GSM BASED ELECTRICITY THEFT CONTROL SYSTEM

By

Capt Junaid Saleem
Capt Touseef Ahmed
Capt Saqib Nazir
Capt Rizwan Gondal

Submitted to the Faculty of Department of Electrical Engineering

Military College of Signals

National University of Sciences and Technology, Islamabad

in partial fulfillment for the requirements of a B.E Degree in

Electrical (Telecom) Engineering

JUNE 2015

Abstract

The aim of this project is to design a GSM base electricity theft control system, which will detect the electricity theft and report the concerned authorities for timely control and necessary actions. Implementation of an efficient and intelligent theft control mechanism can help to resolve this problem to a great extent and save a huge amount of electrical energy. In this way our system will help to increase the available electrical energy produced by the existing resources and will thus ensure efficient utilization. In this project we have focused on unlawful connection detection (Kundi System) and illegal earthling of the electricity connection for theft purposes. To detect the unlawful connection (Kundi system), amount of current leaving by the current transformer is compared with the amount of current entering towards the user end. If the amount of current at user end is less as compared to amount of transformer current that mean unlawful connection is on wire between current transformer and user end. To detect the meter earthling, amount of neutral current leaving from transformer is compared with the amount of neutral current leaving from users end. If amount of current is not equal that mean dubbing in meter of users.

Supervisor Certification

It is hereby certified that the contents and form of the project report entitled “Gsm based Electricity Theft Control System”, submitted by the syndicate of

1. Capt Junaid Saleem
2. Capt Touseef Ahmed
3. Capt Rizwan Gondal
4. Capt Saqib Nazir

has been found satisfactory as per the requirement of the B.E. Degree in Electrical (Telecom) Engineering.

Supervisor:

Brig (Dr) Faheem Arif

MCS, NUST

_____

DECLARATION

We hereby declare that no content of work presented in this thesis has been submitted in support of another award of qualification or degree either in this institution or anywhere else.

DEDICATED TO

Allah Almighty, the Lord of the Worlds, our family and friends who believed in us and for their unwavering support.

Acknowledgements

Allah is very kind, merciful and compassionate. His benevolence and blessings enabled us to accomplish this task.We express our heartfelt gratitude to our parents and family for their prayers, moral support and sincere wishes for the completion of our work.We want to thank our Supervisor Brig Dr.Fahim Arif for his continued interest and support. His generosity to share his experiences and ideas gave us a starting point for this project and hence this thesis.

We are also thankful to those individuals who have provided particularly useful assistance and guidance either technical or otherwise, during this project.

Table of Contents

Table of Figures

LIST OF TABLES

CHAPTER 1: INTRODUCTION

1.1 Background/Motivation

Today is the age of "Global Energy Crisis". Scientists and researcher around the world are exploring alternative solutions to overcome this crisis. Being a developing country, Pakistan is lagging in the race of developing alternative solutions. In electricity field one of the main reasons for this lag is due to the increased rate of electricity theft in Pakistan. Approximately about 20-30 percent of electricity is stolen (19th April 2013, Daily times) in our country by employing various means. Implementation of an efficient and intelligent theft control mechanism can help to resolve this problem to a great extent and save a huge amount of electrical energy. The objective of our project is to develop, design and implement a system which will detect the electricity theft and report the concerned authorities for timely control and necessary actions. In this way our system will help to save the electrical energy produced by the existing resources and thus will ensure efficient utilization. In this project we will be focusing on unlawful connection detection (Kundi System) and illegal earthling of the electricity connection for theft purposes.

1.1.1 Problem Statement

What is the earliest solution to overcome the energy crisis in Pakistan? Whatever progress is being made or has been made in energy sector there is always a need to monitor and control it. Why the amount of electricity which is produced in our country is not efficiently utilized and why the revenue generated from electricity is not as it should be?

1.2 Project Description and Salient Features

1.2.1 Why we need Theft Control System

There are various ways of electricity theft such as tempering in meter, meter tilting, meter by passing and taping from main power supply. Presently people are using new technological methods to use free electricity. A highly effective method of stealing electricity is by placing a strong magnet on a meter which stops the meter coil from rotating and hence the units are not consumed and users enjoy electricity without paying.

Meters can also be bugged by consumers to use free electricity. One of the old methods of meter bugging was by placing magnet beside the electric meter which hinders the rotating coil to register the consumed units. Another most common way of tempering the meter is by grounding the neutral phase which allows the consumer to thoroughly run their load without registry of consumed units, hence enjoying free electricity without paying and can stop tampering skillfully to fool the meter readers.

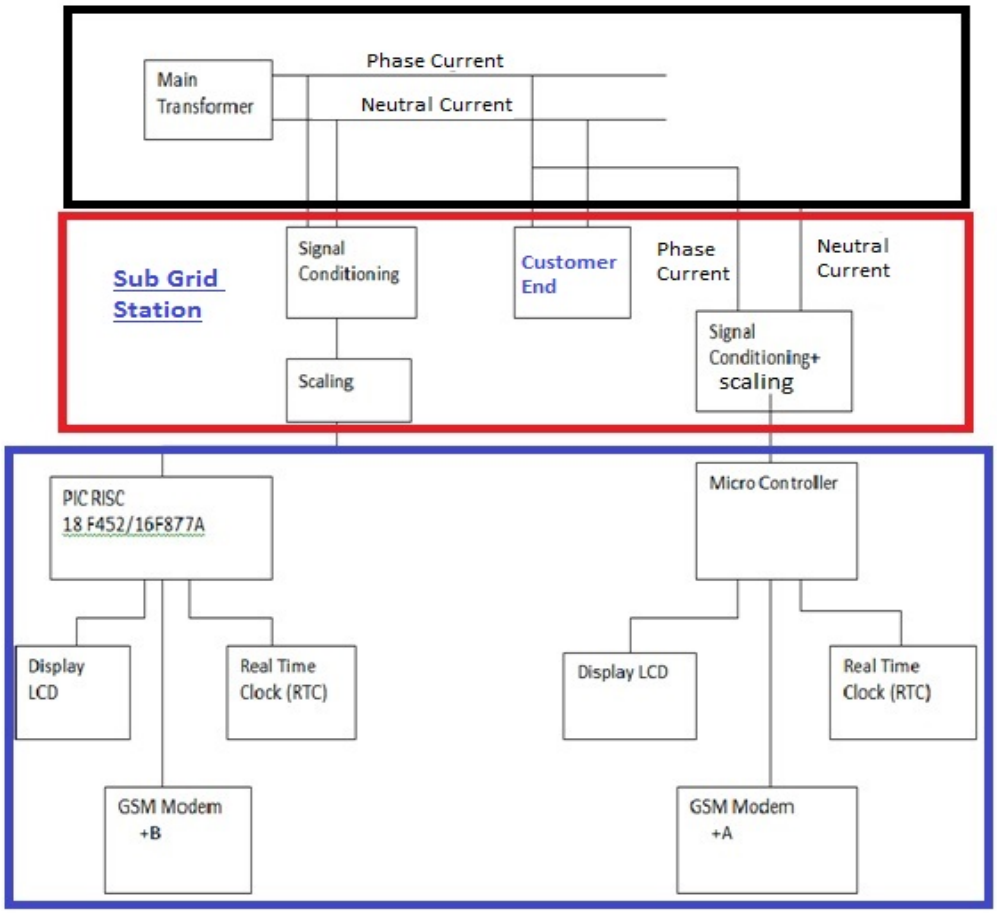
1.2.2 Existing System

For the detection of meter bugging, meter readers are trained to manually identify the tempered meter by visiting each site and then reporting any misuse of electricity to the concerned officials. This existing system is neither practical nor feasible when implemented at large scale. Hence to overcome the existing problem we have proposed a very practical and viable solution to minimize the electricity theft.

1.2.3 Proposed System

We are going to design a system which is currently not implemented in our country, rather is a new dimension in the control of electricity theft augmented by latest technological methods. The project is designed to monitor energy meter through PIC microcontroller and detect any possible electricity theft by comparing the amount of current leaving the transformer (source) with the amount of current entering the METER (user end).Meter dubbing and earthling in between is detected and user through GSM modem is alarmed of any possible theft mechanism being employed. We will be using PIC 16F877A with built-in ADC (analogue to digital conversion), for reliable and fast programming.

1.2.4 System Model



[Fig no. 1]

Stage 1

Current transformers are connected with the main transformer wires. One current transformer is connected with the phase current wire while the other is connected with the neutral current wire.

