DESIGN AND IMPLEMENTATION OF HOME ENERGY METER

This Thesis submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

Submitted by

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CERTIFICATION

This is to certify that this project entitled “DESIGN AND IMPLEMENTATION OF HOME ENERGY METER” is done by the following students under my direct supervision. This project work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering, Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on December 2018.

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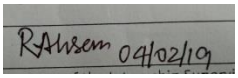

Signature of the supervisor

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Dr. Md. Rezwanul Ahsan
Assistant Professor, Dept. of EEE
Daffodil International University

Dedicated

To

Our Parents & Teachers

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LIST OF ABBREVIATIONS

DC	Direct Current
AC	Alternating Current.
LCD	Liquid Crystal Display
ADC	Analog-to-Digital Converter
IR	Infrared Receiver
IDE	Integrated Development Environment
IC	Integrated Circuit
LED	Light Emitting Diode
PCB	Printed Circuit Board
APFC	Automatic power factor control
PT	Potential transformer
ASCII	American standard code for information interchange

ACKNOWLEDGEMENT

First of all, we give thanks to Allah or God. Then we would like to take this opportunity to express our appreciation and gratitude to our project and thesis supervisor **Dr. Md. Rezwanul Ahsan, Assistant Professor** of the Department of Electrical and Electronic Engineering Faculty of Engineering of the Daffodil International University, for being dedicated to supporting, motivating and guiding us through this project. This project can't be done without his useful advice and helps. Also thank you very much for giving us the opportunity to choose this project. We also want to convey our thankfulness to **Dr.Md. Samsul Alam, Professor & Dean of the Department of EEE** for his help, support, and constant encouragement. Apart from that, we would like to thank our entire friends for sharing knowledge; information and helping us in making this project a success. Also thanks for lending us some tools and equipment. To our beloved family, we want to give them our deepest love and gratitude for being very supportive and also for their Inspiration and encouragement during our studies at this University.

ABSTRACT

With the headway in innovation, the quantity of electronic gadgets in our everyday lives has expanded to make life more straightforward. So a need to build an All-inclusive Remote Framework Proficient age of intensity at present is significant as wastage of intensity is a worldwide concern. Power estimates a framework's capacity proficiency and is a critical viewpoint in enhancing the nature of supply. In most power frameworks, a poor power coming about because of an expanding utilization of inductive burdens is frequently ignored. A power remedy unit would enable the framework to reestablish its capacity factor near solidarity for conservative operation .The points of interest of amending power incorporate decreased power framework misfortunes, expanded load conveying abilities, enhanced voltages and substantially more. Which can screen the vitality utilization of a framework and consequently enhance its capacity? An open source vitality checking library was executed in the plan for exact power count.

CHAPTER 1
INTRODUCTION

1.1 General Introduction

Electricity is one of the vital requirement for sustainment of comforts of life .It should be used very judiciously for its proper utilization. But in our country we have lot of localities where we have surplus supply for the electricity while many areas do not even have access to it. Our policies of its distribution are also partially responsible for this because we are still not able to correctly estimate our exact requirements and still power theft is prevailing.

On the other hand consumers are also not satisfied with the services of power companies. Most of the time they have complaints regarding statistical errors in their monthly bills. With the help of this project we are aiming to receive the monthly energy consumption from a remote location directly to a centralized office. In this way we can reduce human efforts needed to record the meter readings which are till now recorded by visiting every home individually.

The purpose of this project is to remote monitoring and control of the domestic energy meter. This system enables the electricity department to read the meter readings regularly without the person visiting each house.

1.2 History

The incredible innovation of the nineteenth century was the technique for creation. This adage from the English mathematician and thinker Alfred North Whitehead (1891-1947) superbly applies to the historical backdrop of the power meter. The main portion of the nineteenth century acquired splendid revelations electromagnetism. In1820, the French Andre-Marie Ampere (1775-1836) found the electro dynamic collaboration between flows. In 1827, the German Georg Simon Ohm (1787-1854) found the connection among voltage and current in a conductor. In 1831, the English Michael Faraday (1791-1867) found the law of acceptance, on which the activity of generators, engines and transformers is based Revelations were trailed by developments and licenses. The light, the dynamo, the engine, the transformer, the meter and the turbine were designed with hardly a pause in between.

It isn't astonishing that once the time is ready, achievement developments are accomplished semi all the while in various parts of the world. It was not clear, be that as it may, what the units charged ought to be, and what might be the most reasonable estimating standards. Ended up viable with the presentation of Edison's light, and this meter wound up out of date.

1.3 Project Objectives

As an issue of first significance, it can show consistent sharp building imperativeness profile, charging data accounting, and thievery and accuse acknowledgment. With the progress of advancement, objectives of essentialness meters are not exclusively to measure imperativeness units. Goals went far behind from essentially giving essentialness readings of some unequivocal buyer. In like manner, these goals are not steady; they are extending well ordered with the development in progress in imperativeness division. Obviously, if someone isn't doing his fundamental obligation, there is no usage of him. Notwithstanding what kind of things a Vitality Meter can do yet if it isn't evaluating essentialness units, there is no usage of it. With the development of Vitality Units, a Vitality Meter by and by should have the ability to measure Voltage and Current. A possibly astounding plan to decrease nuclear family imperativeness use is to give favorable consistent contribution to customers so they can change their essentialness using conduct. Starting late, ease essentialness analysis indicates have ended up being open. Module control meters (or fitting weight meters) measure imperativeness used by individual contraptions. There is a combination of models open accessible today anyway they all work on a comparative fundamental guideline. The meter is associated with an outlet, and the mechanical assembly to be evaluated is associated with the meter. Such meters can help in essentialness safeguarding by recognizing genuine imperativeness customers, or contraptions that eat up irrational reinforcement control.

