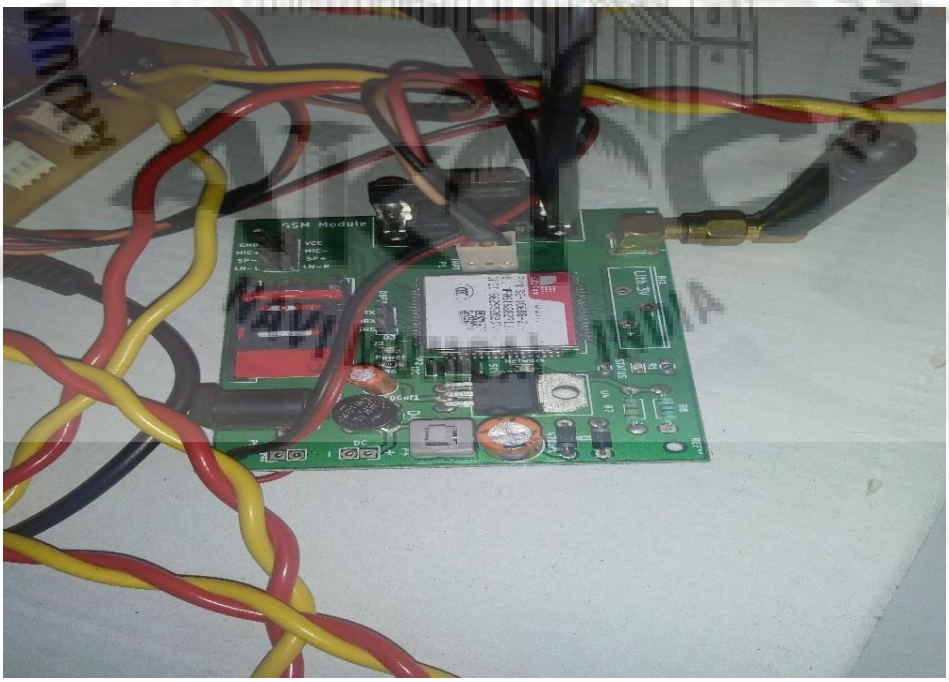


IMAGE CAPTION 3

Chapter 10

Conclusion and Future Scope

10.1 Conclusion:

Hence we realize that the use of Resourceful energy meter using GSM techniques is very essential tool in nowadays to save energy and prevention from wastage of energy.

1. This all results in reduced energy bills which proves to be consumer friendly.
2. Also the consumer can recharge trough any part of the world.
3. Theft of energy is also prevented.
4. Overall it lets the customer consume the energy only according to his needs.

10.2 Future scope:

1. The Resourceful energy meter can be used by developing an app which provides all the data related to the consumption of energy hour by hour or day by day.

2. Alert messages can be send through voice notes to the customers mobile.

3. Buzzer can send an alarm on over usage of energy.

4. Energy limit for daily usage can be set etc, many other future scopes.

CHAPTER 11

11. References:

[1] Loss.P.A.V, Lamego. M.M and Vieira.J.L.F, "A single phase microcontroller based energy meter", IEEE Instrumentation and Measurements Technology conference St. Paul, Minessota, USA, May 18-21, 1998.

[2] Saptarshi De, Rahul Anand, A Naveen and SiratMoinuddin, "E-Metering Solution for checking energy thefts and streamlining revenue collection in India", Student Member, IEEE, 2003.

[3] monitoring systems".Power Engineering Conference, 2005. IPEC 2005. The 7th International, Vol., No., pp.1-147.

[4] Department of Electrical E[1] Loss.P.A.V, Lamego. M.M andVieira.J.L.F, "A single phase microcontroller based energy meter", IEEE Instrumentation and Measurements Technology conference St. Paul, Minessota, USA, May 18-21, 1998.

[5] Saptarshi De, Rahul Anand, A Naveen and SiratMoinuddin, "E-Metering Solution for checking energy thefts and streamlining revenue collection in India", Student Member, IEEE, 2003.

[6] Chandler, T. 2005. "The technology development of automatic metering and monitoring systems". Power Engineering Conference, 2005. IPEC 2005. The 7th International, Vol., No., pp.1-147.

[7] Ali Zaidi.S.K., "Design and implementation of low cost electronic prepaid energy meter", Multitopic Conference, 2008. INMIC 2008. IEEE International 2008.

[8] Syed Khizar Ali Zaidi I, HuraMasroor I, Syed Rehan Ashraf I and Ahmed Hassan, "Design and Implementation of Low Cost Electronic Prepaid Energy Meter", NED University of Engineering and Technology, Karachi, Pakistan, 2010.

[9] HuraMasroor I, Syed Rehan Ashraf I and Ahmed Hassan, "Design and Implementation of low cost Electronic Prepaid Energy Meter',NED University of Engineering and technology, Karachi, Pakistan, 2010.

[10] Jain and Bagree , "A prepaid meter using mobile communication" , International Journal of Engineering, Science and 164 Technology, Vol. 3, No. 3, 2011, pp. 160-166.