Stage 2

After sensing, the current signal conditioning process is carried out by converting AC current to DC current and the ripple effect is removed to smooth the DC current. After that scaling process is performed to bring the high voltage value of 220V to a desired value between 0 to 5 volts on which the microcontroller used in the project works.

Stage 3

After scaling the voltage to the required operational value of PIC 16F877A microcontroller which is 0 to 5 Volts, analogue to digital conversion is performed in conjunction with real time clock (RTC) and the data displaying LCD. GSM modem is incorporated along with the microcontroller that operates according to the basic coding performed in the microcontroller.

1.3 Scope, Objectives, Specifications and Deliverables of the Project:

1.3.1 Scope

To develop GSM based electricity theft control system to minimize the electricity losses in Pakistan and to overcome the power shortage by timely informing the concerned authorities of any possible electricity theft.

1.3.2 Academic Objectives

The project will involve:

- Understanding and use of GSM modem and microcontroller.
- Acquaintance and employment of GSM module.
- Comprehending and employing Microcontroller

Sub Objectives

To Detect the Unlawful Connection (Kundi System)

To detect the unlawful connection (Kundi system), amount of current leaving the Grid is compared with the amount of current entering toward the user end any variation in the received current is detected and notified.

To Detect the Earthling in Electricity Meters

To detect the meter earthling, that results by grounding the neutral phase which allows the consumer to thoroughly run their load but there is no registry of consumed units.

1.3.3 Specifications

Hardware Specification

EQUIPMENT	QUANTITY
Diode	2
Printed Circuit board	2
Current Transformers	4
Adopter	2
Antenna	2
Bridge Rectifier	4
Operational Amplifier LM358.	2
Real Time Clock DS1302	2
LED	6
LCD LM016l	2
Capacitor	10(27Pf,1000Uf,1000Pf,1000Pf,27Pf)
Resistor	8(4.7k,4.7k,10k,4.7k)
Crystal Oscillator	2
GSM modem	2

Microcontroller PIC 16F877A	2

Table 3.1Hardware Specification

Software Specification

SOFTWARE
Proteus 7 Professional
Proton Development Suite
C Sharp

Table 3.2 Software Specification

1.3.4 DELIVERABLES

In case of any un-authorized use of electricity, a SMS will be delivered to the concerned authorities which will contains the user ID, date, phase and neutral current values. The project will also send the phase and current values after every 10 minutes for maintaining the user database.

The project basically involves the design of hardware architecture which includes two units i.e one unit is representing the server or a sub grid of electricity and the second unit is representing the user who is getting electricity from sub grid. That is how we will come to know that what amount of electricity is out from sub grid and what amount of electricity is entering into user meter. It will be implemented using PIC Micro controller interfaced with a GSM module. A small working model will be designed to show the working of the Project. The final design will be tested and practically implemented on model.

CHAPTER 2: LITERATURE REVIEW

2.1 Background

There are various ways of electricity theft such as tempering in meter, meter tilting, meter by passing and taping from main power supply. Now a day's people are using new technological methods to use free electricity. A highly effective method of stealing electricity is by placing a strong magnet on a meter which stops the meter coil from turning and hence the units are not counting by the meters and user enjoys electricity without paying. In our case, we are going to detect the unlawful connection (Kundi system) and earthling in meters and inform the officials through GSM technology.

Meters can be bugged by consumer to use free electricity, which is dishonest and against the law. For the detection of meter bugging, meter readers are trained to identify the tempered meters and to report higher officials to act accordingly. One of the old method of meter bugging was by placing magnets to the meters which stops the coil the register the units but, latter on the meter were made up of plastics which terminated this thread. The second most common way of tempering the meter is by grounding the neutral phase which allows the consumer thoroughly run their load but there is no registry of consumed units. So they don't pay for this electricity that they have used. Consumer freely enjoys the electricity without paying and can stop tampering when they feel any type of danger from Supplier Company. For this purpose new meters were introduced having proper seals and if the seals were broken that means bugging in the meter has been introduced.

2.2 Literature Review

2.2.1 Use and implementation of Current Transformers

The system uses four different types of current transformers for phase and neutral current.

2.2.2 Signal Conditioning

The bridge rectifier will be used for this purpose which will convert AC to DC. Moreover smoothing capacitor will be used to remove the ripples from the signal which will reduce noise and distortion.

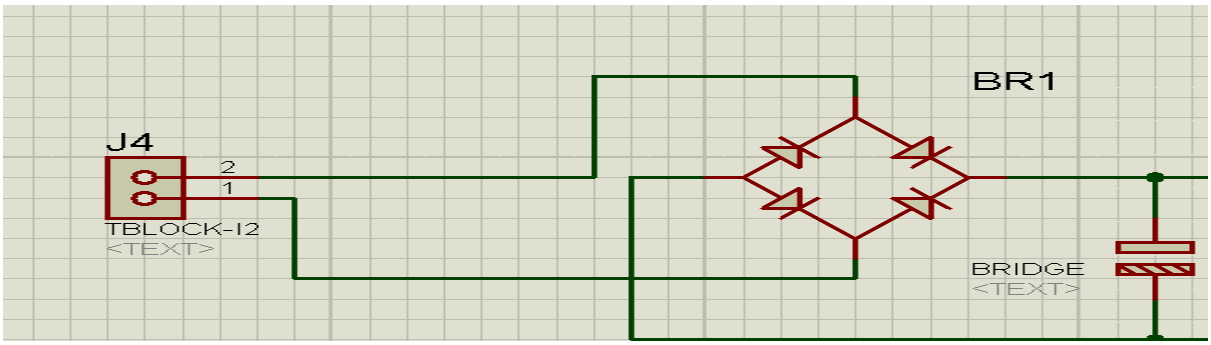


Figure 2 Signal Conditioning on Proteus

2.2.3 Signal Scaling

Next step is to scale the signal to our required potential i.e 5V.This will be done by operational amplifier.

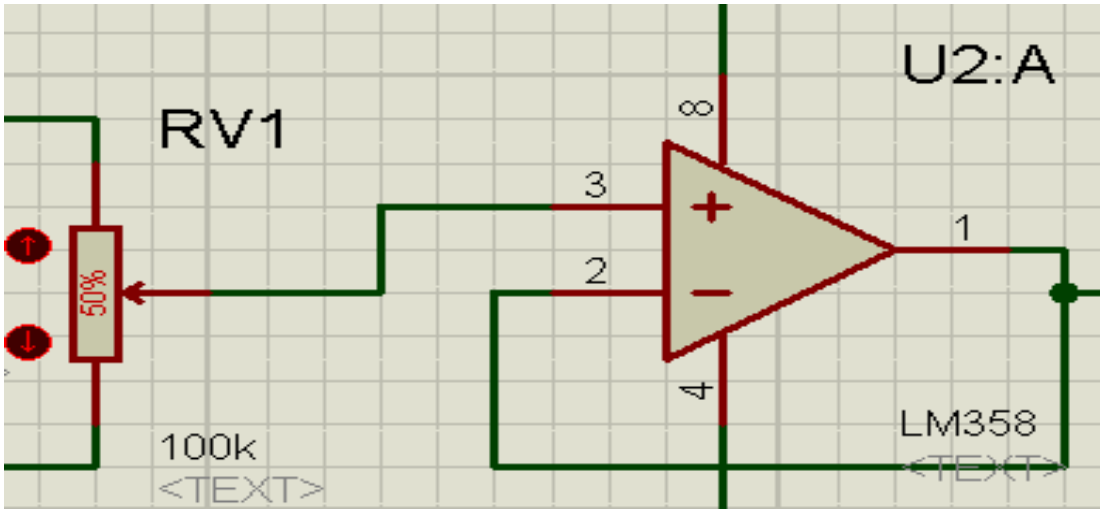


Figure 3 Signal Scaling On Proteus

2.2.4 Data conversion in Microcontroller

Then the analog signal data is fed into microcontroller which is programmed to convert it to digital data. The data is displayed on LCD used in the project. The data on LCD includes date, time, user ID, phase n neutral current values in amperes ,No theft sign " N* " and theft sign " T*".

2.2.5 GSM functioning

The GSM module is programmed so that it sends all data on LCD mentioned above to programmed mobile numbers to concerned authorities after every 10 minutes .In case of theft it will immediately send this data to concerned mobile numbers.

2.2.6 Implementation on a Model

This will be the main portion of our project where the above mentioned is implemented on a model.