1.4 Scope of Project

The proposed framework takes 220v 50Hz mains supply as a power source and ventures down the voltage level to 12v through a PT. The power supply unit, at that point changes over this 12v air conditioning into two diverse DC control comprising +5v. The example voltage flag is acquired from this 12v air conditioning signal and prepared through the voltage sensor circuit for microcontroller input. A present flag test is likewise gotten from the mains supply by a present transformer and handled by

a present sensor circuit for another microcontroller input. The microcontroller performs control factor estimations and changes capacitors from the bank. The outcomes are shown on a 16x2 LCD show. The utilitarian square chart of the total Task is appeared in the accompanying figure:

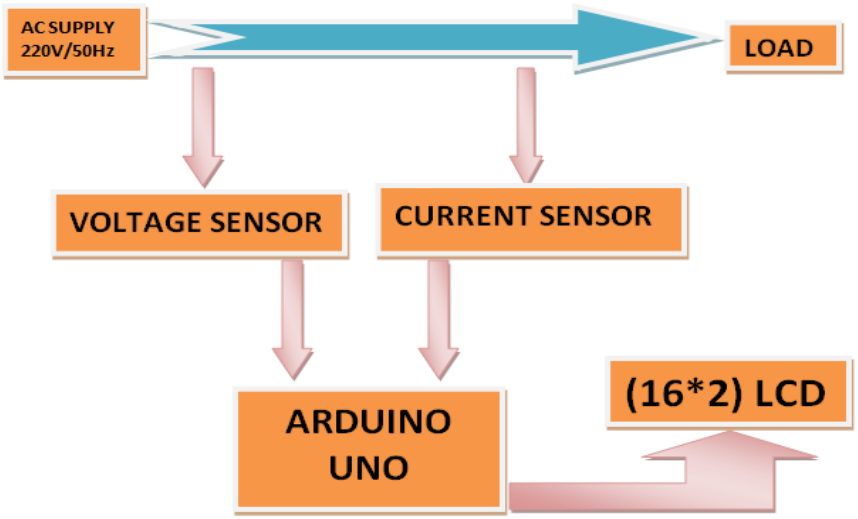


Fig.1.1. Scope of Project

1.5 Report Outline

Chapter 1 introduction

Chapter 2 literature reviews

Chapter 3 Theoretical Model

Chapter 4 hardware development

Chapter 5 results and discussions

Chapter 6 Conclusions and Recommendation

.

CHAPTER 2

OVERVIEW OF THE PROJECT

2.1 Introduction

To complete this project, many types of research and analyze the Design and Implementation of Home Energy Meter and their theories had been done. Several of sources were being the reference for this research such as texts book, journals and internet source. From the past research, many methods were achieved to solve the problem of this project and related to the theory.

2.2 Overall Concept of Our Project

After connecting all equipment according to the circuit we had created the body structure following to the other experimental example from the internet. After preparing the body structure and connection of the circuit we prepared a logic program with the help of C++ program by Arduino. After complete the program, we uploaded the program to the Microcontroller. Then we interface the software and hardware part. After complete the entire program and body with the interface we had tried to experiment it is it work or not. We saw that our project working perfectly.

2.3 Voltage sensor and Current sensor

2.3.1 Voltage sensor circuit

The mains 220v cooling is wandered down to 12v cooling. A voltage divider circuit detaches this 12v in 1:10 extent, which gives around 1.2v sinusoid hail. A DC equalization of 2.5v is associated with the sinusoidal banner. In this way the whole sinusoid can be found in as far as possible 5v and the microcontroller can examine the whole sinusoid movement through its basic data. The circuit layout of the Voltage sensor circuit is showed up as pursues:

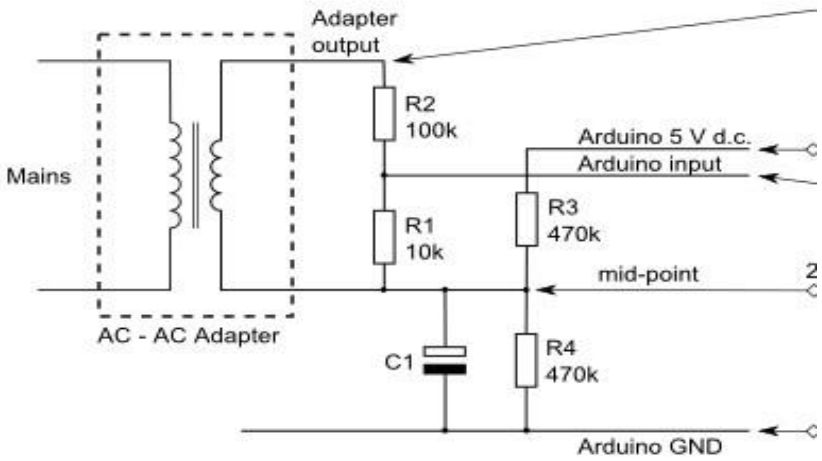


Fig. 2.1 Voltage sensor circuit

2.3.2 Current sensor circuit

The present flag coursing through the mains is recovered through a present transformer. A weight resistor changes the present flag into a voltage frame that speaks to the properties of the present sinusoid. A DC counterbalance voltage of 2.5v is connected to the sinusoidal flag so the reference point is lifted up and the entire sinusoid can be perused in simple mode inside its working extent (0-5v). The circuit graph of the present sensor circuit is appeared following figure

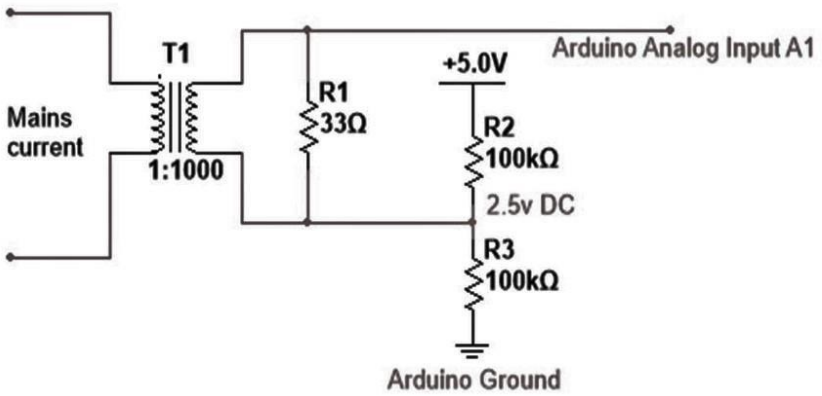


Fig. 2.2 Current sensor circuit

2.4 Arduino UNO Circuit

Arduino UNO circuit was build and the main components for the main circuit for this Arduino are required in order to operate the Arduino UNO. In this circuit the Arduino is connected to the voltage sensor and current sensor, LCD and power Supply for wake up the Arduino.

