SOLAR POWERED GSM BASED AUTOMATIC SOIL FERTILITY CONTROLLED IRRIGATION SYSTEM

Submitted in partial fulfillment of the Degree of

Bachelor of Technology

May – 2014

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Certificate

This is to certify that project report entitled **"Solar Powered GSM based Automatic Soil Fertility Controlled Irrigation System",** submitted by *Vidhu Shekhar (101088), Puneet Inder Singh (101143), Deepesh Kumar (101106*) in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

Date : 26/5/14

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Date: 26/05/2014

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SUMMARY

In the recent past our primary sector has undergone through significant changes such as Green Revolution which emphasized on the use of HYV (High Yielding Variety) seeds, modification in the agriculture processes, uses of chemical fertilizers etc. With advent of electronic generation it will be beneficial that we integrate the current technology with existing agriculture techniques.

In this project we have try to harness the benefits of the new technology and to use our knowledge for the betterment of our society.

This project is based on GSM platform which would allow a user to have a control over a microcontroller and various set of pumping motors attached to it through a mobile phone. The user will get the status of the environment (Soil) and he will then decide whether to irrigate, provide fertilizers to the field or not.

This whole project is powered by solar panel (12V,12 W) which is the sustainable source of energy and helps in reducing the carbon footprints.

Signature of Students

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Date:

_____

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Date:

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Chapter 1

INTRODUCTION

1.1 OBJECTIVE:

To design a hardware device which senses the essential component such as humidity and moisture of soil that determines the fertility of the soil and takes appropriate steps such as providing fertilizers and irrigation to the agricultural field. At present when everything is getting automated, our primary sector also needs e-revolution combined with green revolution which allows the efficient management of the field and helps to endure the weather changes which further helps to increase the productivity of Crops. In this device we are using the Temperature Sensor which senses the temperature of the environment near the surface of soil, Humidity Sensor which senses the humidity present in the soil and Soil moisture Sensor which senses the moisture present in the soil. We are also using the GSM model for sending information that was sensed by these sensors to mobile user. And the mobile is also further interfaced with GSM modem. User analyses the received data and write a SMS which contain the desired instruction and then send to GSM modem. GSM model is interfaced with microcontroller which in turn executes all the desired instruction.

1.2 METHODOLOGY

As in any embedded system project the microcontroller plays an important role so firstly our main aim was to choose the microcontroller which could satisfy certain criteria i.e.

- Speed
- Packaging
- Power Consumption
- Amount of RAM and ROM on chip
- No. of I/O pins and the timer on the chip

- Availability of software development tools, such as compilers and debuggers
- Cost per unit

We chose a PIC 18F452 (Peripheral interface controller). It is 40 pin IC manufactured only by MicroChip Company. It is a RISC machine and also has internal USART, ADC which 8051 does not have internally. It has High performance and run up to 40 MHz of clock frequency.

The architecture of the PIC 18f452 was learnt so that we could understand the working and specifications of the microcontroller better. And this would also help us in programming and simulation in last stage of the project. The architecture and the pin diagram are as follows:

1.2.1 ARCHITECTURE OF PIC MCU:

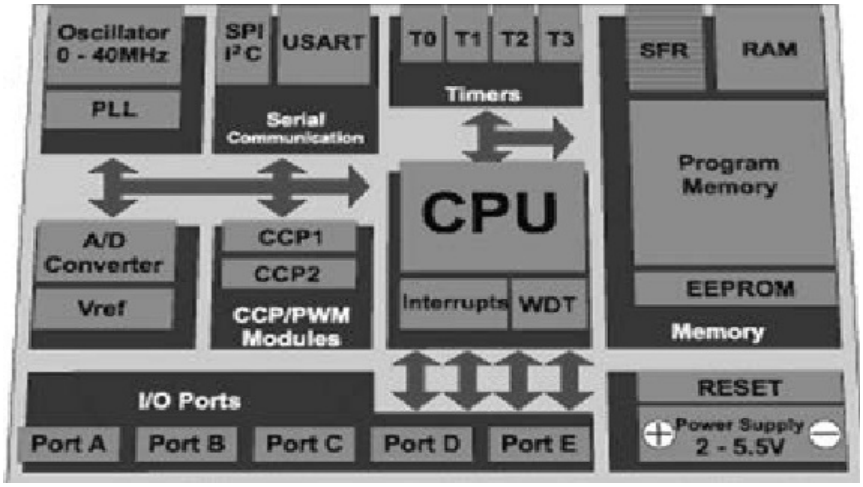


Fig. 1 Architecture of PIC MCU

Study of various peripheral components that are necessarily needed to be interfaced with the PIC was done i.e.

- Interfacing of LCD with microcontroller

- Interfacing of GSM modem
- Functions of MAX232 and its specifications
- Functioning of the relay
- Functioning of the sensors(LM35, humidity sensor, pH sensor)
- Functioning of MCT2E, that prevents MCU from high voltage surge
- Functioning of crystal oscillator.

1.3 AIM OF THE PROJECT:

At present when everything is getting automated, our primary sector also needs e-revolution combined with green revolution. This Project allows the efficient management of the field and helps to endure the weather changes which further helps to increase the productivity of Crops.

1.4 VARIOUS STAGES OF THE PROJECT :

- Programming of GSM Modem-SIM900A.
- Programming of Microcontroller chip.
- Interfacing the microcontroller chip with the LCD.
- Interfacing of Temperature Sensor with the microcontroller chip.
- Interfacing of Humidity Sensor with the microcontroller chip.
- Interfacing of Soil Moisture Sensor with the microcontroller chip.
- Solar panel (12V,12W)
- Rechargeable Battery(12V)

CHAPTER 2

COMPONENTS USED

In this chapter we have mentioned about the various components that we have used in making the project, the description of all the components is given in the following table, it includes the name and values of the given components.