2.2.7 Real time Testing

The final system will then be tested.

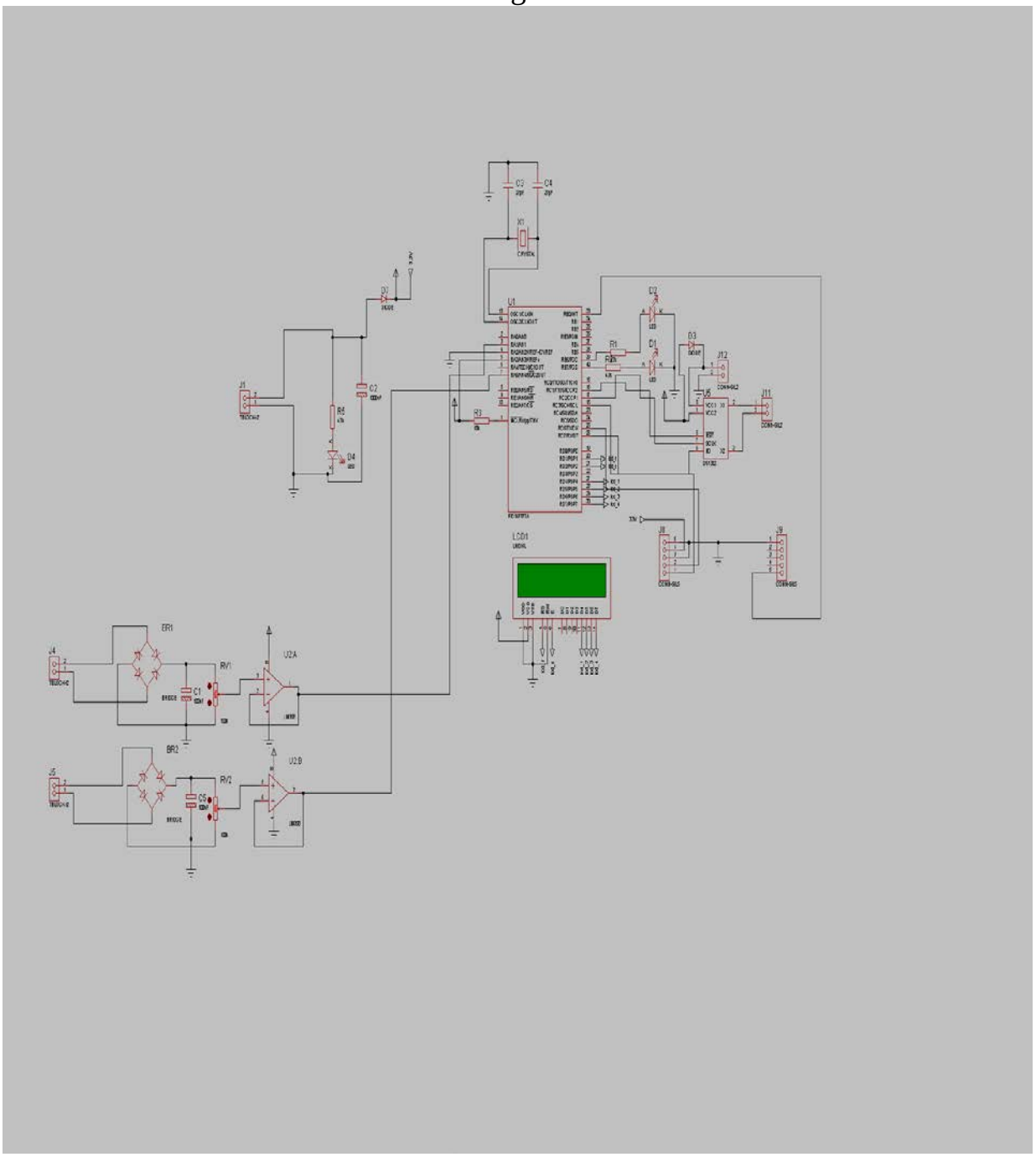
2.2.8 Evaluation

The result of our final implementation will be compared with the expected results.

CHAPTER 3- DESIGN AND DEVELOPMENT

3.1 System Architecture

Fig 4



3.2 Hardware Design

Current Transformer

For the measurement of electric current, the device used is called current transformer and when the voltage transformer, potential transformer is together with current transformer it is said to be instrument transformer. A current transformer produces a reduced current accurately proportional in a circuit when a current in a circuit it too high to directly apply to measuring instruments. For electronic device like metering and protective relays we can use a current transformer. Principles of current sensing used in current transformer's electronic device which can detect and it can also converts current to an easily measure output voltage ,measured output voltage is directly proportional to the current passing through the path. Voltage drop is occurring when a current is passing through the circuit, due to voltage drop and current passing through the circuit magnetic field is generated and magnetic field can carry a conductor. Current sensor is measured because of these phenomena. Direct sensing and indirect sensing are two type of current sensing. One type of current sensing is based on Ohm's law and other type of current sensing is based on Faraday's and Ampere's law. Current transformer consists of two wires neutral and phase. Two sensors are attaching with the phase wire and neutral wire. One senses the phase current and other sensing the neutral current. If secondary winding is connected to load the current will flow and electricity will be shifted from primary circuit through the transformer to the load. If the current increases or decreases, the lines of force will move outwards or inwards respectively.

[Figure # 5] Current Transformer

3.3 Signal Conditioning

Component used in signal conditioning are:-

Bridge Rectifier

A bridge rectifier consists of four diode and it is a type of full-wave rectifier that converts both the positive and negative of AC voltage into the DC voltage. In a bridge circuit a bridge rectifier or diode rectifier is an arrangement of four or more diode which can provided the same polarity of output for the same input polarity. For the conversion of an alternating current input into a direct current output in a common application, it can also be known as bridge rectifier. By using the two-wire AC input, bridge rectifier provided a full-wave rectification, by resulting provided a two-wires DC output. Bridge rectifier is used in our project to converts the AC voltage is converted to DC voltage. Rectifier is a device which converts Ac to DC and the process is known as rectification.

Figure # [6] Bridge

Electric Capacitor

Electric capacitor is generally consisted of two metallic plates which can be insulated and separated from each other by a dielectric and electric capacitor used to stored a charge temporality and it can also used for condenser. Ripple can defined as due to small variation in a circuit provided a ripple. These ripples are not suitable for electronic circuit so we can use the electronic capacitor to remove these ripples, to reduced noise and used for filtering. It is a passive device also called as condenser. It is made up of two conductive plates which are separated by an insulator or by air known as dielectric.

When current is applied, one plate becomes positively charged while the other gets negatively charged. Value of voltage is directly depending on the value of capacitor. If you want to use the high input voltage then we can use the high value capacitor and it can smoothen the signal more and it can also remove the ripple more.

Figure # [7] Capacitor

3.4 Signal Scaling

Component used in scaling are:

Variable Resistor

For the adjusted and adjusting purpose type of resistor used is said to be variable resistor. A type of resistor is said to be varaible resistor which can be used for the adjust properties such as the volume on a stereo and speed of a motor.Varaible resistor is used to vary the current and voltage in a circuit.A resistor instructed in such a way so that its resistance value may be changed without interrupting the circuit to which it is connected it is said to be a variable resistor.

Figure # [8] Variable Resistor

Operational Amp

Integrated circuit(IC) that operate as a voltage amplifier is said to ba a operational amplifier.Operational amplifier is also known as op-amp.Input of operational amplifier has a differential and always a single with a high gain.On the other hand it output is also a single.

Op-Amp LM 358

LM358 is a dual channel OP-AMP. It is a IC which handle a source up to 20MA per channel and it can handle a supply of 3-32VDC.LM358 also includes transducer amplifier.

Figure # [9] OP-AMP

3.5 PIC 16F877A

We use PIC 16F877A is in place of 8051 because built-in ADC of 10 bits present in PIC 16F877A, its programming is easy and it i s fast and more reliable than 8051.