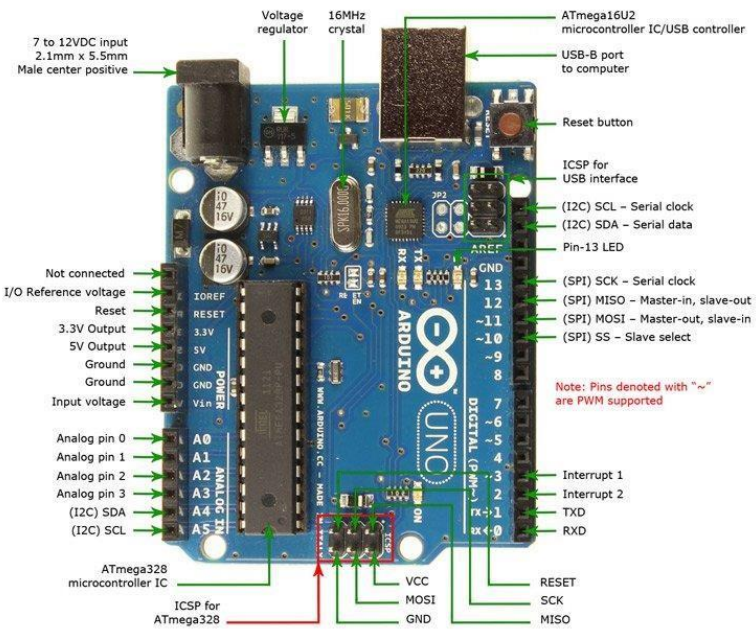


Figure 2.3 Arduino UNO Circuit ATmega

2.5 Schematic diagram of the project

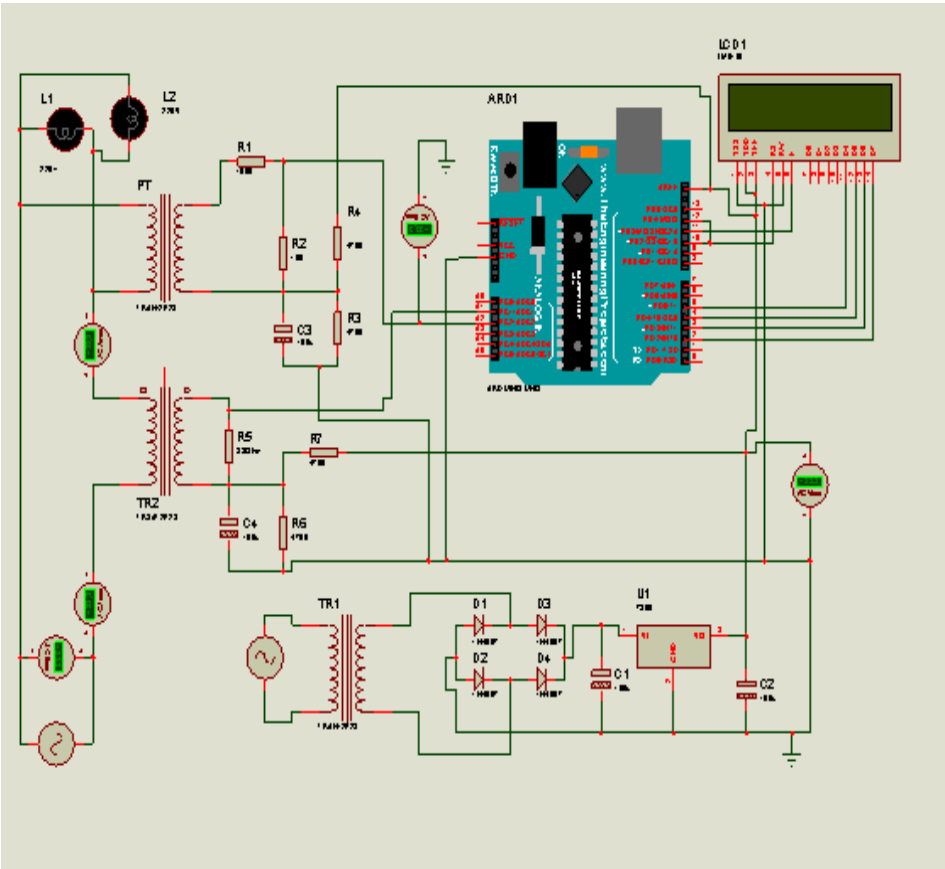


Figure 2.4 Schematic diagram of the Project.

CHAPTER 3

HARDWARE COMPONENTS

3.1 Introduction of Hardware Connection

To complete this project, many types of research and analyze the Design and Implementation of Home Energy Meter and their theories had been done. Several of sources were being the reference for this research such as texts book, journals and internet source. From the past research, many methods were achieved to solve the problem of this project and related to the theory.

3.2 Components and Accessories

Below is a list of all the components and accessories commonly used with an Arduino to develop project:

- Arduino UNO
- Microcontroller
- Voltage sensor
- Current sensor
- LCD
- Capacitors
- Jumper wires
- Resistors
- Motors (DC)
- Vero board
- Soldering Wires
- Connector
- Variable Resistor

3.3 Arduino

3.3.1 Introduction of Arduino

In this undertaking, we have utilized a microcontroller to control entire the procedure of a framework that is Arduino board. All things considered, Arduino is certainly not a simple controller as it has a working framework or boot-loader which keeps running on AVR controllers. Arduino is an open source equipment stage and exceptionally helpful for task improvement reason. There are numerous kinds of Arduino sheets like Arduino UNO, Arduino Mega, Arduino UNO, Lily pad and so forth are accessible in the market or WE can likewise construct one without anyone Else's input.

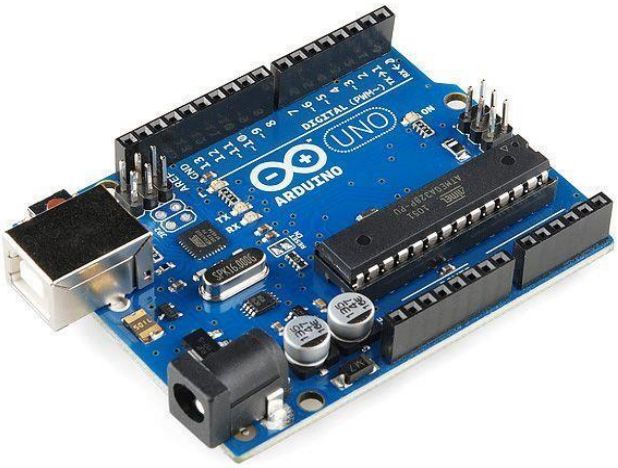


Figure 3.1: Arduino UNO

3.3.2 Main IC of Arduino

The black thing with all the metal legs is an IC, or Integrated Circuit. Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the AT mega line of IC's from the ATMEL company. This can be important, as we may need to know the IC type (along with your board type) before loading up a new program from the Arduino software. This information can usually be found in writing on the top side of the IC. If we want to know more about the difference between various IC's, reading the datasheets is often a good idea.

3.4 Microcontroller

A microcontroller is a solitary chip miniaturized scale PC on a solitary coordinated circuit containing processor center, memory, and programmable info/yield peripherals. Fundamentally, microcontrollers are utilized in naturally controlled items and gadgets, for example, vehicle motor control frameworks, implantable restorative

gadgets, remote controls, office machines, apparatuses, control instruments, toys, and other inserted frameworks. A microcontroller is accessible in various word lengths like chip (4bit,8bit,16bit,32bit,64bit and 128-piece microcontrollers are accessible today). Here we use Atmega328 microcontrollers

.

