CHAPTER 1

INTRODUCTION

1.1 General Introduction

This report is conceived as an idea to ease the lives of those among us who are unfortunate enough to have lost the ability to move their legs due to significant amount of paralysis, accident or due to old age. Many differently abled people usually depend on others in their daily life especially in moving from one place to another. For the wheelchair users, they need continuously someone to help them in getting the wheelchair moving. Their lives are made difficult by the fact that there is lack of an intuitive control system for their wheelchairs that allows moving independently.

The term "IoT- Internet of Things" is regarded as next generation computing of Internet Connected Devices and is now evolving towards "Internet of Everything". IoT is playing a crucial role in transformation of "Traditional Desktop Computing" to "Next Generation Everywhere Computing". Nowadays, the trend is shifting towards Next Generation High Speed, QoS Wireless Communication Standards and High Speed Mobile Broadband Networks like 4G, LTE and even 5G. With IoT, various gadgets like RFID devices, Sensors, Mobile Phones, Tablets, Wearable Gadgets etc. can be connected to Internet and facilitates wider connectivity. Internet of Things (IoT) lays strong foundation for connecting "Things" over Internet so that "Things" can be operated anywhere and everywhere and by anyone and everyone. In IoT environment, sensors and RFID technology provides basis to connect the things and enabling things to share information so that data can be stored, processed and presented in easy understandable form. IoT facilitates smart connectivity and context-aware computing via network

resources. To make Today's World IoT Compliant, huge transformation is required in present computing system in terms of new smart devices, new communication protocols and security to make existing world to be known as "SMART IoT World". The term IoT- Internet of Things was coined by "Kevin Ashton" in 1999 with regard to Supply Chain Management. But seeing the current scenario, the term IoT has been expanded to wide range of applications like Utilities, Transport, Wearable Technologies, Smart Home Automation and even Military Applications like Robotics and Drones. IoT technology is transforming the way we live life every day. From consumer point of view, new IoT products like Home Automation, wearable devices, Household devices etc. are evolving and IoT technology is also giving lots of benefits even to disabled people with development of various health monitoring devices, wearable medical gadgets, Remote Health Monitoring equipment's etc. IoT Technologies like Vehicle Networking, Traffic Management Intelligent Systems are integrated with sensors fitted on roads transforming traditional cities to "SMART CITIES" and overcoming various issues like Traffic Jams, Road Accidents etc. Even though, IoT technology is blessing mankind with huge transformations and improvements in day to day activities, but on the other hand, IoT technology is surrounded by many issues, challenges and drawbacks with regard to security, privacy, data management, hardware failure (sensors failure) etc. which has to be combated as soon as possible for its wide adoption. A large number of IT firms and even research organizations worldwide are seeing lots of potential in the growth of IoT and has released various reports regarding it. CISCO has projected- 24 Billion connected IoT devices by 2019, Morgan Stanley projected- more than 75 Billion networked devices by 2020. Huawei projects- 100 Billion IoT devices by 2025. So, seeing the data projections IT Industry-R&D Incubation centers, Specialized R&D Institutions and Academia Researchers across the nook and corner of the world are researching on various IoT product developments and also on various issues pertaining regarding IoT effective implementations. Considering the huge potential of IoT Technology, current and undergoing development, a novel IoT based wearable Gadget- Data Glove- based on Arduino Technology integrated with varied Sensors like Temperature, Ambient Light and

Accelerometer using 2.4 GHz Wireless Module for transmission of Data is developed and proposed in this research paper.

1.2 Statement of problem

In Conventional metering system to measure electricity consumption the energy provider company hire persons to visit each house and record meter reading manually which is used for billing, the bill then sent to consumer by post or hand delivery, this is not only sluggish but laborious, with the company having no control over these meters. There is a stark amount of revenue loss being incurred by our country due to energy theft which is a serious problem, people try to manipulate meter reading by adopting various corrupt practices such as current reversal, partial earth fault condition, bypass meter, magnetic interference etc.

With the aid of this project a definite solution is proffered which allows power companies to have total control over energy meters and have real time information of same from a remote location with little human effort and at reduced cost as compared to conventional methods.

1.3 Objective of project

The purpose of this project is the remote monitoring and control of the domestic energy meter; its aims includes: to design a circuit which continuously monitors the meter reading and sends message to electricity company, programming of the GSM MODEM with AT (Attention) command sequence, interfacing the programmable chip with the personal computer,

interfacing the programmable chip with the energy meter, interfacing of GSM MODEM with the programmable chip, sending messages from the remote phone to control device.

1.4 Organization of Thesis

In this project we are making an smart energy meter that will deal with the problem of billing . We often step into the cases where the officer concerned with the bill generation does not come and we do not know the procedure in that case this project can the golden opportunity for the problem. This project can also solve the problem where people get away with the bills. For implementing this project we have following chapters which containing-

Chapter 1 containing introduction and objective of the project

Chapter 2 containing literature survey on GSM Modem and Authentication and access control in IOT

Chapter 3 containing methods for implementation of this project which has detailed block diagram, circuit working, circuit diagram and principle.

Chapter 4 containing detailed description of hardware and software used in system with flowchart and algorithm of project.

Chapter 5 containing future scope and conclusion related to the project and reference.

1.5 Block Diagram

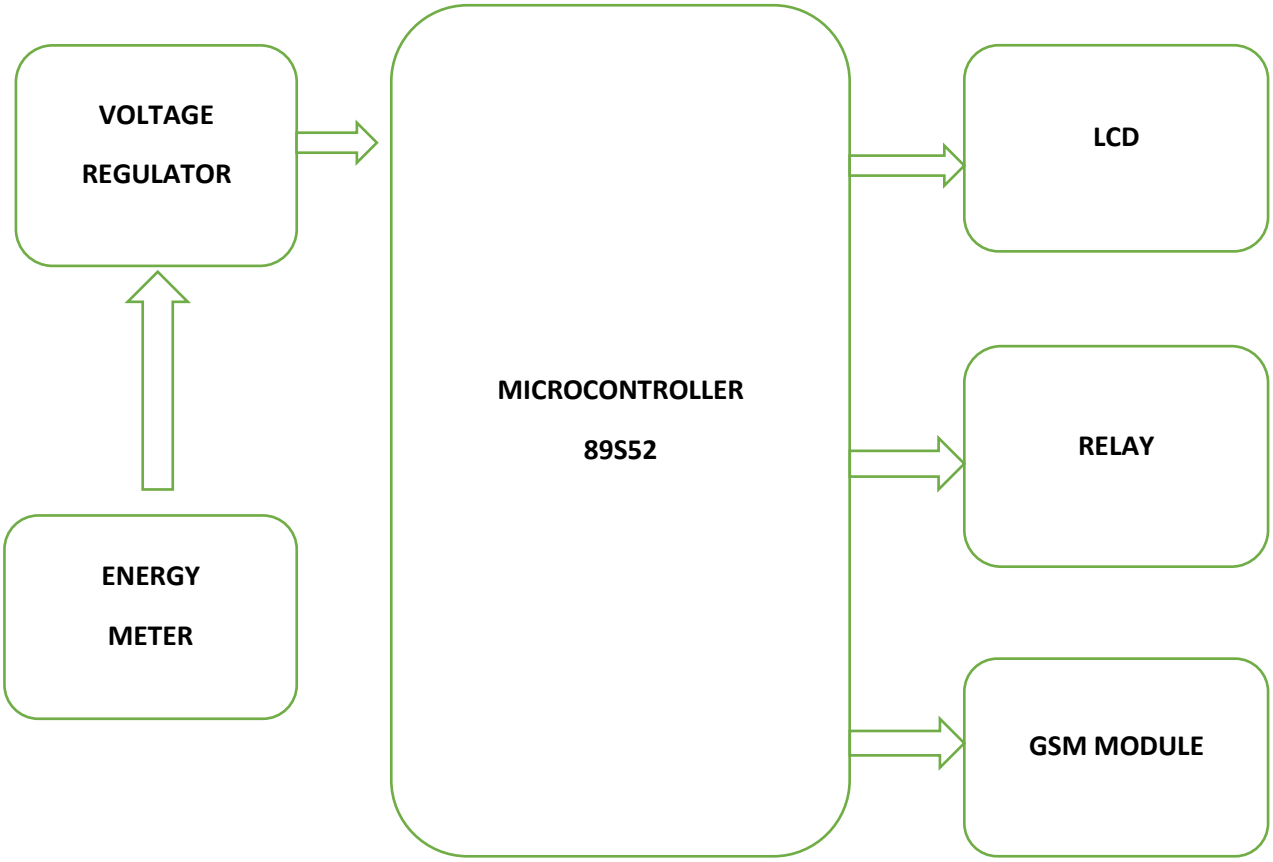

Figure 1.1 Block Diagram

CHAPTER 2
LITERATURE SURVEY

2.1 Introduction

Electrical metering instrument technology has come a long way from what it was more than 100 years ago. From the original bulky meters with heavy magnets and coils, there have been many innovations that have resulted in size & weight reduction in addition to improvement in features and specifications. Resolution and accuracy of the meter have seen substantial improvements over the years. Introduction of the digital meter in the later part of last century has completely changed the way Electrical parameters are measured. Starting with Voltmeters & Ammeters, the digital meter has conquered the entire spectrum of measuring instruments due to their advantages like ease of reading, better resolution and rugged construction. Of particular significance is the introduction of the Electronic Energy Meter in the mid eighties.

Now a days, the energy consumption and energy distribution has became a big subject for discussion because of huge difference in energy production and consumption. In this regard, energy consumers are facing so many problems due to the frequent power failures; another important reason for power cuts is due to the un-limited energy consumption of rich people. In this aspect, to minimize the power cuts and to distribute the energy equally to all areas, some restriction should have over the power consumption of each and every energy consumer, and according to that the Government should implement a policy, by introducing Autonomous Energy Meters everywhere in domestic sector. Hence, the need has come to think on this line and a solution has to be emerged out. Smart energy meter can easily take readings and we can reduce the miss usage of power and also here we majorly decrease the bill of user by alerting them with a alert message before doubling the unit charge.

2.2 Working Operation

The smart energy meter working is here to give a consumed units to the user and indicate the units to the user before reaching reference units that reference unit is fixed by the server of main pc at that reference unit .unit rate will be increase so before reaching that point smart meter indicates to the user for this purpose in this system ARM7 and energy meter and GSM network are using. In the power supply unit we used power supply circuit which required to convert AC signal to DC signal and also to reduce the amplitude of the signal. The available voltage signal from the mains is 230V/50Hz which is an AC voltage, but the required is DC voltage with the amplitude of +5V and +12V for various applications.