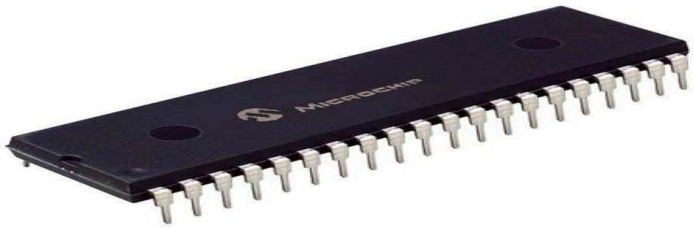


Figure # [10] PIC 16F877A

Specifications

- 40 pin device
- 5v power supply needed
- Operating frequency 20 MHz
- Flash memory 8k
- Data memory 368 bytes
- Built in analog to digital converter
- EEPROM memory 256 bytes
- 35 instruction set

Pin out Description

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	13	14	30	I	ST/CMOS(4)	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	14	15	31	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
MCLR/VPP/THV	1	2	18	I/P	ST	Master clear (reset) input or programming voltage input or high voltage test mode control. This pin is an active low reset to the device.
						PORTA is a bi-directional I/O port.
RA0/AN0	2	3	19	I/O	TTL	RA0 can also be analog input0
RA1/AN1	3	4	20	I/O	TTL	RA1 can also be analog input1
RA2/AN2/VREF-	4	5	21	I/O	TTL	RA2 can also be analog input2 or negative analog reference voltage
RA3/AN3/VREF+	5	6	22	I/O	TTL	RA3 can also be analog input3 or positive analog reference voltage
RA4/T0CKI	6	7	23	I/O	ST	RA4 can also be the clock input to the Timer0 timer/counter. Output is open drain type.
RA5/SS/AN4	7	8	24	I/O	TTL	RA5 can also be analog input4 or the slave select for the synchronous serial port.
						PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT	33	36	8	I/O	TTL/ST(1)	RB0 can also be the external interrupt pin.
RB1	34	37	9	I/O	TTL	
RB2	35	38	10	I/O	TTL	
RB3/PGM	36	39	11	I/O	TTL	RB3 can also be the low voltage programming input
RB4	37	41	14	I/O	TTL	Interrupt on change pin.
RB5	38	42	15	I/O	TTL	Interrupt on change pin.
RB6/PGC	39	43	16	I/O	TTL/ST(2)	Interrupt on change pin or In-Circuit Debugger pin. Serial programming clock.
RB7/PGD	40	44	17	I/O	TTL/ST(2)	Interrupt on change pin or In-Circuit Debugger pin. Serial programming data.

Continued…

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
						PORTC is a bi-directional I/O port.
RC0/T1OSO/T1CKI	15	16	32	I/O	ST	RC0 can also be the Timer1 oscillator output or a Timer1 clock input.
RC1/T1OSI/CCP2	16	18	35	I/O	ST	RC1 can also be the Timer1 oscillator input or Capture2 input/Compare2 output/PWM2 output.
RC2/CCP1	17	19	36	I/O	ST	RC2 can also be the Capture1 input/Compare1 output/ PWM1 output.
RC3/SCK/SCL	18	20	37	I/O	ST	RC3 can also be the synchronous serial clock input/ output for both SPI and I^2C modes.
RC4/SDI/SDA	23	25	42	I/O	ST	RC4 can also be the SPI Data In (SPI mode) or data I/O (I^2C mode).
RC5/SDO	24	26	43	I/O	ST	RC5 can also be the SPI Data Out (SPI mode).
RC6/TX/CK	25	27	44	I/O	ST	RC6 can also be the USART Asynchronous Transmit or Synchronous Clock.
RC7/RX/DT	26	29	1	I/O	ST	RC7 can also be the USART Asynchronous Receive or Synchronous Data.
						PORTD is a bi-directional I/O port or parallel slave port when interfacing to a microprocessor bus.
RD0/PSP0	19	21	38	I/O	ST/TTL(3)	
RD1/PSP1	20	22	39	I/O	ST/TTL(3)	
RD2/PSP2	21	23	40	I/O	ST/TTL(3)	
RD3/PSP3	22	24	41	I/O	ST/TTL(3)	
RD4/PSP4	27	30	2	I/O	ST/TTL(3)	
RD5/PSP5	28	31	3	I/O	ST/TTL(3)	
RD6/PSP6	29	32	4	I/O	ST/TTL(3)	
RD7/PSP7	30	33	5	I/O	ST/TTL(3)	
						PORTE is a bi-directional I/O port.
RE0/$\overline{RD}$/AN5	8	9	25	I/O	ST/TTL(3)	RE0 can also be read control for the parallel slave port, or analog input5.
RE1/$\overline{WR}$/AN6	9	10	26	I/O	ST/TTL(3)	RE1 can also be write control for the parallel slave port, or analog input6.
RE2/$\overline{CS}$/AN7	10	11	27	I/O	ST/TTL(3)	RE2 can also be select control for the parallel slave port, or analog input7.
VSS	12,31	13,34	6,29	P	—	Ground reference for logic and I/O pins.
VDD	11,32	12,35	7,28	P	—	Positive supply for logic and I/O pins.

Table 4.1 Description

Program Memory Map

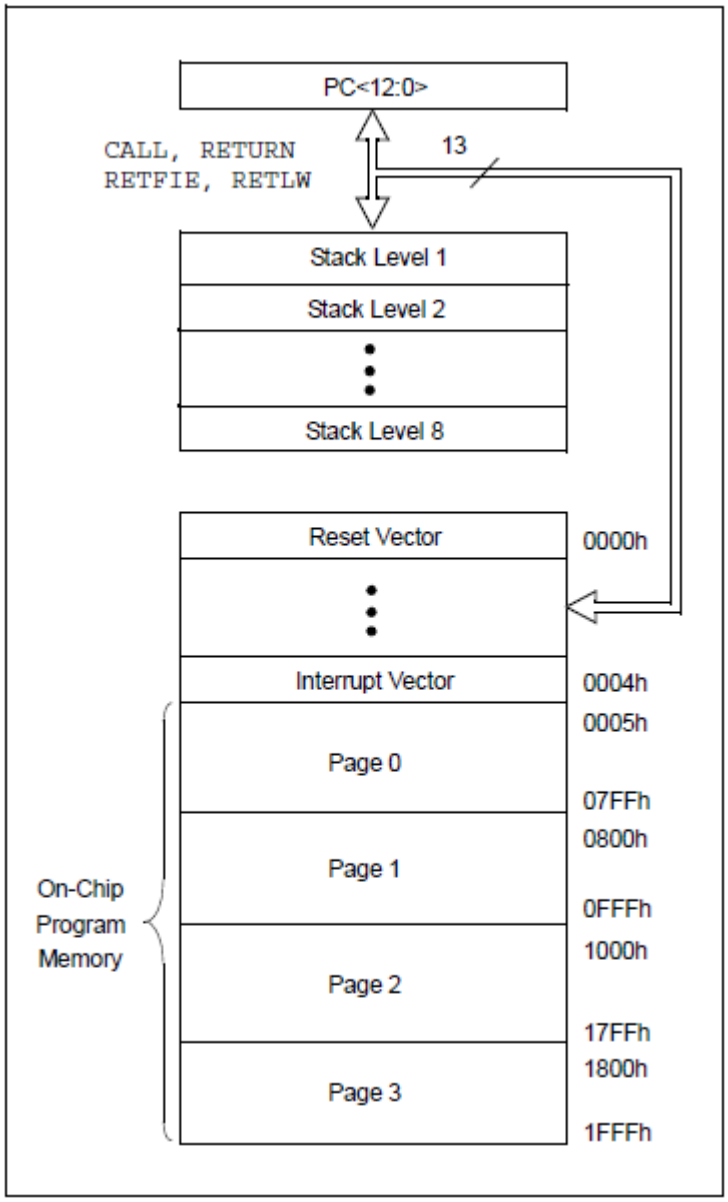


Table 4.2 Program Memory Map

3.6 Real Time Clock

Real time clock is used to update complete information about time and date at any instant of time. Because of real time mechanism incorporated in the clock, real time detection occurs.

Keeping the record of the current time a computer clock mostly in the form of an integrated circuit is used is said to be a real time clock. For keeping the accurate time record RTC are already available in many electronic circuits. The minimum time of real time clock to run without external power is 9 years.

Figure # [11] Real Time Clock

3.7 GSM Module

We are using GSM module in our project for sending message from sender to our main server.The GSM modem is a quad-band module which works on 850/900/1800/1900 MHZ which used for both GPRS and call purpose.the module is managaed by processor called AMR 926E-JS,which control phone communication.The processor is also responsible for the SIM card.GSM 900 integrates analogue to digital converter and real time clock.During transmission continuous energy of 3.4 to 3.5V can be applied while it can absorb maximum of 0.8A.