Figure 3.2: Atmega328 Microcontroller

In this article, we will go over the stick out of the Atmega328 chip. The Atmega328 is an exceptionally prominent microcontroller chip delivered by Atmel. It is an 8-bit microcontroller that has 32K of blaze memory, 1K of EEPROM, and 2K of inward SRAM. The Atmega328 is one of the microcontroller chips that are utilized with the prominent Arduino Duemilanove sheets. The Arduino Duemilanove board accompanies either 1 of 2 microcontroller chips, the Atmega168 or the Atmega328. Of these 2, the Atmega328 is the overhauled, further developed chip. Not at all like the Atmega168 which has 16K of blaze program memory and 512 bytes of inside SRAM, has the Atmega328 had 32K glimmer program memory and 2K of Interior SRAM. The Atmega328 has 28 pins. It has 14 advanced I/O pins, of which 6 can be utilized as PWM yields and 6 simple info pins. These I/O pins represent 20 of the pins

.

3.5 Liquid Crystal Display (LCD)

3.5.1 Introduction of LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16*2 display means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

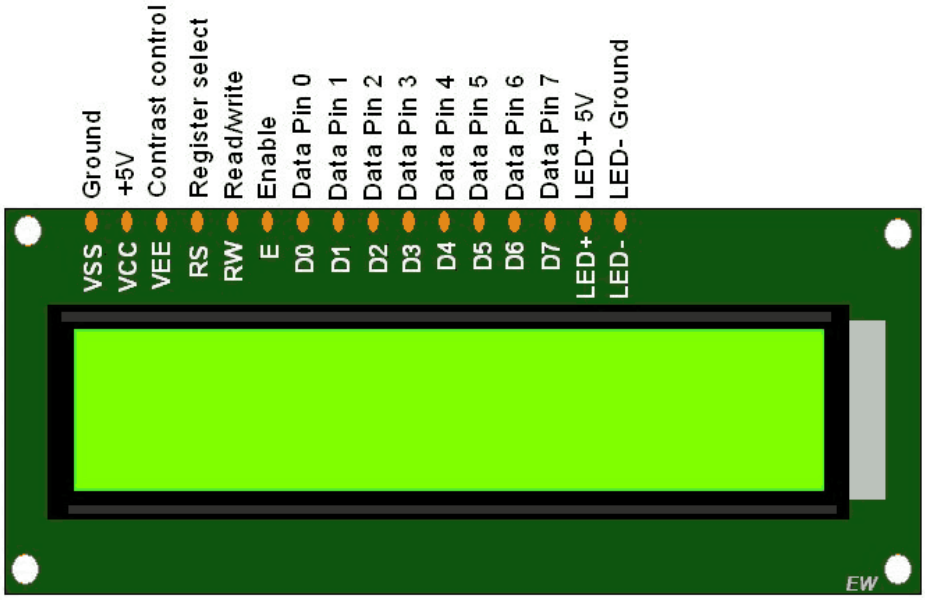


Figure 3.3 Pin diagram of LCD

3.5.2 Pin Description of LCD

Table 3.1: Pin Description of LCD

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2

10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

3.6 Potentiometer

3.6.1 Introduction of potentiometer

A potentiometer is a three-terminal resistor with a sliding or pivoting contact that shapes a movable voltage divider. On the off chance that just two terminals are utilized, one end and the wiper, it goes about as a variable resistor or rheostat. They are utilized for volume and gain controls just as an assortment of different applications. Preset variable resistors or potentiometers are likewise utilized in circuits that require a little acclimation to be made to set the circuit up after produce.

Figure 3.4 Potentiometer

3.6.2 Potentiometer Application

Potentiometers are infrequently used to straightforwardly control noteworthy measures of intensity (in excess of a watt or somewhere in the vicinity). Rather they are utilized to modify the dimension of simple signs (for instance volume controls on sound hardware), and as control contributions for electronic circuits. Anyway they stay in numerous applications, for example, volume controls and as position sensors.a. Audio control

a. Television
b. Transducer
c. Motion control
d. Computation

3.7 Resistor

3.7.1 Introduction of Resistor

The resistor is an inactive electrical segment to make opposition in the stream of electric flow. In practically all electrical systems and electronic circuits they can be found. The opposition is estimated in ohms. An ohm is the obstruction that happens when a current of one ampere goes through a resistor with a one volt drop over its terminals. The current is relative to the voltage over the terminal closures. This proportion is spoken to by Ohm's law: R=V/I

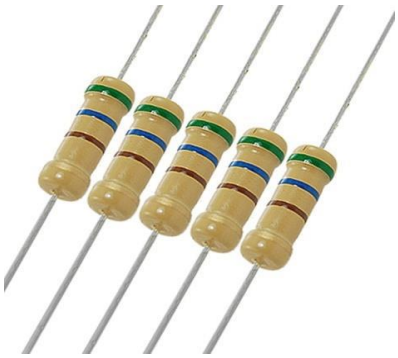


Figure 3.5 Resistor

3.7.2 Series and Parallel Resistors

The absolute obstruction of resistors associated in arrangement is the entirety of their individual opposition esteems.

Req = R1 + R2 +… …. + Rn

The absolute obstruction of resistor associated in parallel is the complementary of the total of the reciprocals of the individual resistors.

3.7.3 Application of Resistor

In electronic circuits:

- Resistors are used to reduce current flow.
- Adjust signal levels.
- To divide voltages bias active elements, and terminate transmission lines, among other uses.

3.8 Connector

- An electrical connector, a contraption for consolidating electrical circuits
- Sound and video connector, electrical connectors (or optical connectors) for Passing on sound pennant and video development, of either direct or moved affiliation
- Gender of connectors and fasten
- Power connector, contraptions that enable electrically worked gear to be connected
- RF connector, an electrical connector planned to work at radio frequencies in the multi-megahertz run.
- A military standard circled by the Unified States Bureau of Resistance that depicts the mechanical, electrical, and important qualities of a progressive information transport

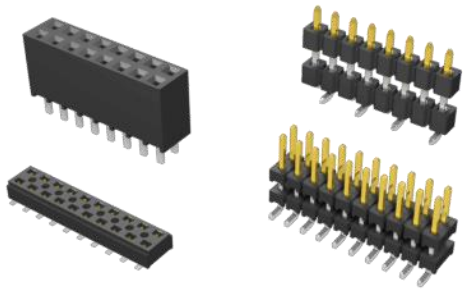


Fig: 3.6 Connector

3.9 Vero board

Vero board is a brand of strip board, a pre-surrounded circuit board material of copper strips on a securing board. Which is the ordinary name for a comprehensively used kind of devices prototyping board depicted by a 0.1 inch (2.54 mm) typical (rectangular) system of openings, with wide parallel portions of copper cladding running one way the separation across more than one side of the board? It is routinely also known by the name of the main thing Vero board, which is a trademark, in the UK, of English association Vero Innovations Ltd and Canadian association Pixel Print Ltd. In using the board, breaks are made in the tracks, when in doubt around holes, to segment the strips into different electrical centers. With thought, it is possible to break between holes to consider parts that have two stick pushes only a solitary position isolated, for instance, twin segment headers for IDCs.