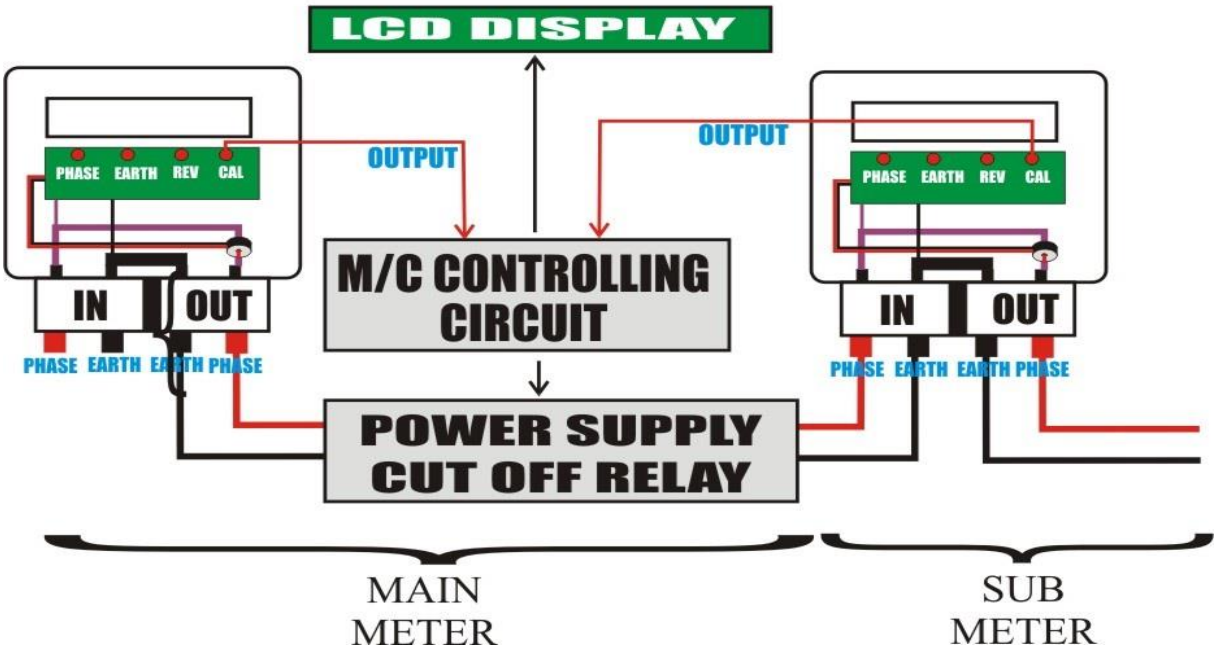

Figure 2.1 Connections for the Meter

Input is given to the meter from the main power supply which is 230v for home appliances this is given to meter from the bottom side phase and neutral the meter starts counting when

power supply is ON phase LED indicates supply position whether it is ON or OFF and in this energy meter we having call LED this call LED blink 3200 times per one unit after one unit micro controller reads consumed units and counter will get increase one unit we set the certain time that is one month after that one month it sends SMS to the user by using GSM. GSM module is used to establish communication between a computer and a GSM-GPRS system.

2.3 Existing System

In existing system either an electronic energy meter or an electro-mechanical meter is fixed in the premise for measuring the usage. The meters currently in use are only capable of recording kWh units. The kWh units used then still have to be recorded by meter readers monthly, on foot.

The recorded data need to be processed by a meter reading company. For processing the meter reading, company needs to firstly link each recorded power usage datum to an account holder and then determine the amount owed by means of the specific tariff in use many systems built on various platforms have been proposed by different research groups all over the world for Automatic Meter Reading.

Tele watt meters were implemented to transmit data on monthly basis to a remote central office through a dedicated telephone line and a pair of modems. A microprocessor or DSP-based meter is used in this to measure the electricity consumption of multiple users in a residential area. A master PC at the control centre was used to send commands to a remote meter, which in turn transmitted data back, using the Power Line Communication technique. These techniques were mainly implemented in areas that had a fixed telephone network. Bluetooth energy meters were designed and implemented in some areas where several meters in close proximity, communicated wirelessly with a Master PC.

In this measurement technique that encompasses the GSM network as a mean of transmitting energy data is more relevant. The GSM network offers most coverage in most developed and developing countries. This method is also effective in rural areas, which are not densely populated, and in which, most people do nothave access to a fixed telephone network. So in a country like India we need to focus more on this method as it can be implemented very easily and effectively.In this system PIC controller is used to control . output pulses from the metering IC are counted using the default timer of PIC MCU. The signal from meter through Octocoupler is normally high and the high to low transition of this voltage wave indicates the occurrence of a pulse. The counting of low pulse is an inefficient method as improper grounding issues may even be counted as a pulse by the device. So the produced pulse is reversed before applying to the counter. A TTL compatible inverter circuit is used for this purpose.

CHAPTER 3

METHODOLOGY

3.1 Proposed System

In Existing system PIC is used for controlling In proposed system we are using ARM7 microcontroller this system developed for automatic reading and instant billing and for utility off and on before and after paying bill. PIC Microcontroller needs more clock cycles compared with ARM7 micro controller so its operation speed is low and PIC having separate memory spaces for RAM and program memory but ARM7 having harward architecture. C compiler choice is limited in PIC but in ARM7 compiler is more suitable for any operation it also more efficient in console functions. This proposed system operate with high speed and it will sends the messge before increasing of unit charge by using data provided in the main server system for this here using GSM system which uses GPRS network for connecting.

So,these will increase electricity bill more so by using this proposed system we can reduce majorly.It usefull for both the user and electricity board it reduces human needs by providing services using cellular network and visual studio.

3.2 Interfacing

This project consists of following blocks ARM7 controller is central for all controlling of this smart energy meter. Energy meter is another important one in this system which is used for live reading of electricity consumption and which is interfaced with controller

to communicate with server and which operates according server commands. The smart energy meter working is here to give a consumed units to the user and indicate the units to the user before reaching reference units that reference unit is fixed by the server of main pc at that reference unit .unit rate will be increase so before reaching that point smart meter indicates to the user for this purpose in this system ARM7 and energy meter and GSM network are using.

In the power supply unit we used power supply circuit which required to convert AC signal to DC signal and also to reduce the amplitude of the signal. The available voltage signal from the mains is 230V/50Hz which is an AC voltage, but the required is DC voltage with the amplitude of +5V and +12V for various applications. In this section we have Transformer, Bridge rectifier, are connected serially and voltage regulators 7805 and 7812 for +5V and +12V via a 1000µF capacitor in parallel are connected parallel. Each voltage regulator output is again is connected to the capacitors connected parallel through which the corresponding output +5V or +12V are taken the LPC 2148 is operating with 3.3v so by using an adaptor which converts 230v to 5v dc is connected we connect either ac or dc converted adaptor in LPC 2148 we have bridge rectifier which converts into dc if we given supply in ac.

The LPC2148 microcontrollers are based on a 32 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate.

For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. In this single phase analog energy meter is used to connecting load and getting consumed units input and output connections are given as shown in bellow figure.

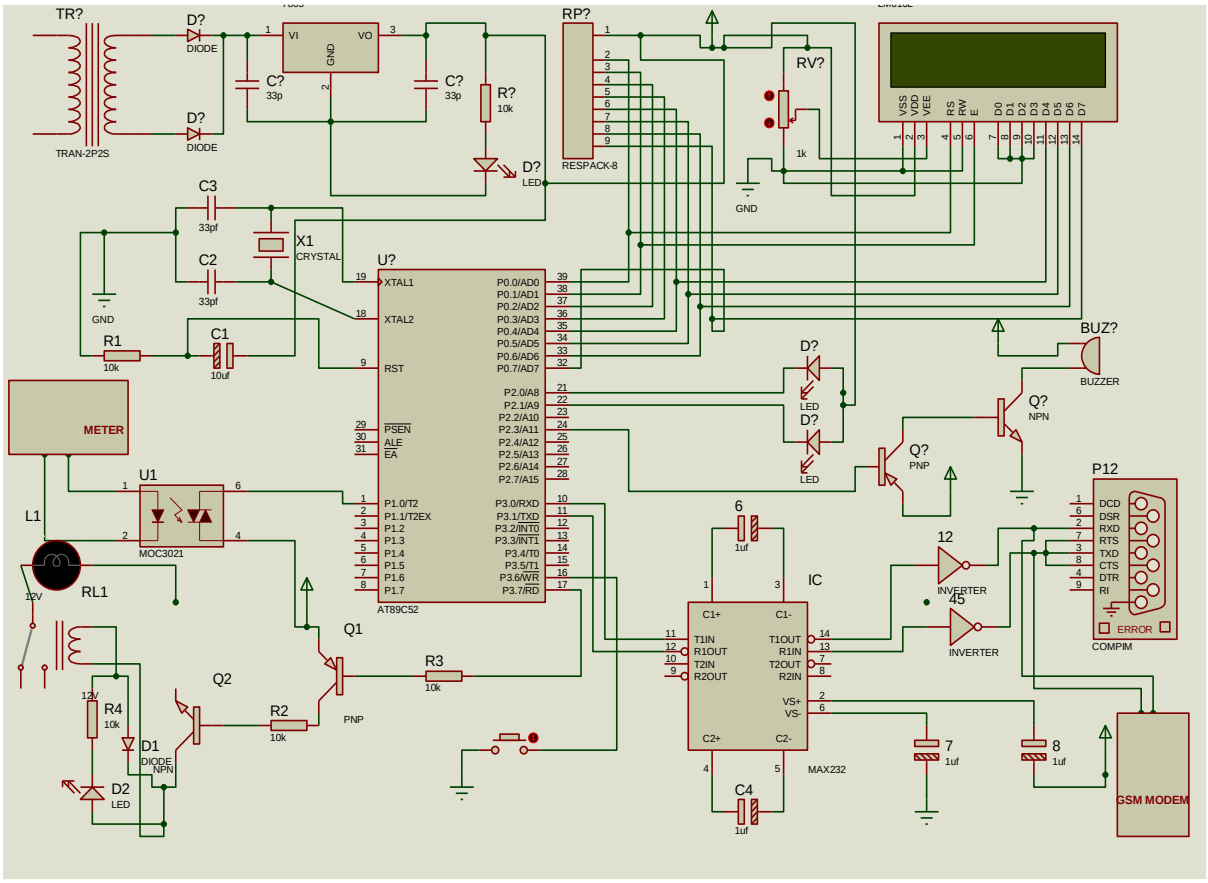

Figure 3.1 Circuit Diagram of Smart Meter

Input is given to the meter from the main power supply which is 230v for home appliances this is given to meter from the bottom side phase and neutral the meter starts counting when power supply is ON phase LED indicates supply position whether it is ON or OFF and in this energy meter we having call LED this call LED blink 3200 times per one unit after one unit micro controller reads consumed units and counter will get increase one unit we set the certain time that is one month after that one month it sends SMS to the user by using GSM. GSM module is used to establish communication between a computer and a GSM-GPRS system.