Figure # [12] GSM Module

3.8 Component Input Requirements

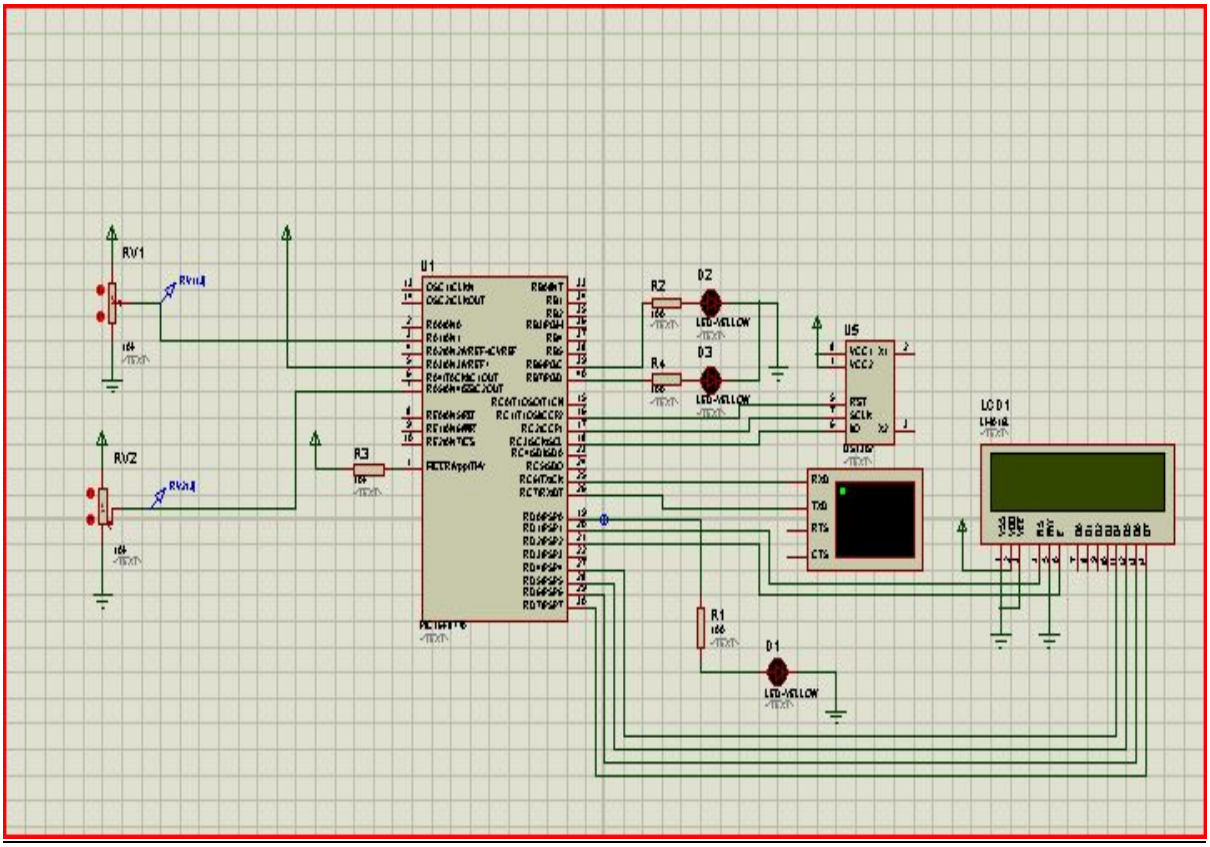
- Power input requirements for each component is 4.3V.
- We are using Female Headers as Connector.
- Memory and/or storage space requirements are maximum 1 GB.
- No Hard drive/floppy drive/CD-ROM required
- Processor requirement is not specific and we can use any latest processor.

3.9 Graphical User Interface (GUI)

Our graphical user interference features reception of messages from a mobile phone, Data included in message is date, time, user Id, precise values of neutral and phase current. A complete report is formed in the case of theft or no theft and is reported to the concerned authorities (assigned mobile numbers) after every 10 minutes.

CHAPTER- 4: ANALYSIS AND EVALUATION

4.1 Simulation Diagram



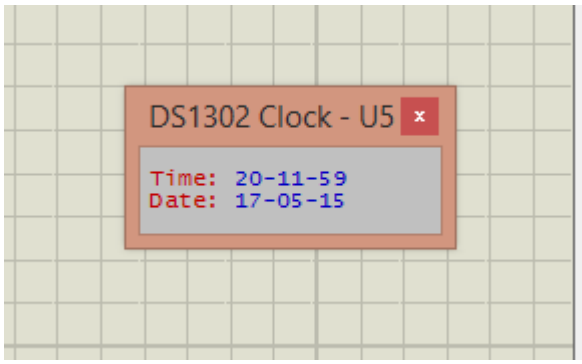
Fig[13]

When we run the simulation on Proteus software first of all real time clock is displayed having time and date which is continuously updating. Then LCD flashes the time and date after coordinating with the real time clock. Later E.T.D.S (electricity theft detection system) will appear on the LCD screen. After 40 to 45 seconds virtual terminal will appear on the screen and certain commands run in the terminal. LCD will show us the phase and neutral current with time and date. In the last step the terminal will again open and execute the commands in the terminal.

4.2 Simulation Output

Real Time Clock

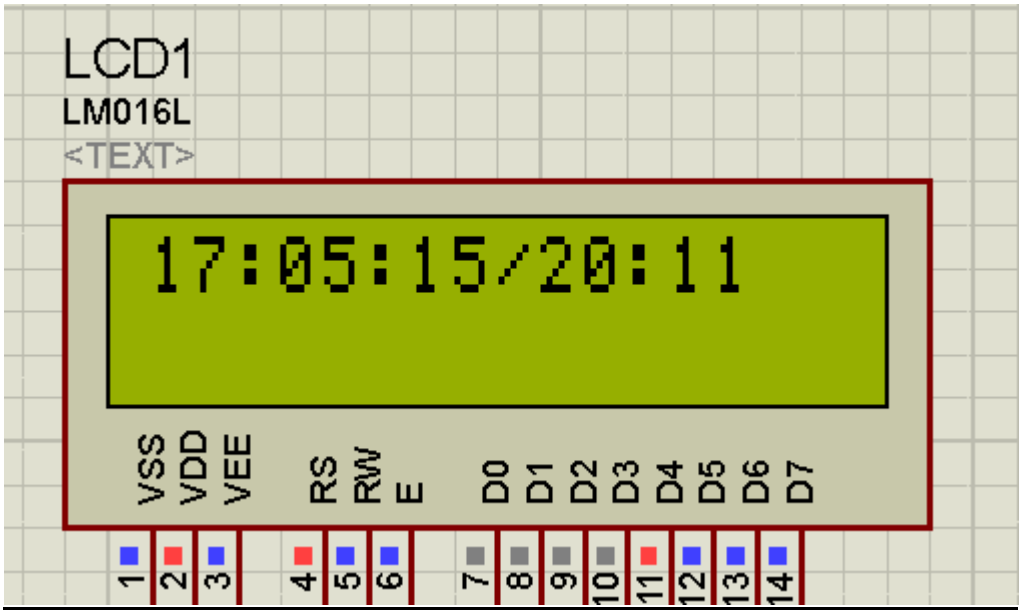
The simulation on proteus shows this date and time because of the Real Time Clock we have used in the circuit.



Fig[14]

LCD Output 1

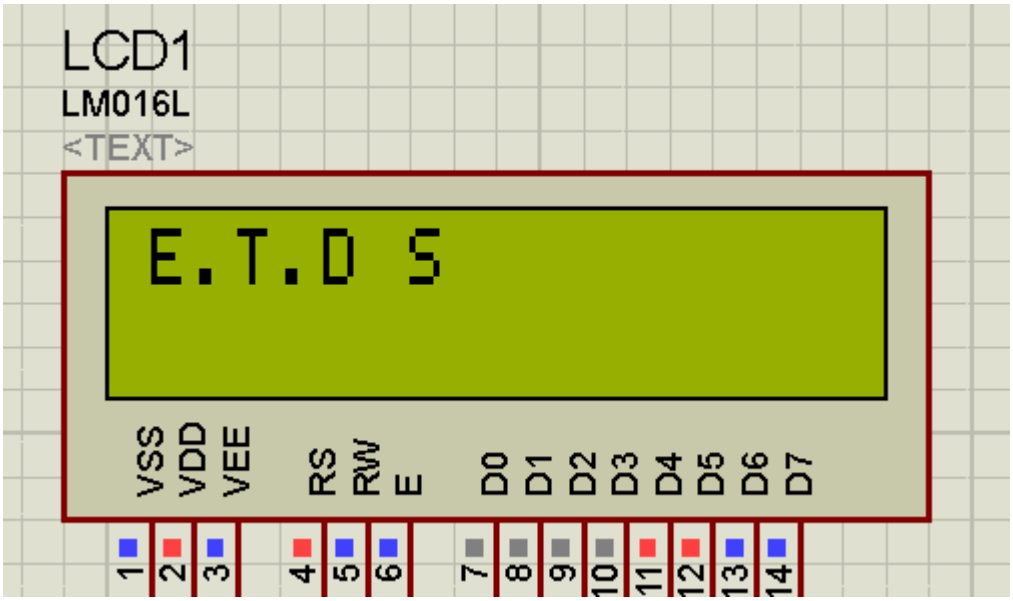
The first thing that will appear on LCD is real time date and time which is maintained by Real Time Clock.