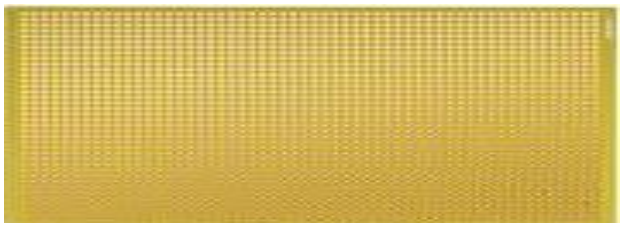


Figure: 3.7 Vero Board

3.10 Soldering Wires

Fix is basically a metal wire with a "low" condensing point, where low for our inspirations suggests low enough to be melted with a coupling iron. For equipment, it is usually a mix of tin and lead. Right when the coupling wire cooled an electrical affiliation will lead. This is getting a tolerable mechanical relationship between the wires. The filaments of each wire should be distorted together, continue progressively like a single component.

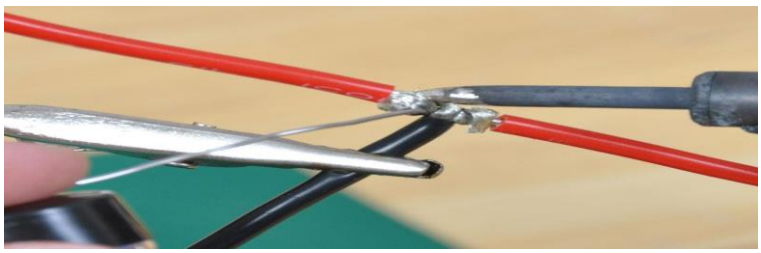


Figure: 3.8Soldering Wires

CHAPTER 4

DESIGN AND IMPLEMENTATION

4.1 Basic Block Diagram

In this Arduino UNO voltage and current sensor interfacing, Arduino UNO is used to Control the whole method. A voltage and current sensor is used for estimation of voltage, current, unit and power factor at its yield stick. You can without quite a bit of a stretch check it with a voltmeter by partner Vcc at stick 1 and Ground at stick 3 and yield voltage at stick 2 of the voltage and current sensor. For a model, if the yield voltage of the voltage and current sensor is indicate stack. Arduino UNO scrutinizes yield voltage, current, unit and power factor of voltage and current sensor by using Simple stick A2 and A1 plays out the calculation to change over this Simple motivation to an automated estimation of voltage, current, unit and power factor. After tallies Arduino UNO sends these figuring to 16x2 LCD units by using fitting headings of LCD.

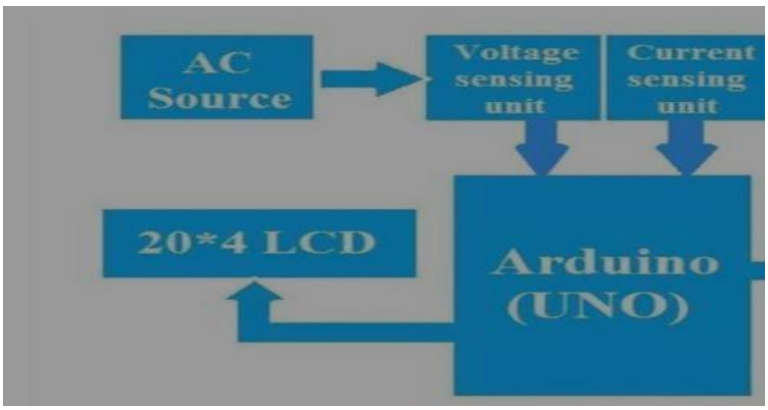


Figure: 4.1 Basic Block Diagram

4.2 Writing and Burning Programming into the Arduino UNO

4.2.1 Writing Programming

There are a few C compilers available for the ATmega328 microcontroller. These compilers have numerous comparative highlights and they would all be able to be utilized to create C based abnormal state programs for Atmega328 microcontroller a

Portion of the C compilers utilized frequently in business, modern and educational.The famous and ground-breaking mikro C is anything but difficult to learn and accompanies the high assets. Mikro C is a worked in test system and an in-circuit debugger. The program is incorporated by a compiler Mikro C. After the change procedure, a hexadecimal code is produced.