Global System for Mobile communication is an architecture used for mobile communication in most of the countries. Global Packet Radio Service GPRS is an extension of GSM that enables higher data transmission rate. GSM module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces for computer.

Mobile Termination is interfaced with the GSM mobile network and is controlled by a baseband processor. It handles access to SIM, speech encoding and decoding, signaling and other network related tasks.

3.3 Hardware used

The component used are as listed below :

I. Microcontroller (AT89S52)
II. Capacitor (1000uf, 470uf)
III. Resistor (1k, 10k, 470)ohm
IV. Transistor (npn and pnp)
V. Diode (IN4007)
VI. Opto-coupler (pc187)
VII. Energy Meter (240V,6A)
VIII. Voltage regulator IC (LM358)

3.4 Software used

I. Proteus (circuit designing)
II. Keil
III. Ares (PCB Layout)

3.5 Significance

The significance of these project benefits the Consumers of electric service and the electric services company as it provides precise consumption information, clear and accurate billing, automatic outage information and faster recovery, better and faster customer service, smart automated processes instead of manual work, accurate information from the network load to optimise maintenance and investments, detection of tampering of meters, demand and distribution management, better company credibility, consumer meter reading which eliminates cost and inadequacies of manual reading, observation and control of energy consumption and production, this is useful for planning and power allocation purposes. The project provides learning's on the following advancements in terms of theory practice: GSM modem interfacing to Microcontroller, PC interfacing with GSM modem, energy meter interfacing to Microcontroller, embedded C programming, PCB (printed circuit board) design, LCD interfacing to Microcontroller. 1.4 SCOPE The scope of this project is to design and construct GSM based a one phase two wire energy meter with voltage rating of 220V, current of 25 -100A operating at 50Hz and interfaced 18 with a microcontroller unit and GSM module with a LCD with the wireless communication features over SMS. Within the scope of this project, the prototype model is equipped with a dedicated SIM (Subscriber Identification Module).

CHAPTER 4

HARDWARE SPECIFICATION

4.1 Microcontroller

A microcontroller is a single chip that contains the processor (the CPU), non-volatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit. Also called a "computer on a chip," billions of microcontroller units (MCUs) are embedded each year in a myriad of products from toys to appliances to automobiles. For example, a single vehicle can use 70 or more microcontrollers.

The Intel MCS-51 Harvard architecture single chip microcontroller (µC) series was developed by Intel in 1980 for use in embedded systems. Intel's original versions were popular in the 1980s and early 1990s, but has today largely been superseded by a vast range of faster and/or functionally enhanced 8051-compatible devices manufactured by more than 20 independent manufacturers including Atmel, Infineon Technologies(formerly Siemens AG),Maxim Integrated Products (via its Dallas Semiconductor subsidiary), NXP (formerly Philips Semiconductor), Nuvoton (formerly Win bond), ST Microelectronics , Silicon Laboratories (formerly Cygnal),Texas Instruments and Cypress Semiconductor.

Intel's original MCS-51 family was developed using NMOS technology, but later versions, identified by a letter C in their name (e.g., 80C51) used CMOS technology and were less power-hungry than their NMOS predecessors. This made them more suitable for battery-powered devices.

4.1.1 AT89S52 Features

It provides many functions (CPU, RAM, ROM, I/O, interrupt logic, timer, etc.) in a single package

I. 8-bit ALU, Accumulator and 8-bit Registers; hence it is an 8 bit microcontroller
II. 8-bit data bus – It can access 8 bits of data in one operation
III. 16-bit address bus – It can access 2^{16} memory locations – 64 KB (65536 locations) each of RAM and ROM
IV. On-chip RAM – 128 bytes (data memory)
V. On-chip ROM – 4 Kbyte (program memory)
VI. Four byte bi-directional input/output port
VII. UART (serial port)
VIII. Two 16-bit Counter/timers
IX. Two-level interrupt priority
X. Power saving mode (on some derivatives)

A particularly useful feature of the 8051 core is the inclusion of a Boolean processing engine which allows bit-level Boolean logic operations to be carried out directly and efficiently on internal registers and RAM. This feature helped cement the 8051's popularity in industrial control applications. Another valued feature is that it has four separate register sets, which can be used to greatly reduce interrupt latency compared to the more common method of storing interrupt context on a stack.

The MCS-51 UARTs make it simple to use the chip as a serial communications interface. External pins can be configured to connect to internal shift registers in a variety of ways, and the internal timers can also be used, allowing serial communications in a number of modes, both synchronous and asynchronous. Some modes allow communications with no external components. A mode compatible with an RS-485 multi-point communications environment is

achievable, but the 8051's real strength is fitting in with existing ad-hoc protocols (e.g., when controlling serial-controlled devices).

Once a UART, and a timer if necessary, have been configured, the programmer needs only to write a simple interrupt routine to refill the *send* shift register whenever the last bit is shifted out by the UART and/or empty the full *receive* shift register (copy the data somewhere else). The main program then performs serial reads and writes simply by reading and writing 8-bit data to stacks. MCS-51 based microcontrollers typically include one or two UARTs, two or three timers, 128 or 256 bytes of internal data RAM (16 bytes of which are bit-addressable), up to 128 bytes of I/O, 512 bytes to 64 Kb of internal program memory, and sometimes a quantity of extended data RAM (ERAM) located in the external data space. The original 8051 core ran at 12 clock cycles per machine cycle, with most instructions executing in one or two machine cycles. With a 12 MHz clock frequency, the 8051 could thus execute 1 million one-cycle instructions per second or 500,000 two-cycle instructions per second. Enhanced 8051 cores are now commonly used which run at six, four, two, or even one clock per machine cycle, and have clock frequencies of up to 100 MHz, and are thus capable of an even greater number of instructions per second. All SILabs, some Dallas and a few Atmel devices have single cycle cores.

4.1.2 Memory Architecture

The MCS-51 has four distinct types of memory – internal RAM, special function registers, program memory, and external data memory.Internal RAM (IRAM) is located from address 0 to address 0xFF. IRAM from 0x00 to 0x7F can be accessed directly, and the bytes from 0x20 to 0x2F are also bit-addressable. IRAM from 0x80 to 0xFF must be accessed indirectly, using the @R0 or @R1 syntax, with the address to access loaded in R0 or R1.

Special function registers (SFR) are located from address 0x80 to 0xFF, and are accessed directly using the same instructions as for the lower half of IRAM. Some of the SFR's are also bit-addressable.Program memory (PMEM, though less common in usage than IRAM and XRAM) is located starting at address 0. It may be on- or off-chip, depending on the particular model of chip being used. Program memory is read-only, though some variants of the 8051 use on-chip flash memory and provide a method of re-programming the memory in-system or in-application. Aside from storing code, program memory can also store tables of constants that can be accessed by MOVC A, @DPTR, using the 16-bit special function register DPTR.

External data memory (XRAM) also starts at address 0. It can also be on- or off-chip; what makes it "external" is that it must be accessed using the MOVX (Move external) instruction. Many variants of the 8051 include the standard 256 bytes of IRAM plus a few KB of XRAM on the chip. If more XRAM is required by an application, the internal XRAM can be disabled, and all MOVX instructions will fetch from the external bus.

4.1.3 Instruction Set

The MCS-51 instruction set offers several addressing modes, including

I. direct register, using ACC (the accumulator) and R0-R7

II. direct memory, which access the internal RAM or the SFR's, depending on the address

III. indirect memory, using R0, R1, or DPTR to hold the memory address. The instruction used may vary to access internal RAM, external RAM, or program memory.

IV. individual bits of a range of IRAM and some of the SFR's

Many of the operations allow any addressing mode for the source or the destination, for example, MOV 020h, 03fh will copy the value in memory location 0x3f in the internal RAM to the memory location 0x20, also in internal RAM. Because the 8051 is an accumulator-based architecture, all arithmetic operations must use the accumulator, e.g. ADD A, 020h will add the value in memory location 0x20 in the internal RAM to the accumulator.

One does not need to master these instructions to program the 8051. With the availability of good quality C compilers, including open source virtually all programs can be written with high level language.

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM.A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.The Flash program memory supports both parallel programming and in serial

In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible. The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash Program memory to be reconfigured even while the application is running.