Fig[15]

LCD Output 2

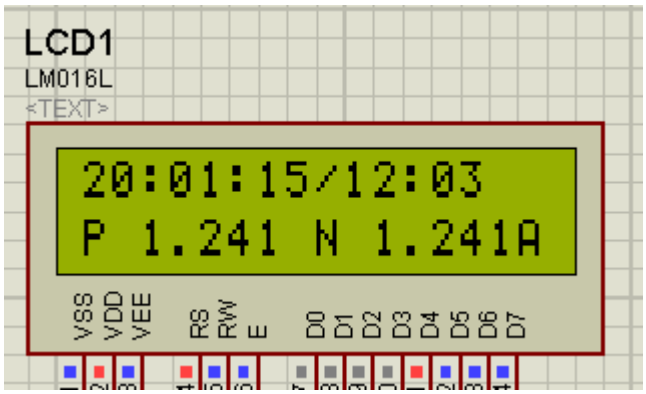
This is 2nd output on LCD which is E.T.D.S .It stands for Electricity Theft Detection System.



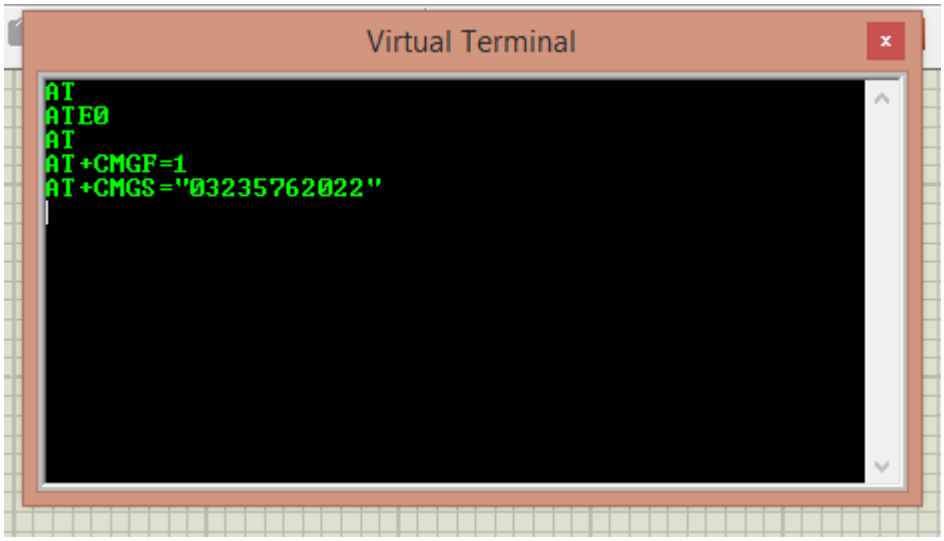
Fig[16]

LCD Output 3

This is the 3rd output on LCD which shows the phase (P) current and Neutral (N) current values in Amperes along with the date and time.



Fig[17]



Fig[18]

Virtual Terminal Output 1

GSM module gets ready with an attention command AT, subsequently its SMS or message sending mode gets activated with (AT + CMGF) command and a message is sent to the specified mobile number through (AT + CMGS) command. The SMS will be received by the mobile number specified which contains the following data.

$ETS= header of predefined library

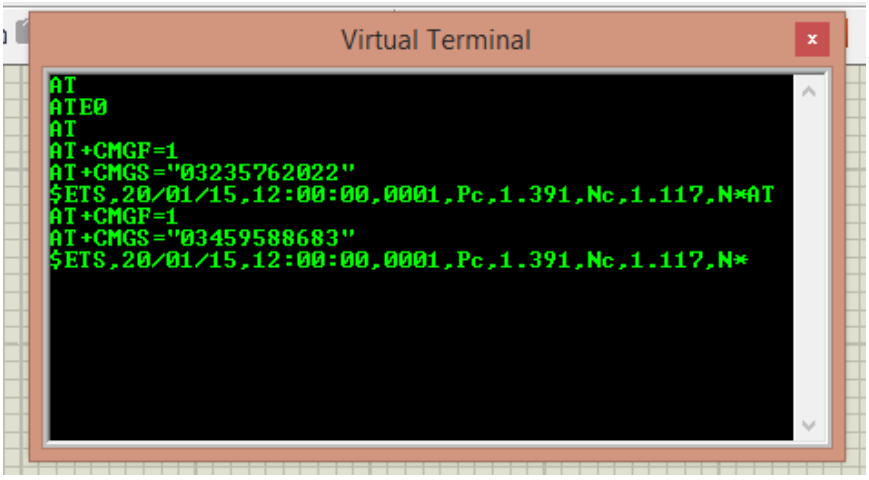
Date

Time

User specific ID

Phase and Neutral current values

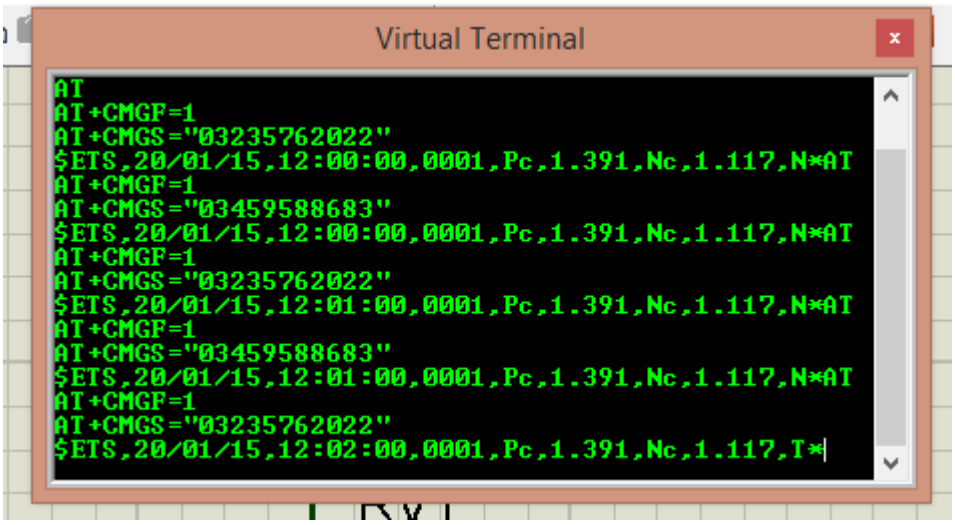
N*=Normal or No Theft



Fig[19]

Virtual Terminal Output 2

This is the 2nd output of virtual terminal which shows the values of phase and neutral current at specified date and time with concerned user ID, Any variation less than 0.1A is not considered as theft, hence no theft report is generated and sent every 10 minutes.



Fig[20]

Virtual Terminal Output 3

This output depicts the variation in phase and neutral current which is greater than 0.1 A indicating theft.

4.3 performance Testing

In performance testing first we tested the simulation on Proteus software and then we implemented it on the hardware.

4.4 Load Testing

We have tested the load by 220 volts and 1 ampere but it is capable up to 1000 volts and 5 ampere.

4.5 Installation Testing

This project is just a demo but it can be installed on any system

FUTURE WORK

- The motivation for us to take up this project is the current inefficient distribution system of the electricity all over Pakistan, and an earnest endeavour to implement this system throughout the country to curb this menace.

- The regulatory authorities are expected to apply the existing laws in a stringent form so as to minimize the number of people involved in electricity theft.

- As the majority of the power we generated is by burning coal, which adds to the already severe problem of the greenhouse effect, implementation of the recommended system will definitely helping in curbing this dilemma.