4.2.2 Burning the Program

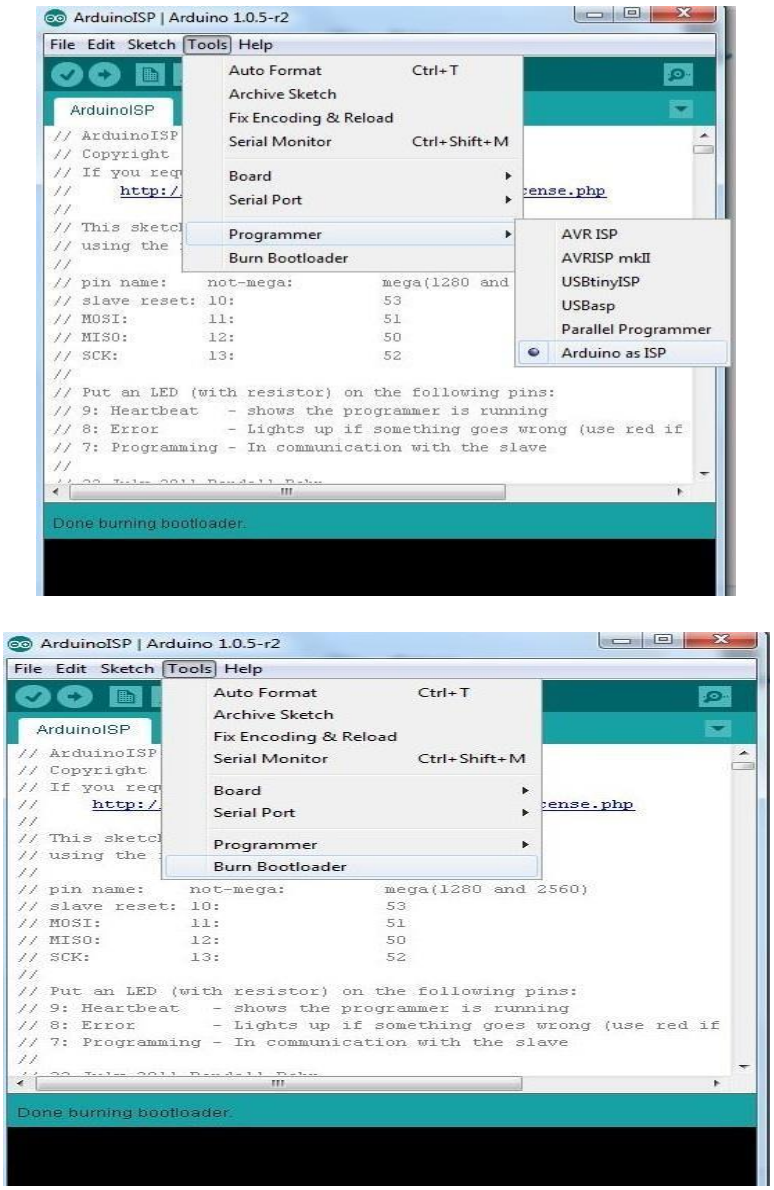
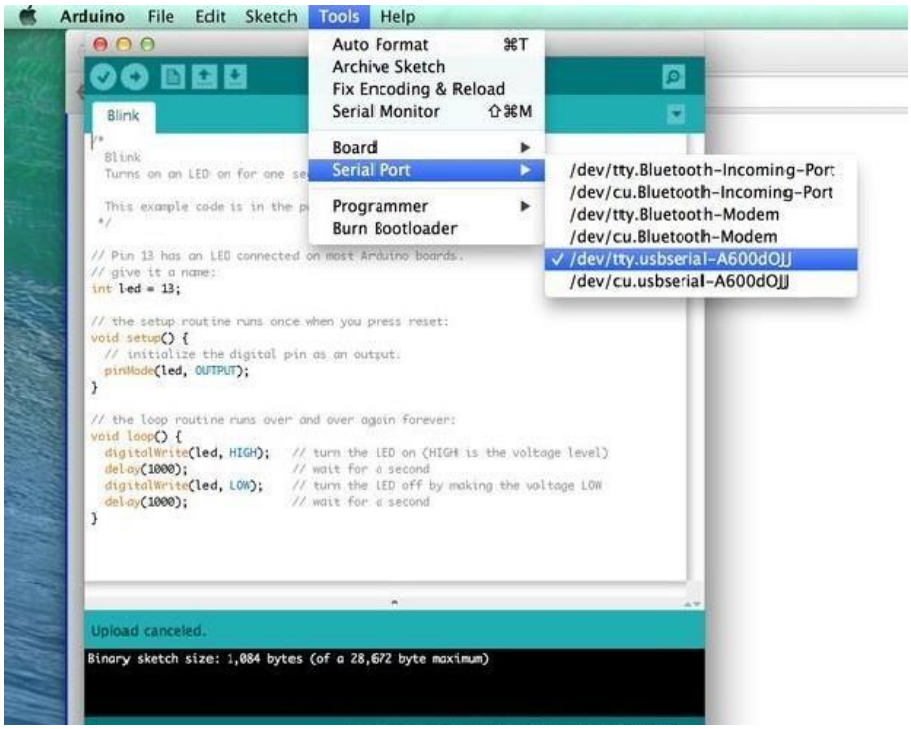


Figure 4.2 Burning the Program

4.2.3 Burning Boot Loader Process



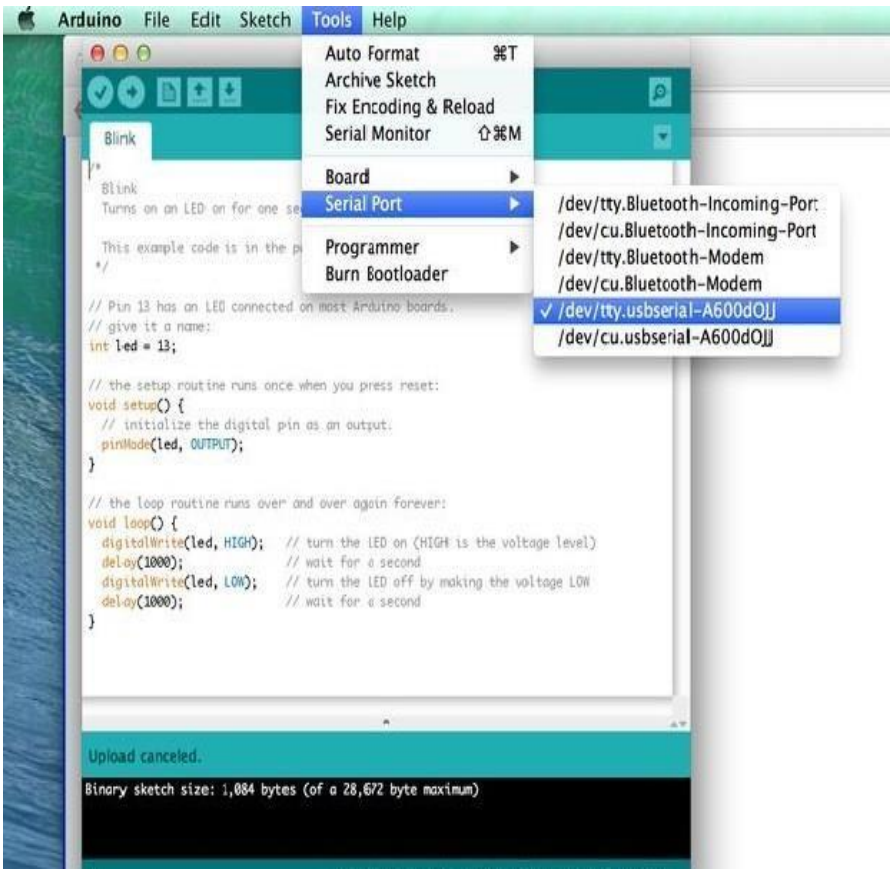


Figure 4.3 Burning Boot Loader Process

4.3 Implementing

4.3.1 Implement of voltage sensor

Delving into the subtleties of the Voltage Sensor like its usefulness and schematic let me give you an outline of the accessible Pins of the Voltage Sensor Module. Essentially, a 24V Voltage Sensor, similar to the one utilized here, has 4 sticks altogether. Two of them are on the two-stick screw terminal and three are male header pins.