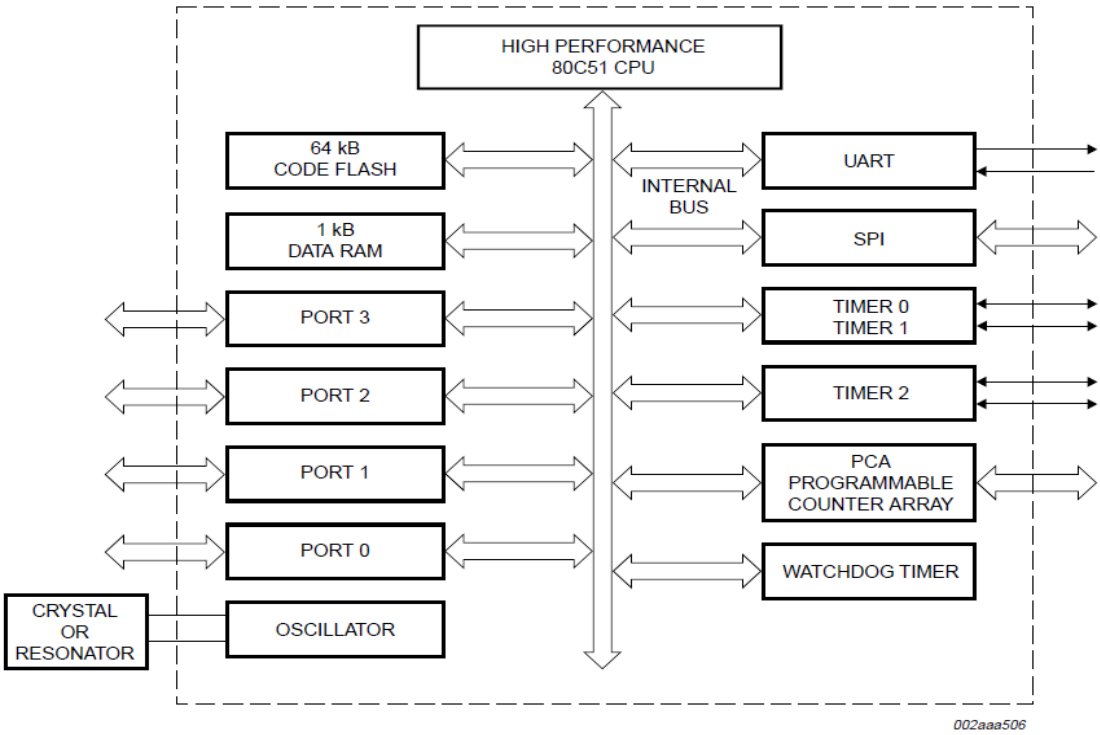

Figure 4.1 Block Diagram of AT89S52

4.1.4 Pin Description

I. 8-bit ALU, Accumulator and 8-bit Registers; hence it is an 8 bit microcontroller

II. 8-bit data bus – It can access 8 bits of data in one operation

III. 16-bit address bus – It can access 2^{16} memory locations – 64 KB (65536 locations) each of RAM and ROM

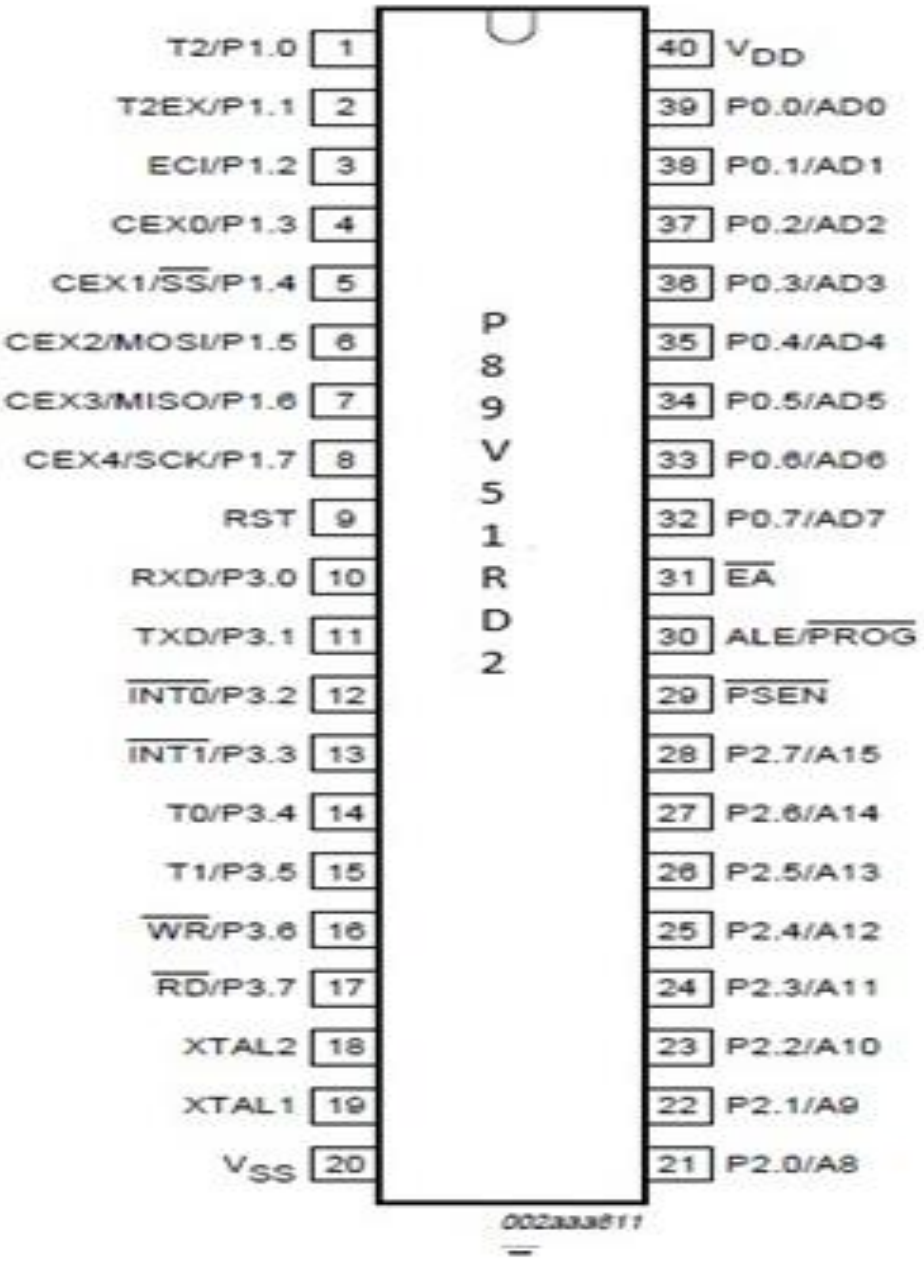

Figure 4.2 Pinouts of AT89S52

SYMBOL	PIN	TYPE	DESCRIPTION
P0.0 to P0.7	39 to 32	I/O	Port 0: Port 0 is an 8-bit open drain bi-directional I/O Port. Port 0 pins that have '1's written to them float, and in this state can be used as high-impedance inputs. Port 0 is also the multiplexed low-order address and data bus during accesses to external code and data memory. In this application, it uses strong internal pull-ups when transitioning to '1's. Port 0 also receives the code bytes during the external host mode programming, and outputs the code bytes during the external host mode verification. External pull-ups are required during program verification or as a general purpose I/O port.
PI.0 to P1.7	1 to 8	I/O with internal pull-up	Port 1: Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 pins are pulled high by the internal pull-ups

			when ‘1’s are written to them and can be used as inputs in this state. As inputs, Port 1 pins that are externally pulled LOW will source current (IIL) because of the internal pull-ups. P1.5, P1.6, P1.7 have high current drive of 16 mA. Port 1 also receives the low-order address bytes during the external host mode programming and verification
P1.0	1	I/O	T2: External count input to Timer/Counter 2 or Clock-out from Timer/Counter 2
P1.1	2	I	T2EX: Timer/Counter 2 capture/reload trigger and direction control
P1.2	3	I	ECI: External clock input. This signal is the external clock input for the PCA.
P1.3	4	I/O	CEX0: Capture/compare external I/O for PCA Module 0.

			Each capture/compare module connects to a Port 1 pin for external I/O. When not used by the PCA, this pin can handle standard I/O.
P1.4	5	I/O	SS: Slave port select input for SPI CEX1: Capture/compare external I/O for PCA Module 1
P1.5	6	I/O	MOSI: Master Output Slave Input for SPI CEX2: Capture/compare external I/O for PCA Module 2
P1.6	7	I/O	MISO: Master Input Slave Output for SPI CEX3: Capture/compare external I/O for PCA Module 3
P1.7	8	I/0	SCK: Master Output Slave Input for SPI CEX4: Capture/compare external I/O for PCA Module 4
P2.0 to P2.7	21 to 28	I/O with internal pull-up	Port 2: Port 2 is an 8-bit bi-directional I/O port with internal pull-ups.

			Port 2 pins are pulled HIGH by the internal pull-ups when ‘1’s are written to them and can be used as inputs in this state. As inputs, Port 2 pins that are externally pulled LOW will source current (IIL) because of the internal pull-ups. Port 2 sends the high-order address byte during fetches from external program memory and during accesses to external Data Memory that use 16-bit address (MOVX@DPTR). In this application, it uses strong internal pull-ups when transitioning to ‘1’s. Port 2 also receives some control signals and a partial of high-order address bits during

P3.0 to P3.7	10 to 17	I/O with internal pull-up	Port 3: Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. Port 3 pins are pulled HIGH by the internal pull-ups when '1's are written to them and can be used as inputs in this state. As inputs, Port 3 pins that are externally pulled LOW will source current (IIL) because of the internal pull-ups. Port 3 also receives some control signals and a partial of high-order address bits during the external host mode programming and verification.
P3.0	10	I	RXD: serial input port
P3.1	11	O	TXD: serial output port
P3.2	12	I	------ INT0: external interrupt 0 input
P3.3	13	I	------ INT1: external interrupt 1 input
P3.4	14	I	T0: external count input to Timer/Counter 0

P3.5	15	I	T1: external count input to Timer/Counter 1
P3.6	16	O	----- WR: external data memory write strobe
P3.7	17	O	----- RD: external data memory read strobe
----- PSEN	29	I/O	--------- Program Store Enable: PSEN is the read strobe for external program memory. When the device is executing from internal program memory, PSEN is inactive (HIGH). When the device is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory. A forced HIGH-to-LOW input transition on the PSEN pin while the RST input is continually held HIGH for more than 10 machine cycles will cause the device to enter external host mode

			programming.
RST	9	I	Reset: While the oscillator is running, a HIGH logic state on this pin for two machine cycles will reset the device. If the PSEN pin is driven by a HIGH-to-LOW input transition while the RST input pin is held HIGH, the device will enter the external host mode, otherwise the device will enter the normal operation mode.
EA ----	31	I	External Access Enable: EA must be connected to VSS in order to enable the device to fetch code from the external program memory. EA must be strapped to VDD for internal program execution. However, Security lock level 4 will disable EA, and program execution is only possible from internal program memory. The EA pin can tolerate a high

			voltage of 12 V.
------- PROG/ALE	30	I/O	Address Latch Enable: ALE is the output signal for latching the low byte of the address during an access to external memory. This pin is also the programming pulse input (PROG) for flash programming. Normally the ALE is emitted at a constant rate of 1□6 the crystal frequencyand can be used for external timing and clocking. One ALE pulse is skipped during each access to external data memory. However, if AO is set to '1', ALE is disabled.
NC	-	I/O	No Connect
XTAL1	19	I	Crystal 1: Input to the inverting oscillator amplifier and input to the internal clock generator circuits.

XTAL2	18	0	Crystal 2: Output from the inverting oscillator amplifier.
VDD	40		POWER SUPPLY
VSS	20		GROUND

Table 4.1 Pin Description

4.2 Power Supply

All digital circuits require regulated power supply. In this article we are going to learn how to get a regulated positive supply from the mains supply.