- The project can be incorporated with a database software to maintain and monitor the received data over the time from various users.

- An incorporation of a circuit breaker at user end can be utilized to cut off the power supply if any defaulter is caught using unlawful means to use electricity.

CONCLUSION

Overview

The conclusion of this project lies behind the fact that this project is of high scope for WAPDA & Power industries. It can detect electricity theft if neutral is grounded, while through the use of GSM Module a theft message is sent to the main WAPDA server for timely remedial action against the defaulter. The message will have the consumer id, date and time stamping of data, and the status that whether theft exists at the specified time or not. This project makes the electricity system reliable and reduces the chances of theft throughout the system.

Objectives Achieved

- Understanding and use of GSM modem is achieved.
- Use and employment of microcontroller including its programming is learnt.
- Energy conservation is achieved by the detection of unlawful use of electricity.
- Team spirit is achieved.

Limitations

We designed this project for low voltage values and smaller values of current ranging from (220V and 2A) respectively considering the meagre resources and budgetary constraints, however the real time implementation calls for the increased sizes hardware with increased current values as well as a healthy budget to implement this system throughout the country.

Applications

- At the WAPDA server software is installed on the server which will read the messages that are sent from the GSM modem. It's a best way of detecting theft easily. This also in another way of saving of electricity. If theft is reduced electricity can be saved, as in Pakistan these days there is a huge energy crisis which has led to heavy load shedding which has adverse effects not only on the daily life of the citizens but also the industry and hence affecting adversely economy of Pakistan.

- The system will have high authenticity and chances of theft and unwanted (Kundi) will minimize. The circuit cost is not very high except GSM module and all other equipment are easily available in the market. If this system is installed on every consumer terminal after the energy meter, it will detect the theft with the help of CT's (current transformers).
- A onetime investment can bring huge change in the electricity theft. Hence the system is reliable and chances towards theft and unwanted connection (Kundi) can be minimized. This system is fast responding and all the data will be recorded with consumer ID, time and date.

REFERENCES

Previous Work Done On The Subject Globally:

Following patent exist on the subject:

a. AMR (Automatic Meter Reading) augmented by wireless communication system of energy meter used with relay control and GPRS.

b. Measuring of energy meter and monitoring of IR sensor (placed in the screw portion of energy meter seal) through PIC microcontroller.

AT MCS

No previous work has been done on this project at MCS, however another dimension in the same context has been exploited in this year that has resulted in development of smart meters with theft control system.

BIBLIOGRAPHY

[1] Abhinandan Jain, Dilip Kumar, Jyoti Kedia ‘‘Design and Development of GSM based Energy Meter’’ in IJERT, 2012.

[2] S. Arun, Dr, Sidappa Naidu, “Design and Implementation of Automatic Meter Reading System Using GSM, ZIGBEE through GPRS” in International journal of advanced research in computer science software engineering, 2012.

[3] GSM Module [http://www.open-electronics.org/gsm-remote-control-part-4-sim900/]