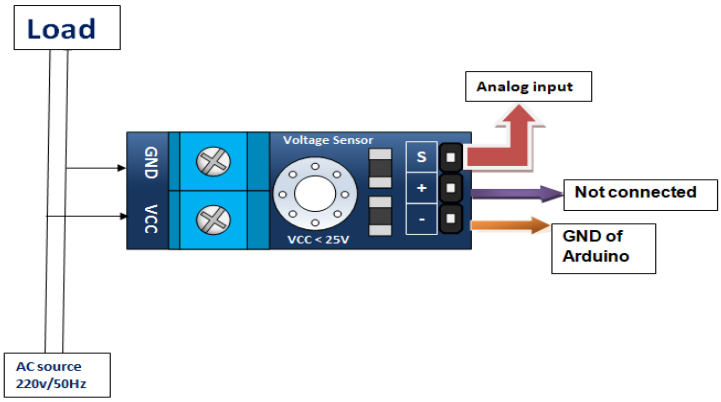


Figure 4.4 Implement of voltage sensor

4.3.2 Implement of Current sensor

The Current Sensors offered on the web are proposed to be successfully used with littler scale controllers like the Arduino. Concentrate on the furthest point at the pile end of the device. In case we are related as outlined underneath, the yield will raise. In case we relate it reverse of this picture, the yield will lessen from the 2.5 volt balance. In case the light showed up in the picture above was isolated, the yield of the current sensor module would be 2.5 volts.

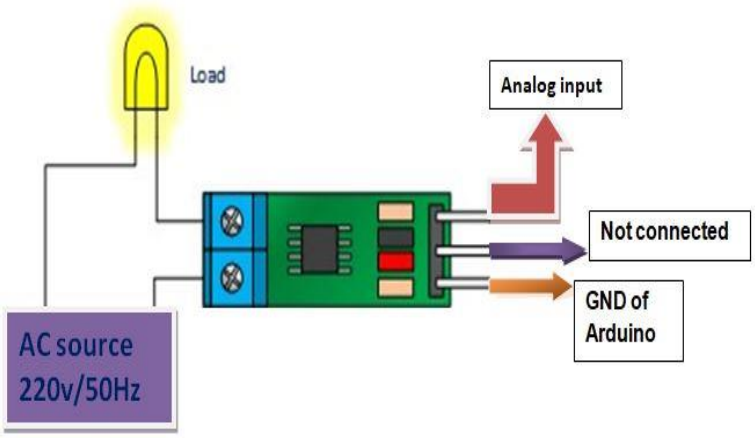


Figure 4.5 Implement of Current sensors (ACS712)

4.3.3 Implement of project

This project name Design and Implementation of Home Energy Meter using Arduino UNO, LM35, and LCD. The project measured voltage, current, power factor and unit give the output displaying on LCD screen.

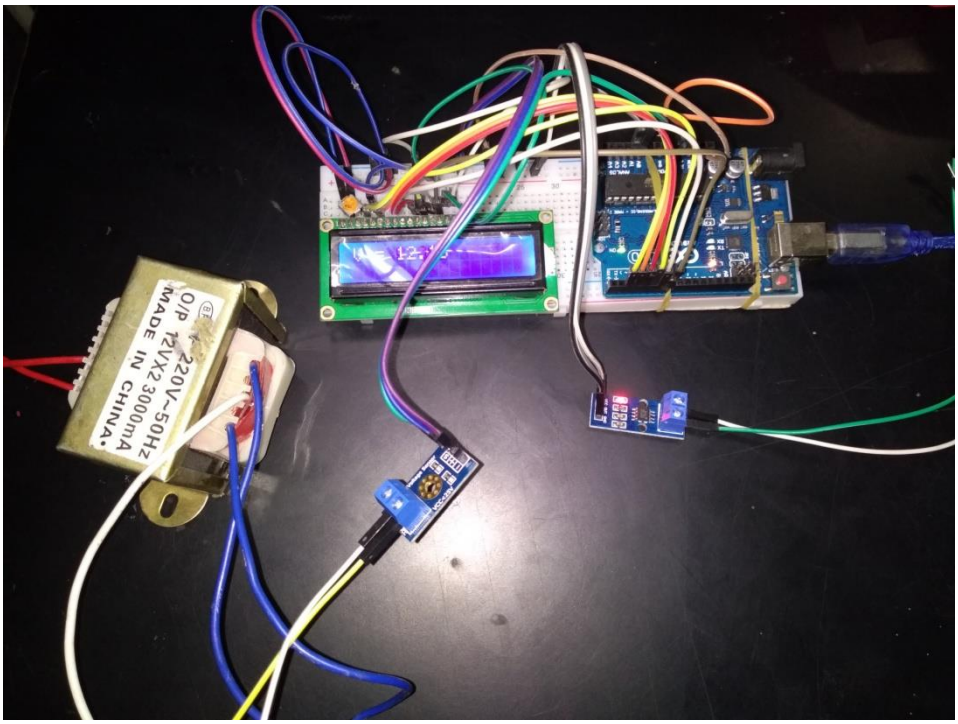


Figure 4.6 Implement of project

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Result

5.1.1 Project analysis

After connecting all equipment according to the circuit we had created the body structure following to the other experimental example from the internet. After preparing the body structure and connection of the circuit we prepared a logic program with the help of C++ program by Arduino. Our project picture is given below:

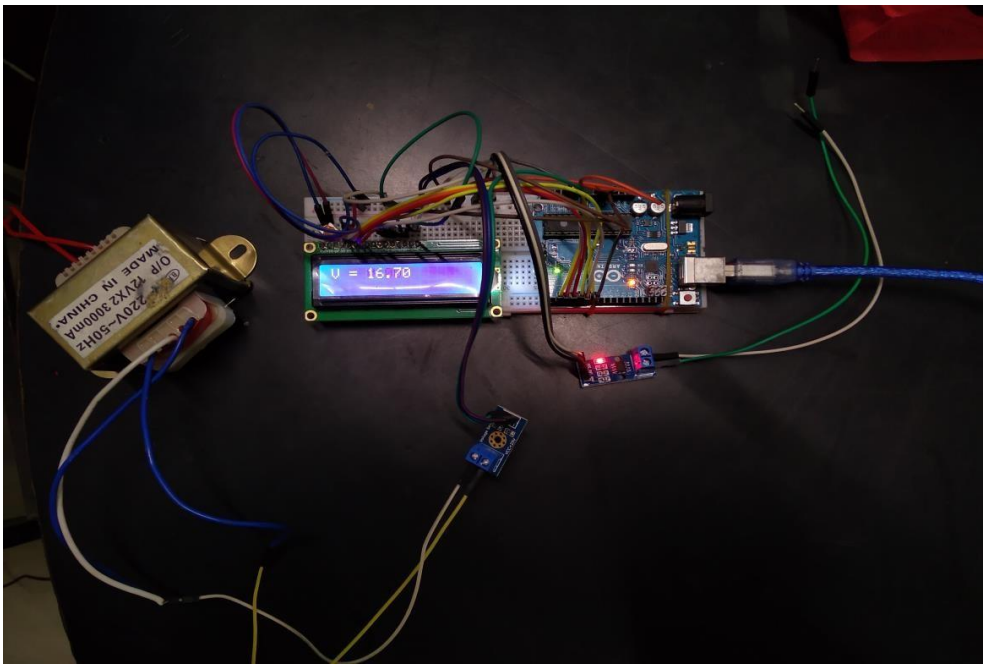
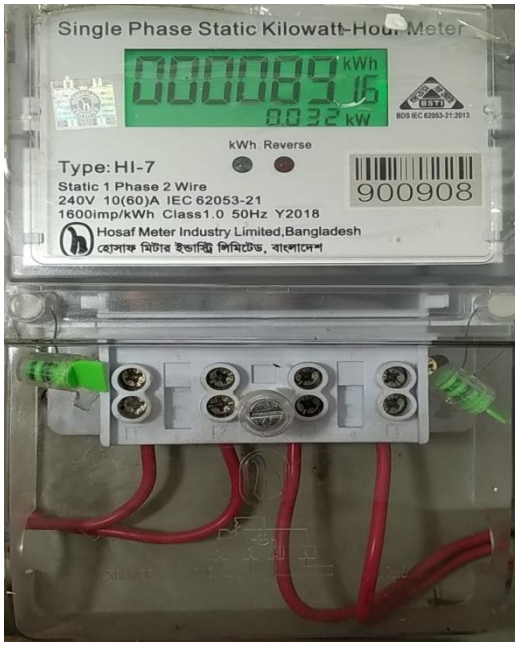


Fig. 5.1 Our Project Picture

After complete the program, we uploaded the program to the Microcontroller. Then we interface the software and hardware part. After complete the entire program and body with the interface we had tried to experiment it is it work or not. We saw that our project working perfectly.

5.1.2 Data analysis



5.2 Data analysis

Table 5.1 Data Analysis

Serial No	No of load	Electric Meter(kw)	Energy meter(kw)	Error (%)
01	1 light (32w)	0.032	0.032	0.00
02	2 light(2*32w)	0.113	0.100	1.50
03	3 light(3*32w)	0.211	0.200	1.35
04	4 light(4*32w)	0.396	0.350	1.75

5.2 System Cost

Table 5.2 Cost Analysis

Serial	**Components**	**Price in (BDT)**
01	Arduino UNO	400/-
02	Variable resistor	20/-
03	Connecting wire	50/-
04	Power supply adaptor	120/-

05	Vero board	50/-
06	Wire connector	100/-
07	Motor	100/-
08	LCD (16×2)	300/-
09	White Wood Board	200/-
10	Glue Gun Stick	50/-
11	Reel Connector	50/-
12	Charging Port	100/-
13	Others	100/-
14	Voltage sensor	150/-
15	Current sensor	150/-
Total Cost		= 1800/-

5.3 Discussion

The venture is being tried in protons and is working appropriately. It is likewise tried in bread board and is appropriately working. It has bunches of use like we can utilize this undertaking in Room, medication store room, microwave and so on. In this task, we have utilized exceptionally less part so it is practical and it is less convoluted than a basic small scale controller based code bolt framework

5.4 Summary

In this chapter has discussed the result and discussion. With our project, we became successful to demonstrate with regarding the objectives of the project. At last, completing this chapter the project is ready to use.

CHAPTER 6
CONCLUSIONSION

6.1 Conclusion

At last in the wake of finishing this task we get the reasonable thought regarding the Energy Meter. We examined about the parts and used to actualize this task. We consider the subtleties data about the parts used to finish this venture, for example, Microcontroller, LCD, Voltage controller, Crystal Oscillator, diode and so forth. We come to realize how to make a circuit association and afterward check the yield. It will help us in our future work. The paper depicts the plan and working of Home Energy Meter and speaks to how Home Energy Meter can be utilized for Automatic Meter Reading. It is the most affordable execution to create humankind in this period of innovation. With the present upgrade in the utilization of innovation to encourage humankind, it is a productive and functional usage of present systems. This paper likewise demonstrates that how client can deal with the heap by utilizing Home Energy Meter. It gives ease in taking the meter readings, precision, discovery of broken conditions, less activity cost and expulsion of conceivable defilement identified with meter perusing.

6.2 Limitations of the Work

The working method of this undertaking is exceptionally simple yet we are confronting some constraint for doing this task. For example, coding issue, program composing, associating with PCB board, recognize following and so forth.

6.3 Future Scopes

Energy savings and consumer satisfaction are two major design considerations for modern lighting systems. A smart home control system can provide both significant cost saving in a home environment .as well as a great level of flexible and control for the building administrators and great comfort for the occupants. For future work, the implementation of a remote access system for control would be welcome development in home energy management. The proposal approach is expected to

benefit the real world implementation of an automated HEM system for demand Response application and help reduce power system.

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APPENDIX A

Programming code

```
#include "LiquidCrystal.h"
 Liquid Crystal lcd(2, 3, 4, 5, 6, 7);
const int sensorValue = A2;
const int sensorValue2 =A1;
float R1 = 10000.0;
float R2 = 1000.0;
float VRef =12;
float CMax = 1024;
float Rb = 33;
float vRt = (220/11);
float iRt = (100/(50/1000));
float Rd = (R1+R2)/R2;
void setup()
{
//Serial. Begin (9600);
lcd.begin (16, 2);
}
// the loop routine runs over and over again forever:
Void loop ()
{
Value= analog Read (sensor Value);
value2= analog Read (sensorValue2);
Counts = (value/ VRef)* CEMEX;
voltage calibration constant = vRt * Rd;
Vrms=(counts/CEMEX)*VRef*voltagecalibrationconstant;
```

```
counts2 = (sensorValue2/VRef)*CMax;
current calibration constant = iRt/Rb;
Irms = (counts2/Cmax)* VRef * current calibration constant;
int long timemillis=millis();
int long time=timemillis/1000;
float realPower == emon1. realPower;
float apparentPower   = emon1.apparentPower;
lcd.setCursor(0,0);
lcd.print("V=");
lcd.setCursor(2,0);
lcd.print(Vrms);
lcd.setCursor(5,0);
 lcd.print("I=");
 lcd.print(Irms);
 lcd.setCursor(0,1);
 lcd.println("PF=");
lcd.setCursor(1,10);
lcd.print(powerFactor);
delay (2000);
}
```