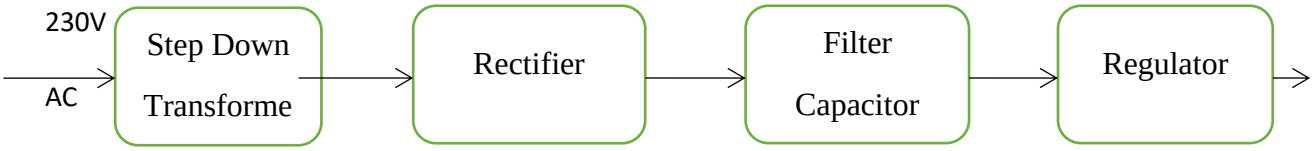

Figure 4.3 Block Diagram of Power Supply

4.2.1 Step Down Transformer

A transformer consists of two coils also called as “Windings” namely Primary & Secondary.
A transformer consists of two coils also called as “Windings” namely Primary & Secondary.

They are linked together through inductively coupled electrical conductors also called as CORE. A changing current in the primary causes a change in the Magnetic Field in the core & this in turn induces an alternating voltage in the secondary coil. If load is applied to the secondary then an alternating current will flow through the load. If we consider an ideal condition then all the energy from the primary circuit will be transferred to the secondary circuit through the magnetic field.

4.2.2 Rectifier

A rectifier is a device that converts an AC signal into DC signal. For rectification purpose we use a diode, a diode is a device that allows current to pass only in one direction i.e. when the anode of the diode is positive with respect to the cathode also called as forward biased condition & blocks current in the reversed biased condition. Rectifier can be classified as follows:

I. Half Wave Rectifier
II. Full Wave Rectifier
III. Bridge Rectifier

4.2.3 Filter Capacitor

Even though half wave & full wave rectifier give DC output, none of them provides a constant output voltage. For this we require to smoothen the waveform received from the rectifier.

This can be done by using a capacitor at the output of the rectifier this capacitor is also called as “Filter capacitor” or “Smoothing capacitor” or “Reservoir capacitor”. Even after using this capacitor a small amount of ripple will remain.

4.2.4 Voltage Regulator

A Voltage regulator is a device which converts varying input voltage into a constant regulated output voltage. Voltage regulator can be of two types

I. Linear Voltage Regulator: Also called as Resistive Voltage regulator because they dissipate the excessive voltage resistively as heat.

II. Switching Regulators : They regulate the output voltage by switching the Current ON/OFF very rapidly. Since their output is either ON or OFF it dissipates very low power thus achieving higher efficiency as compared to linear voltage regulators. But they are more complex & generate high noise due to their switching action. For low level of output power switching regulators tend to be costly but for higher output wattage they are much cheaper than linear regulators.

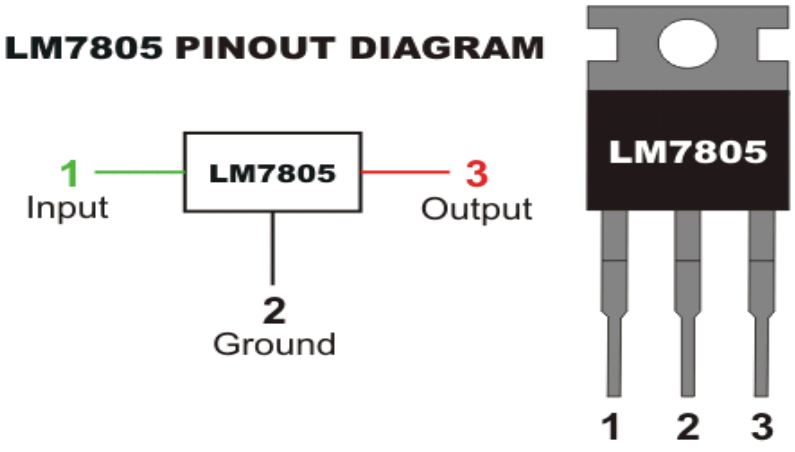

Figure 4.4 LM7805

In IC 7805 voltage regulator, lots of energy is exhausted in the form of heat. The difference in the value of input voltage and output voltage comes as heat. So, if the difference between input voltage and the output voltage is high, there will be more heat generation. Without a heat sink, this too much heat will cause malfunction.

We call, the bare minimum tolerable difference between the input and output voltage to keep the output voltage at the proper level as dropout voltage. It is better to keep the input voltage 2 to 3V greater than the output voltage, or a suitable heat sink should be placed to dissipate excess heat. We have to calculate the heat sink size properly. The following formula will give an idea of this calculation.

4.3 2X16 LCD

The LCD is a dot matrix liquid crystal display that displays alphanumeric, Kana (Japanese) character and symbols. The built - in controller & driver LSIs provide convenient connectively between a dot matrix LCD and most 4 or 8 bit microprocessors or microcontrollers. All the functions required for dot matrix liquid crystal display drive are internally provided. Internal refresh is provided by the LCD. The CMOS technology makes the device ideal for application in hand held, portable and other battery powered instruments with low power consumption. Generating custom characters on LCD is not very hard. It requires the knowledge about custom generated random access memory (CG-RAM) of LCD and the LCD chip controller.

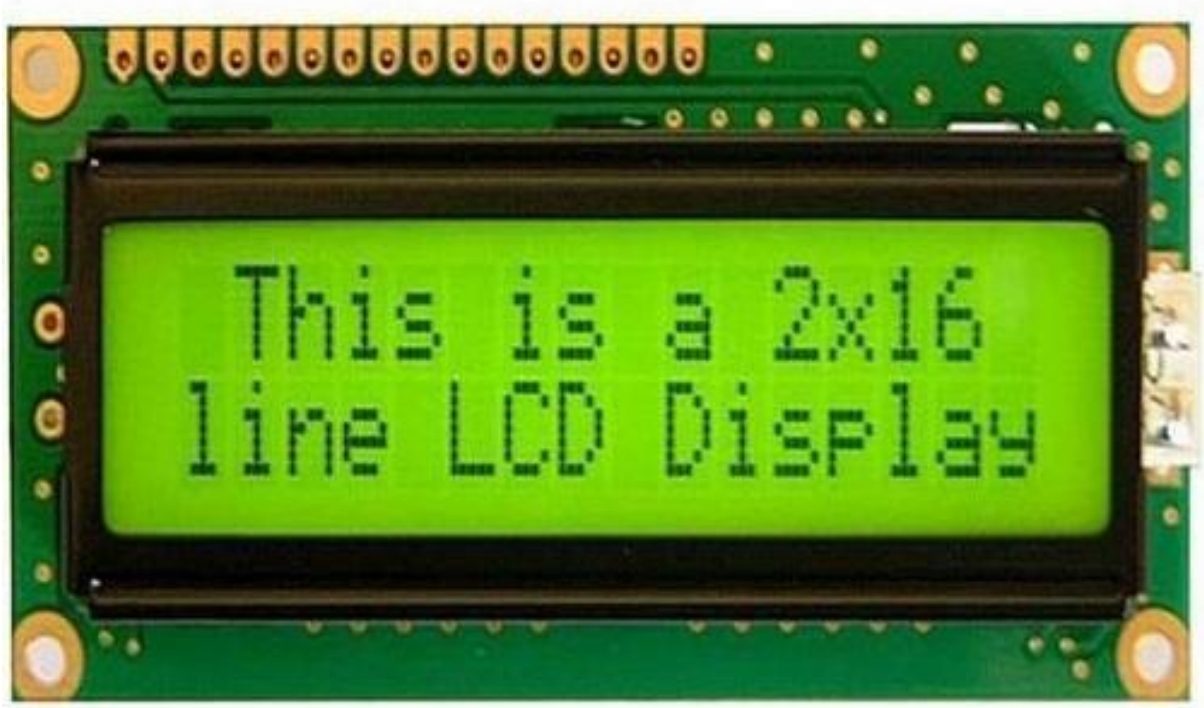

Figure 4.5 2X16 LCD Display

Most LCDs contain Hitachi_HD4478 controller. CG-RAM is the main component in making custom characters. It stores the custom characters once declared in the code. CG-RAM size is 64 byte providing the option of creating eight characters at a time. Each character is eight byte in size. CG-RAM address starts from 0x40 (Hexadecimal) or 64 in decimal. We can generate custom characters at these addresses. Once we generate our characters at these addresses, now we can print them on the LCD at any time by just sending simple commands to the LCD.

4.4 Opto Coupler (MOC3020)

An opto-isolator (also called an optocoupler, photocoupler, or optical isolator) is an electronic component that transfers electrical **signals** between two isolated circuits by using light. Opto-isolators prevent high voltages from affecting the system receiving the signal. Commercially available opto-isolators withstand input-to-output voltages up to 10 kV dc voltage transients with speeds up to 25 kV/μs. We know from our tutorials about Transformers that they can not only provide a step-down (or step-up) voltage, but they also provide "electrical isolation" between the higher voltage on the primary side and the lower voltage on the secondary side.

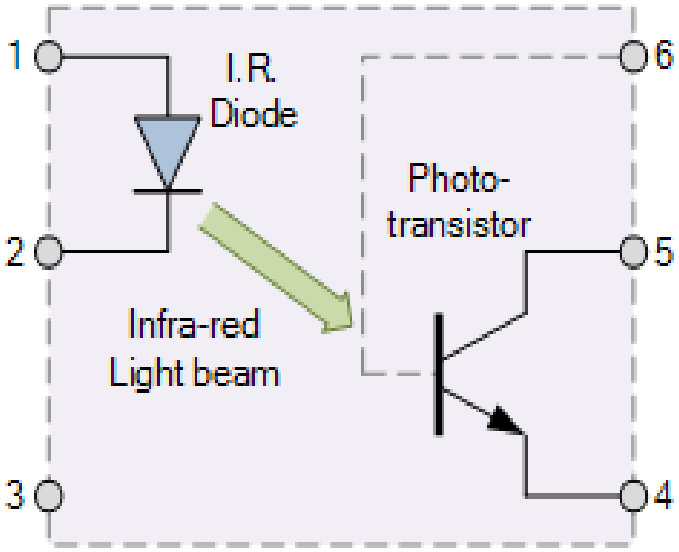

Figure 4.6 Optocoupler

4.5 Energy Meter

The meter which is used for measuring the energy utilises by the electric load is known as the energy meter. The energy is the total power consumed and utilised by the load at a particular

interval of time. It is used in domestic and industrial AC circuit for measuring the power consumption. The meter is less expensive and accurate .Energy Meter that is used is a analog type meter. This energy meter operates on 230V 6A power supply and the meter constant of the meter is around 2300 , that is for 1 unit to get displayed on the meter it has to make 2300 revolutions of the rotating disc.