Appendix A

CODE

```
     Device = 16F877A       'this will include header file of
the microcontroller we are using
        XTAL = 11.0592         'crystal with microcontroller
that we are using
          LCD_DTPIN = PORTD.4
          LCD_RSPIN = PORTD.1
          LCD_ENPIN = PORTD\\\\\\\\\\\\\\\\\\\\\\
          LCD_INTERFACE = 4   ' 4-bit Interface
        LCD_LINES = 4
          LCD_TYPE = 0
          LCD_COMMANDUS = 4000
          LCD_DATAUS = 100
          Declare SERIAL_BAUD = 9600 '            '
          RSOUT_PIN = PORTC.6        '
          RSOUT_MODE = TRUE          '
          RSOUT_PACE = 1             '  serial port of
microcontroller setting for comunication with gsm modem
          RSIN_PIN = PORTC.7         '
          RSIN_MODE = TRUE           '
        Declare HSERIAL_BAUD = 9600     '              ' Set
baud rate to 9600
        HSERIAL_RCSTA = %10010000    '   ' Enable serial port
and continuous receive
        HSERIAL_TXSTA = %00100100    '   ' Enable transmit and
asynchronous mode
        HSERIAL_CLEAR = On         '         ' Enable Error
clearing on received characters
         ALL_DIGITAL = TRUE   ' Set PORTA and PORTE to all
digital
        PORTB_PULLUPS=true  'enabling portb pullups
        '''''''''''''''''''''''''''''''''''''

        Symbol rst PORTC.1  '
        Symbol dta PORTC.3  ' pin assignment for rtc clock
ds1302 time keeping chip
        Symbol clk PORTC.2  '
        Dim t_b As Bit

        '''''''''''''''''''''''''''''''''''''
        Dim time_byteh As Byte            '
        Dim time_bytel As Byte             '
```

```
        Dim temp_array[4] As Byte          '
        Dim temp_arrayl[4] As Byte         '
                                           '
        Dim AD_RESULT[8] As Word           '    variables that
are used in our coding
        Dim value[8] As Word               '
        Dim difference_c As Byte
'
                                           '
                                           '
        Dim count_er As Byte               '
        Dim temp_array_counter As Byte     '
                                           '
        'Dim time_counter As DWord          '
        Dim sampling_complete As Bit       '
        Dim sms_array[40] As Byte          '
        Dim sms_counter As Byte            '
        Dim sm_s As Byte                   '
        Dim emty_counter As Byte           '
        Dim sample_counter As Byte         '
        Symbol sim300=PORTB.0            ' this is pin
assignment for sim300 for on off
        Symbol a1=PORTC.0                '
        Symbol in=PORTC.4                '
        Symbol b1=PORTD.0                '
        Symbol c1=PORTD.1
        Symbol load=PORTD.0            '
        Symbol led=PORTB.7               '
        Symbol led1=PORTB.6              '
      '  Dim sim_active_counter As Word
        Dim first_time_show As Bit
        Dim var_r As Float
        '--------------------------
        Dim year As Byte             '
        Dim day As Byte              '
        Dim month As Byte            '
        Dim date As Byte             ' variables assigned for rtc
data
        Dim hour As Byte             '
        Dim mint As Byte             '
        Dim sec As Byte              '
        Dim control As Byte          '
        '--------------------------
        Dim array[2] As Word
        Dim p_c1 As Float
        Dim p_c2 As Float
        ADCON1 = %10000001'1101      ' making port A pin analog
```

```
        TRISC=%00010000              'making portc pins input
and output 1 means input 0 means output
        TRISB=0
        TRISD=0
        PORTC=0

        count_er=0

        sampling_complete=0


 '       DelayMS 1000
 '       count_er=ERead 1
  '      If count_er<>"$" Then
  '      Cls
  '      GoSub set_time
  '      Print "Time Set"
  '      EWrite 1,["$"]
  '      Else
  '      Cls
  '      GoSub get_time
  '      GoSub show_time
  '      EndIf
        DelayMS 2000
        GoSub set_time
        Cls
        Print "E.T.D S"

       Low sim300      '
        DelayMS 2000     ' this send a pulse high to low on
sim300 on off pin
    '    GoSub set_time   ' this will set the time on rtc

        High sim300
        DelayMS 5000      '
        DelayMS 5000      '
        DelayMS 5000      ' this is delay for sim900 gsm modem
to get connected with network
        DelayMS 3000      '
        DelayMS 5000      '
       DelayMS 5000      '
          Cls
        first_time_show=0
      Repeat:
      HRSOut "A":DelayMS 500 : HRSOut "T":DelayMS 500 : HRSOut
"\r" : DelayMS 2000
      Inc first_time_show
```

```
      Until first_time_show=3
      first_time_show=0

         HRSOut "A":DelayMS 500 : HRSOut "T":DelayMS 500 :HRSOut
"E":DelayMS 500 : HRSOut "0":DelayMS 500 : HRSOut "\r" : DelayMS
2000
        While 1=1          ' start of an infinite loop
        GoSub get_time     'get time check what is the time
        DelayMS 500     'half second delay
        GoSub show_time
        GoSub getsample
        If mint=$0 Or mint=$10 Or mint=$20 Or mint=$30 Or
mint=$40 Or mint=$50 Then
        GoSub send_sms
        EndIf
        Toggle led      'toggle led means if led is on then off
it and if it was off then on it
        Wend  ' repeat the whole thing again

        send_sms:
        HRSOut "A":DelayMS 50: HRSOut "T":DelayMS 50: HRSOut
"\r" : DelayMS 50:
        DelayMS 100
        HRSOut "A":DelayMS 50: HRSOut "T":DelayMS 50: HRSOut
"+":DelayMS 50: HRSOut "C": DelayMS 50:HRSOut "M":DelayMS
50:HRSOut "G": DelayMS 50:HRSOut "F":DelayMS 50: HRSOut
"=":DelayMS 50: HRSOut "1":DelayMS 50: HRSOut "\r": DelayMS 50
        DelayMS 100
        HRSOut "A":DelayMS 50: HRSOut "T":DelayMS 50: HRSOut
"+":DelayMS 50: HRSOut "C":DelayMS 50: HRSOut "M": DelayMS 50:
HRSOut "G":DelayMS 50: HRSOut "S":DelayMS 50: HRSOut "=":DelayMS
50
        HRSOut "\""
        HRSOut "0":DelayMS 50: HRSOut "3":DelayMS 50: HRSOut
"4":DelayMS 50: HRSOut "5":DelayMS 50
        HRSOut "9":DelayMS 50: HRSOut "5":DelayMS 50: HRSOut
"8":DelayMS 50: HRSOut "8":DelayMS 50: HRSOut "6": DelayMS
50:HRSOut "8":DelayMS 50: HRSOut "3" :DelayMS 50
        HRSOut "\""
        DelayMS 50
        HRSOut "\r"
        DelayMS 1000

        HRSOut "$":DelayMS 10
        HRSOut "E":DelayMS 100:HRSOut "T":DelayMS 100:HRSOut
"S":DelayMS 100:HRSOut ",":DelayMS 100:
        GoSub show_time_mobile
```

```
        ' hrsout ",":delayms 100
         HRSOut "00" : DelayMS 100 : HRSOut "01," : DelayMS 100
         HRSOut "Pc,":DelayMS 100 : HRSOut Dec p_c1 :DelayMS 100
         HRSOut ",Lc,":DelayMS 100 : HRSOut Dec p_c2:DelayMS 100
          HRSOut ",":DelayMS 50
         If t_b=1 Then
         HRSOut "T" : DelayMS 100
         EndIf
         If t_b=0 Then
         HRSOut "N" : DelayMS 100
         EndIf
         HRSOut "*" : DelayMS 1000


         HRSOut 26
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         DelayMS 2000
         HRSOut "A":DelayMS 50: HRSOut "T":DelayMS 50: HRSOut
"\r" : DelayMS 50:
         DelayMS 100
         HRSOut "A":DelayMS 50: HRSOut "T":DelayMS 50: HRSOut
"+":DelayMS 50: HRSOut "C": DelayMS 50:HRSOut "M":DelayMS
50:HRSOut "G": DelayMS 50:HRSOut "F":DelayMS 50: HRSOut
"=":DelayMS 50: HRSOut "1":DelayMS 50: HRSOut "\r": DelayMS 50
         DelayMS 100
         HRSOut "A":DelayMS 50: HRSOut "T":DelayMS 50: HRSOut
"+":DelayMS 50: HRSOut "C":DelayMS 50: HRSOut "M": DelayMS 50:
HRSOut "G":DelayMS 50: HRSOut "S":DelayMS 50: HRSOut "=":DelayMS
50
         HRSOut "\""
         HRSOut "0":DelayMS 50: HRSOut "3":DelayMS 50: HRSOut
"0":DelayMS 50: HRSOut "0":DelayMS 50
         HRSOut "5":DelayMS 50: HRSOut "5":DelayMS 50: HRSOut
"5":DelayMS 50: HRSOut "4":DelayMS 50: HRSOut "4": DelayMS
50:HRSOut "8":DelayMS 50: HRSOut "8" :DelayMS 50
         HRSOut "\""
         DelayMS 50
```

```
        HRSOut "\r"
        DelayMS 1000
    HRSOut "$":DelayMS 10
        HRSOut "E":DelayMS 100:HRSOut "T":DelayMS 100:HRSOut
"S":DelayMS 100:HRSOut ",":DelayMS 100:
        GoSub show_time_mobile
      '  HRSOut ",":DelayMS 100
        HRSOut "00" : DelayMS 100 : HRSOut "01," : DelayMS 100
        HRSOut "Pc,":DelayMS 100 : HRSOut Dec p_c1 :DelayMS 100
        HRSOut ",Nc,":DelayMS 100 : HRSOut Dec p_c2:DelayMS 100
        HRSOut ",":DelayMS 50
        If t_b=1 Then
        HRSOut "T" : DelayMS 100
        EndIf
        If t_b=0 Then
        HRSOut "N" : DelayMS 100
        EndIf
        HRSOut "*" : DelayMS 1000
        HRSOut 26
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        DelayMS 2000
        Return
        read_adc:
        AD_RESULT[0] = ADIn 0
        AD_RESULT[1] = ADIn 1
        AD_RESULT [2]= ADIn 4

        Return

        '-------------------------
set_time:
Low rst 'reset rtc
Low clk
'-----------------------
year=$15
day=$02
month=$01
```

```
date=$20
hour=$12
mint=$00
sec=$00
Set rst
SHOut dta,clk,lsbfirst,[$8e,0]
Clear rst
Set rst
SHOut dta,clk,lsbfirst,[$be,sec,mint,hour,date,month,day,year,0]
Clear rst
'-------------------------
Return
show_time:
'GoSub get_time
Cls
Cursor 1,1
Print HEX2 date,":",HEX2 month,":",HEX2 year,"/"
'Cursor 2,1
Print HEX2 hour,":",HEX2 mint',":",HEX2 sec
'DelayMS 300
Return
'-------------------------
get_time:
Set rst 'ready for transforme
SHOut dta,clk,lsbfirst,[$bf]
SHIn dta,clk,lsbpre,[sec,mint,hour,date,month,day,year,control]
Clear rst
Return
'///////////////
show_time_mobile:
GoSub get_time
sec=$00
HRSOut HEX2 date : DelayMS 50
HRSOut "/" : DelayMS 50
HRSOut  HEX2 month : DelayMS 50
HRSOut "/" : DelayMS 50
HRSOut  HEX2 year : DelayMS 50
HRSOut "," : DelayMS 50

HRSOut HEX2 hour : DelayMS 50
HRSOut ":" : DelayMS 50
HRSOut  HEX2 mint : DelayMS 50
HRSOut ":" : DelayMS 50
HRSOut  HEX2 sec : DelayMS 50
HRSOut ","
DelayMS 300
Return
```

```
'/////////////////
conver_time_date:
mint=0
sec=0
Return
'///
send_keep_alive:
 HRSOut "A": DelayMS 50: HRSOut "T": DelayMS 50: HRSOut "\r":
DelayMS 50
Return
make_rtc_ready:
Set rst
SHOut dta,clk,lsbfirst,[$8e,0]
Clear rst
Return
'''
 getsample:
       array[0]=0
       array[1]=0
       For count_er=0 To 99 Step 1
       array[0]= array[0]+ ADIn 1
       array[1]= array[1]+ ADIn 4
       Next
       p_c1=(array[0]/100)/204.8 : p_c1=p_c1/2.01
       p_c2=(array[1]/100)/204.8 : p_c2=p_c2/2.01
       Cursor 2,1
       Print "P ",Dec p_c1,
       Cursor 2,9
       Print "N ",Dec p_c2 ,"A"

       If (p_c1-p_c2)>0.2 Then
       Inc difference_c
       Else
       difference_c=0
       Low load
       EndIf
       If difference_c > 5 Then
       t_b=1
       GoSub send_theft_msg
       Else
       t_b=0
       EndIf
       Return
       ''''''
       send_theft_msg:
       High load
       GoSub send_sms: Return
```

Appendix B

Timeline & Demonstration Outline

Ser	Task	2014						2015				
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	**Learning Micro controller Programing**											
2	**Requirement Engineering**											
3	**Design & Architecture**											
4	**Coding/Implementation**											
5	**Testing(Unit/Integration)**											
6	**Testing**											
7	**Documentation**											

Table # [1]

Appendix C

COST BREAKDOWN

2 * PIC Micro controller	1000
2 * GSM modems	10000
Bridge Rectifier	500
Operational Amplifier LM358	500
Real Time Clock DS1302	500
4* Current Transformers	1600
Adopter	800
LED & bulbs	250
2*LCD LM016l	2000
Capacitor	100
Resistor	100
Crystal Oscillator	250
Microcontroller Burner	3000
Model preparation and assembling	3000
2*SIM cards	500
Total	24100

Table[2]