4.6 Transistor

Transistors make our electronics world go 'round. They're critical as a control source in just about every modern circuit. Sometimes you see them, but more-often-than-not they're hidden deep within the die of an integrated circuit. In this tutorial we'll introduce you to the basics of the most common transistor around: the bi-polar junction transistor (BJT). In small, discrete quantities, transistors can be used to create simple electronic switches, digital logic, and signal amplifying circuits. In quantities of thousands, millions, and even billions, transistors are interconnected and embedded into tiny chips to create computer memories, microprocessors, and other complex ICs.Transistors used are:

I. NPN Transistor

II. PNP Transistor

4.7 Relay

A relay is classified into many types, a standard and generally used relay is made up of electromagnets which in general used as a switch. Dictionary says that relay means the act of passing something from one thing to another, the same meaning can be applied to this device because the signal received from one side of the device controls the switching operation on the

other side. So relay is a switch which controls (open and close) circuits electromechanically. The main operation of this device is to make or break contact with the help of a signal without any human involvement in order to switch it ON or OFF. It is mainly used to control a high powered circuit using a low power signal. Generally a DC signal is used to control circuit which is driven by high voltage like controlling AC home appliances with DC signals from microcontrollers.

CHAPTER 5

SOFTWARE SPECIFICATIONS

5.1 Proteus

The Proteus Design Suite is a complete software solution for circuit simulation and PCB design. It comprises several modules for schematic capture, firmware IDE and PCB layout that appear as tabs inside a single, integrated application. This provides a smooth AGILE workflow for the design engineer and helps products get to market faster.The Proteus PCB Design products include both schematic capture and PCB layout modules and are designed to be both easy to use and powerful. Features such as a world class shaped based autorouter, 3D Visualisation, automatic net tuning, design snippets and assembly variants save you time during product design. Meanwhile, a powerful design rule system enforces whatever rules and clearances you might need for your PCB. The routing of tracks is fully design rule aware and live clearance checking makes it easy to locate and correct any violations.

The Proteus simulation products all use the schematic capture module as the electronic circuit and our customized mixed-mode SPICE engine to run the simulation. Proteus VSM then allows the the microcontroller to also be simulated on the schematic while Proteus IoT Builder enables the design and test of the remote user interface for the circuit. For embedded engineers, Proteus VSM bridges the gap in the design life cycle between schematic capture and PCB layout. It enables you to write and apply your firmware to a microcontroller component on the schematic (PIC, AVR, ARM, 8051, etc.) and then co-simulate the program within a mixed-mode SPICE circuit simulation.

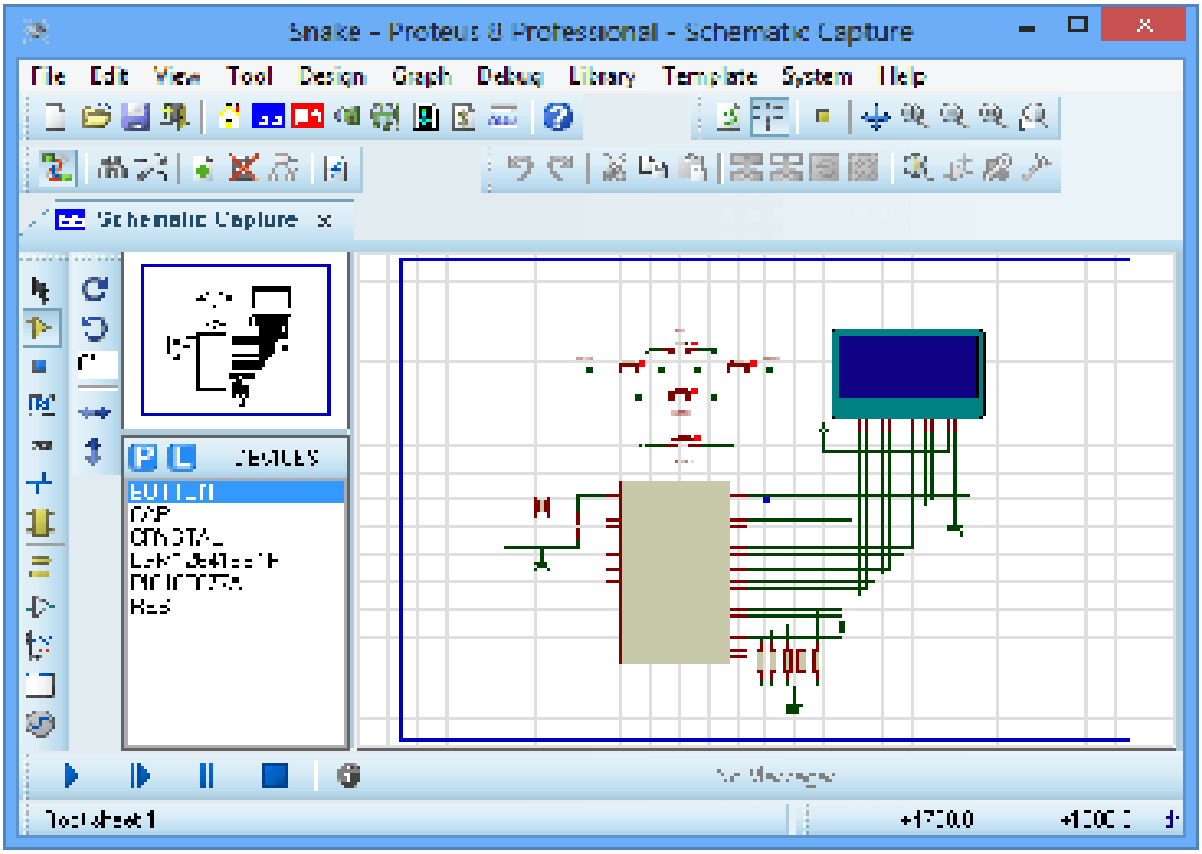

Figure 5.1 Proteus Homepage

For academics and the maker market, Proteus Visual Designer allows Arduino programs to be written with simple flowcharting methods and Arduino shields to be placed on the schematic with a mouse click. The entire Arduino system can then be simulated, tested and debugged in software. Proteus IoT builder then adds the ability to create a user interface for your phone or tablet to interact with the Arduino electronics. You can even test this by controlling the running simulation from your mobile device.

5.2 Keil

Keil MDK is the complete software development environment for a wide range of Arm Cortex-M based microcontroller devices. MDK includes the µVision IDE and debugger, Arm C/C++ compiler, and essential middleware components. It supports all silicon vendors with more than 5,500 devices and is easy to learn and use.

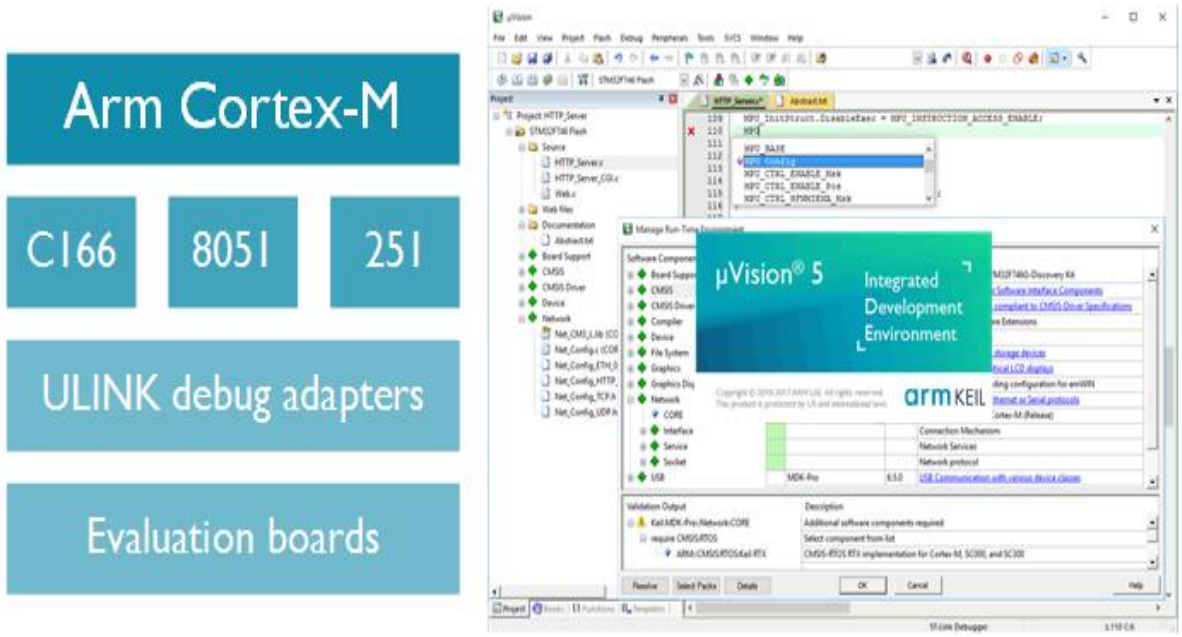

Figure 5.2 Keil Homepage

I. Arm Development Studio

Designed specifically for Arm processors, Development Studio is the most comprehensive embedded C/C++ dedicated software development toolchain for the

architecture. It includes Keil MDK and accelerates software engineering whilst helping you build robust and more efficient products.

II. 8051 Development Tools

Keil C51 is the industry-standard toolchain for all 8051-compatible devices, it supports classic 8051, Dallas 390, NXP MX, extended 8051 variants, and C251 devices. The µVision IDE and debugger integrates complete device simulation, interfaces to many target debug adapters, and provides various monitor debug solutions.

III. C166 Development Tools

Keil C166 development tools support the Infineon C166, XC166, XE166, XC2000 and ST10 microcontroller families. The µVision IDE and debugger interfaces to the Infineon DAVE code generation tool and various debug solutions including the ULINK2.

IV. Evaluation Boards

An extensive range of evaluation boards and starter kits is available from various vendors to quick start your development. Boards from Keil are available for Arm, 8051, and 166 processor-based devices.

5.3 Compiling the Program

1. Start the software **Keil uVision4**.
2. In the menu, select **Project** -> **New Project**.

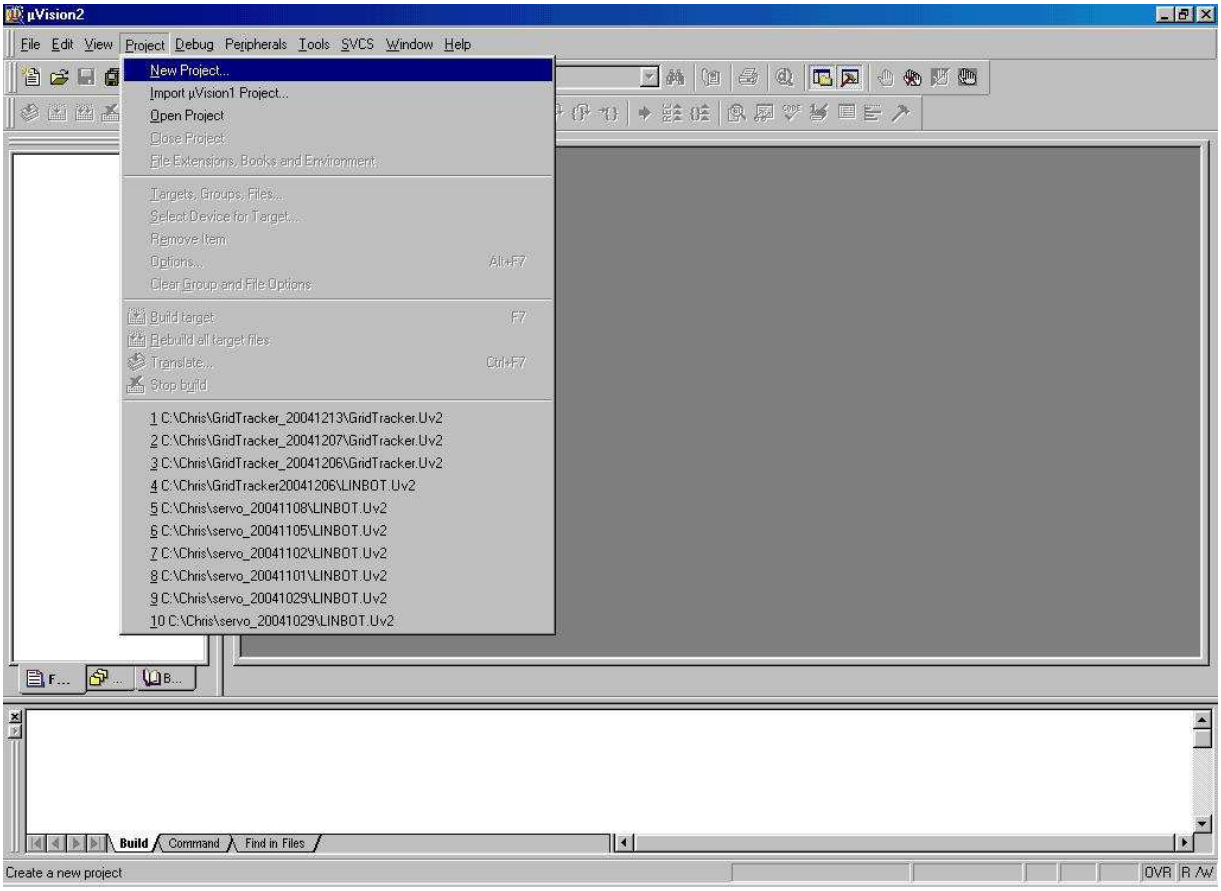

Figure 5.3 Selection of New Project

3. Select Device for Target. Click Philips -> P89V51RD2, click OK.

4. Project -> Options for Target. Select tab "**Output**". Click check box "Create HEX File". Click OK.

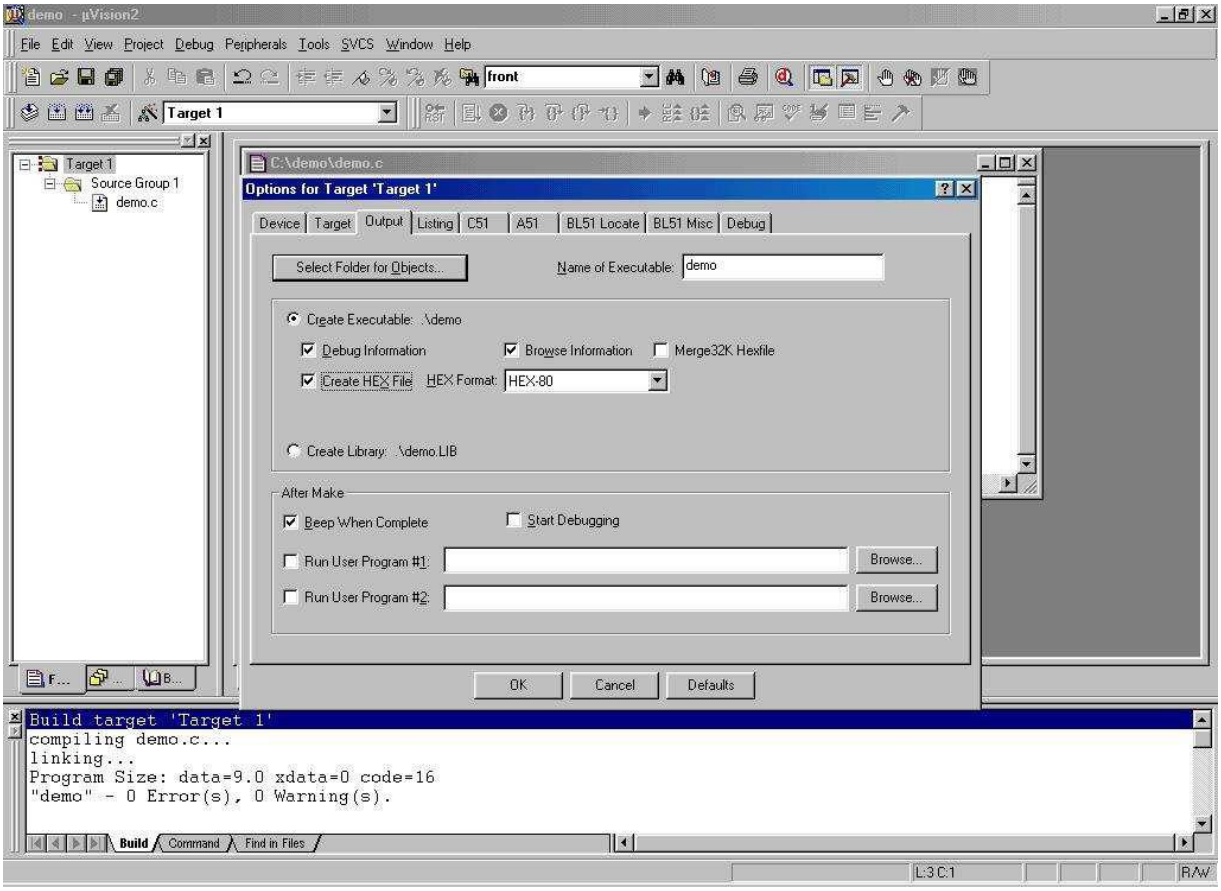

Figure 5.4 Selecting the Device

5. You can press F7 or select Project -> Build Target to compile the C program and link the object file to HEX file.

6. If everything is OK, a Hex file should be created and a message **creating new file from "main"** will prompt out.

CHAPTER 6
IMPLEMENTATION

6.1 Working

This project consists of following blocks ARM7 controller is central for all controlling of this smart energy meter. Energy meter is another important one in this system which is used for live reading of electricity consumption and which is interfaced with controller to communicate with server and which operates according server commands. Total blocks of this system is shown below:

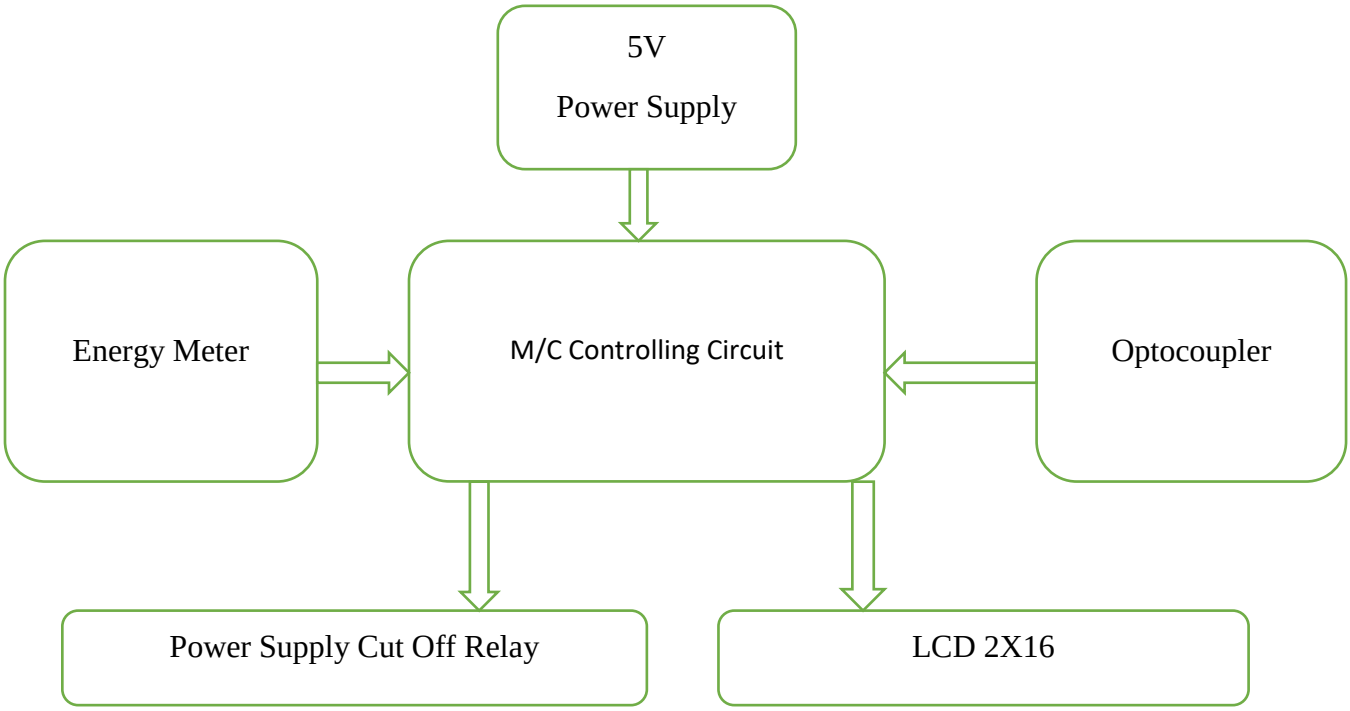

Figure 6.1 System Block Diagram

The smart energy meter working is here to give a consumed units to the user and indicate the units to the user before reaching reference units that reference unit is fixed by the server of main pc at that reference unit .unit rate will be increase so before reaching that point smart meter indicates to the user for this purpose in this system ARM7 and energy meter and GSM network are using.

In the power supply unit we used power supply circuit which required to convert AC signal to DC signal and also to reduce the amplitude of the signal. The available voltage signal from the mains is 230V/50Hz which is an AC voltage, but the required is DC voltage with the amplitude of +5V and +12V for various applications. In this section we have Transformer, Bridge rectifier, are connected serially and voltage regulators 7805 and 7812 for +5V and +12V via a 1000µF capacitor in parallel are connected parallel. Each voltage regulator output is again is connected to the capacitors connected parallel through which the corresponding output +5V or +12V are taken the LPC 2148 is operating with 3.3v so by using an adaptor which converts 230v to 5v dc is connected we connect either ac or dc converted adaptor in LPC 2148 we have bridge rectifier which converts into dc if we given supply in ac.

The LPC2148 microcontrollers are based on a 32 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. In this single phase analog energy meter is used to connecting load and getting consumed units input and output connections are given as shown in bellow figure.

Input is given to the meter from the main power supply which is 230v for home appliances this is given to meter from the bottom side phase and neutral the meter starts counting when power supply is ON phase LED indicates supply position whether it is ON or OFF and in this energy meter we having call LED this call LED blink 3200 times per one unit after one unit micro controller reads consumed units and counter will get increase one unit we set the certain time that is one month after that one month it sends SMS to the user by using GSM. GSM module is used to establish communication between a computer and a GSM-GPRS system.

Global System for Mobile communication is an architecture used for mobile communication in most of the countries. Global Packet Radio Service GPRS is an extension of GSM that enables higher data transmission rate. GSM module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces for computer. Mobile Termination is interfaced with the GSM mobile network and is controlled by a baseband processor. It handles access to SIM, speech encoding and decoding, signaling and other network related tasks.

6.2 Interfacing LCD

A Liquid Crystal Display (LCD) is an electronic device that can be used to show numbers or text. There are two main types of LCD display, numeric displays (used in watches, calculators etc.) and alphanumeric text displays. LCD screen is an electronic display module and find a wide range of applications. A LCD display modules is 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 20x4 LCD displays 20 characters per line and there are 4 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers: 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.

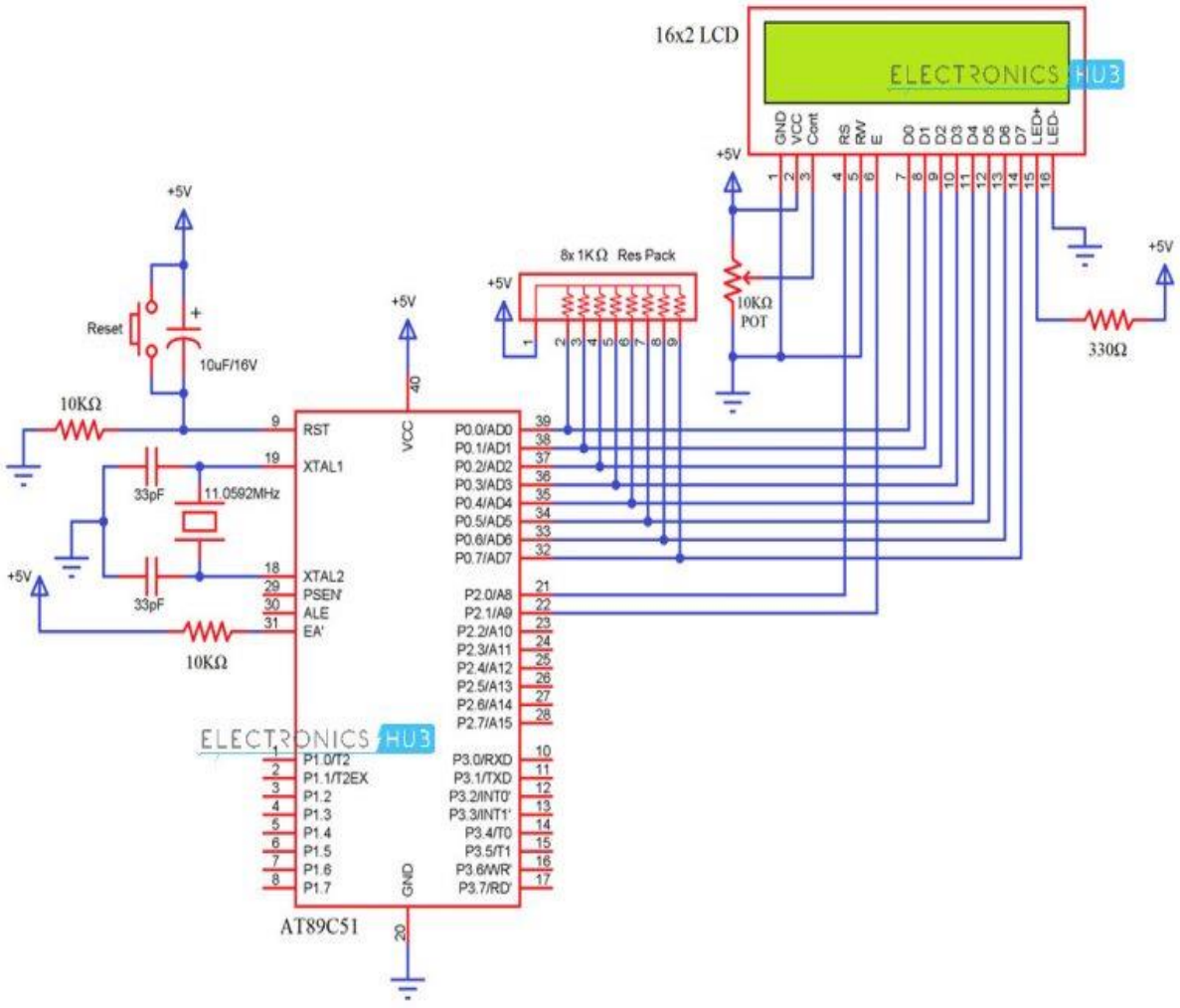

Figure 6.2 LCD Interfacing

6.3 Circuit

The crystal oscillator, along with two 33pF Capacitors, are connected to XTAL1 and XTAL2, which will provide the system clock to the microcontroller. RST Pin is pulled-LOW with the help of a 10KΩ Resistor. With the help of a 10µF Capacitor and a Push Button, you can reset the 8051 Microcontroller. EA is pulled-HIGH with the help of a 10KΩ resistor.

The data pins of the LCD are connected to PORT0 (first, the PORT0 pins must be pulled-HIGH with the help of a 1KΩ Resistor Pack). RS and E are connected to PORT2 pins P2.0 and P2.1.A 10KΩ Potentiometer is used to adjust the contrast of the LCD**.**

Initializing LCD

To initialize LCD to the 8051 the following instruction and commands are to be embed in to the functions

- 0x38 is used for 8-bit data initialization.
- 0xoC for making LCD display on and cursor off.
- 0X01 for clearing the display of the LCD.
- 0x80 for positioning the cursor at first line .

Sending Commands to the LCD

- E=1; enable pin should be high
- RS=0; Register select should be low for sending commands
- Placing the data on the data registers
- R/W=0; Read/Write pin should be low for writing the data.

Writing the Data to the LCD

- E=1; enable pin should be high
- RS=1; Register select should be high for writing data
- Placing the data on the data registers
- R/W=0; Read/Write pin should be low for writing the data.

CHAPTER 7

FUTURE SCOPE AND APPLICATIONS

I. The energy meter can be designed to have a unique identification number that will indicate the locality and consumer type as the billing system is different for different types of users. This number along with the consumed units of electricity can be sent with-out human intervention. The department can maintain a database to identify the type of location using this number and calculate the bill accordingly and send it to the user.

II. For developing countries like India where a major chunk of the population lives below poverty line will become alert while consuming electricity if their bills reach them on a weekly or monthly basis as desired by them.

III. If such bills reach more frequently, the users can become alert if there is theft of electricity by undesired sources or if the electrical appliances are left in working mode even when the users are not around.

IV. The system can be made smart by having a battery backup in case of power failure.

V. Further reliability analysis can be done about the number of failures during the initial implementation, mature stage and the last stage.

VI. Effort can be made for the meters to remain robust so that the users do not have to replace their meters frequently. Also, these meters should be compatible with more than one remote monitoring system.

CHAPTER 8
CONCLUSION

This scheme reduces human intervention required in keeping track of the total power consumption of the users. An SMS is sent directly to the user indicating the consumption and bill without the need of any individual from the Electricity Department to physically visit the site to note down the readings by the use of GSM module. This automation not only reduces the labor cost but also makes the system more efficient and accurate. Smart energy meter with reading indication has been developed by using GSM. Which is more useful to consumer for billing and maintaining less bill payment and it decreases the human needs for paying and other issues related to billing. We can extend it for industrial purposes also by interfacing three phase meters but the circuit have to modify for getting proper voltage to the controller.

APPENDIX A

```
 1        #include <AT89X52.H>
 2        #include <string.h>
 3        #include <intris.h>
*** WARNING C318 IN LINE 3 OF gsm.c: can't open file 'intris.h'
 4        #define lcdport P0
 5        sbit lcdrs=P0^0;
 6        sbit lcden=P0^1;
 7
 8        sbit start=P1^0;
 9        sbit sens1=P1^1;
10         sbit read=P1^2;
11         sbit sw1=P1^3;
12         sbit fault=P1^4;
13
14         sbit load=P2^0;
15         sbit buzzer=P2^1;
16
17         void check();
18         void display();
19         void compare();
20         void day();
21
22         void lcdinit();
23         void lcdcmd(unsigned char);
24         void lcddata(unsigned char);
25         void lcdstring(unsigned char *);
26         void lcdgoto(unsigned char,unsigned char);
27         void lcdclr();
28         void delay(unsigned int);
29
30         bit flag=1;
31         unsigned char tens=0,unit=0;
32         unsigned char set_pt;
33         unsigned char a=2;
36
37
```

```
 73          void main()
 74          {
 75    1             P0=0XFF;
 76    1             P1=0XFF;
 77    1             P2=0XFF;
 78    1             P3=0XFF;
 79    1             lcdinit();
 80    1             delay(60000);
 81    1             lcdinit();
 82    1             delay(60000);
 83    1             lcdclr();
 84    1             lcdgoto(1,5);
 85    1             lcdstring("PROJECT");
 86    1             lcdgoto(2,1);
 87    1             lcdstring("Year:2017-18.....");
 88    1             delay(60000);
 89    1             delay(60000);
 90    1             lcdclr();
 91    1             lcdgoto(1,5);
 92    1             lcdstring("AUTOMATIC");
 93    1             lcdgoto(2,1);
 94    1             lcdstring("Billing System...");
 95    1             delay(60000);
 96    1             delay(60000);
 97    1          serialcomm();
 98    1             serialcomm();
 99    1             while(1)
100    1              {
101    2
102
115    3                    check();
116    3                    display();
```

APPENDIX B

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