2.1 COMPONENTS LIST:

Name	**Capacity**	**Quantity**
Regulator	7805/LM317	1
Capacitor	10µf	4
Ceramic Capacitor	10^{-2} pf	2
BJT		2
Push Button		1
GSM Modem	SIM900A	1

MAX 232		1
LCD	16*2	1
40 Pin Base		1
PIC – 18F452		1
Crystal Oscillator		1
LED		2
Resistance	220Ω	3
Resistance	1k	1
Resistance	10k	2
Relay		1
Temperature Sensor		1
Humidity Sensor		1
Soil Moisture Sensor		1
PCB for PIC		2
Solar Panel (12V, 12W)		1
Rechargeable battery (12V)		1
Pumping Motor		1

2.2 GSM AND ITS INTRODUCTION:

As shown in block diagram GSM is interfaced with the PIC MCU. This will help in controlling the commands of the PIC by mobile through GSM Modem. So GSM Modem can be assumed as a point of interface between mobile set and MCU.

The GSM system is the most widely used cellular technology in use in the world today. It has been a particularly successful cellular phone technology for a variety of reasons including the ability to roam worldwide with the certainty of being able to be able to operate on GSM networks in exactly the same way - provided billing agreements are in place.

The letters GSM originally stood for the words GroupeSpeciale Mobile, but as it became clear this cellular technology was being used world wide the meaning of GSM was changed to Global System for Mobile Communications. Since this cellular technology was first deployed in 1991, the use of GSM has grown steadily, and it is now the most widely cell phone system in the world. GSM reached the 1 billion subscriber point in February 2004, and is now well over the 3 billion subscriber mark and still steadily increasing.

Fig.2 Models of mobile phone

2.2.1 System Overview:

The GSM system was designed as a second generation (2G) cellular phone technology. One of the basic aims was to provide a system that would enable greater capacity to be achieved than the previous first generation analogue systems. GSM achieved this by using a digital TDMA (time division multiple access approach). By adopting this technique more users could be accommodated within the available bandwidth. In addition to this, ciphering of the digitally encoded speech was adopted to retain privacy. Using the earlier analogue cellular technologies it was possible for anyone with a scanner receiver to listen to calls and a number of famous personalities had been "eavesdropped" with embarrassing consequences.

2.2.2 GSM Services:

Speech or voice calls are obviously the primary function for the GSM cellular system. To achieve this speech is digitally encoded and later decoded using a vectored. A variety of vocoders are available for use, being aimed at different scenarios.

In addition to the voice services, GSM cellular technology supports a variety of other data services. Although their performance is nowhere near the level of those provided by 3G, they are nevertheless still important and useful. A variety of data services are supported with user data rates up to 9.6 kbps. Services including Group 3 facsimile, video text and teletex can be supported.

One service that has grown enormously is the short message service. Developed as part of the GSM specification, it has also been incorporated into other cellular technologies. It can be thought of as being similar to the paging service but is far more comprehensive allowing bi-directional messaging, store and forward delivery, and it also allows alphanumeric messages of a reasonable length. This service has become particularly popular, initially with the young as it provided a simple, low fixed cost.

2.2.3 GSM Basics:

The GSM cellular technology had a number of design aims when the development started:

- It should offer good subjective speech quality
- It should have a low phone or terminal cost
- Terminals should be able to be handheld
- The system should support international roaming
- It should offer good spectral efficiency
- The system should offer ISDN compatibility

The resulting GSM cellular technology that was developed provided for all of these. The overall system definition for GSM describes not only the air interface but also the network or infrastructure technology. By adopting this approach it is possible to define the operation of the whole network to enable international roaming as well as enabling network elements from different manufacturers to operate alongside each other, although this last feature is not completely true, especially with older items.

GSM cellular technology uses 200 kHz RF channels. These are time division multiplexed to enable up to eight users to access each carrier. In this way it is a TDMA / FDMA system.

The base transceiver stations (BTS) are organized into small groups, controlled by a base station controller (BSC) which is typically co-located with one of the BTSs. The BSC with its associated BTSs is termed the base station subsystem (BSS).

Further into the core network is the main switching area. This is known as the mobile switching centre (MSC). Associated with it is the location registers, namely the home location register (HLR) and the visitor location register (VLR) which track the location of mobiles and enable calls to be routed to

them. Additionally there is the Authentication Centre (AuC), and the Equipment Identify Register (EIR) that are used in authenticating the mobile before it is allowed onto the network and for billing. The operation of these registers are explained in the following pages.

Last but not least is the mobile itself. Often termed the ME or mobile equipment, this is the item that the end user sees. One important feature that was first implemented on GSM was the use of a Subscriber Identity Module. This card carried with it the users identity and other information to allow the user to upgrade a phone very easily, while retaining the same identity on the network. It was also used to store other information such as "phone book" and other items. This item alone has allowed people to change phones very easily, and this has fuelled the phone manufacturing industry and enabled new phones with additional features to be launched. This has allowed mobile operators to increase their average revenue per user (ARPU) by ensuring that users are able to access any new features that may be launched on the network requiring more sophisticated phones.

2.2.4 Introduction to GSM Modem:

SIM900A is a complete dual band GSM/GPRS solution. We have designed ready to use GSM modem using this module with its simple serial TTL interface. It delivers GSM/GPRS 900/1800MHz performance for voice, sms, data and fax in small form factor and low power consumption.

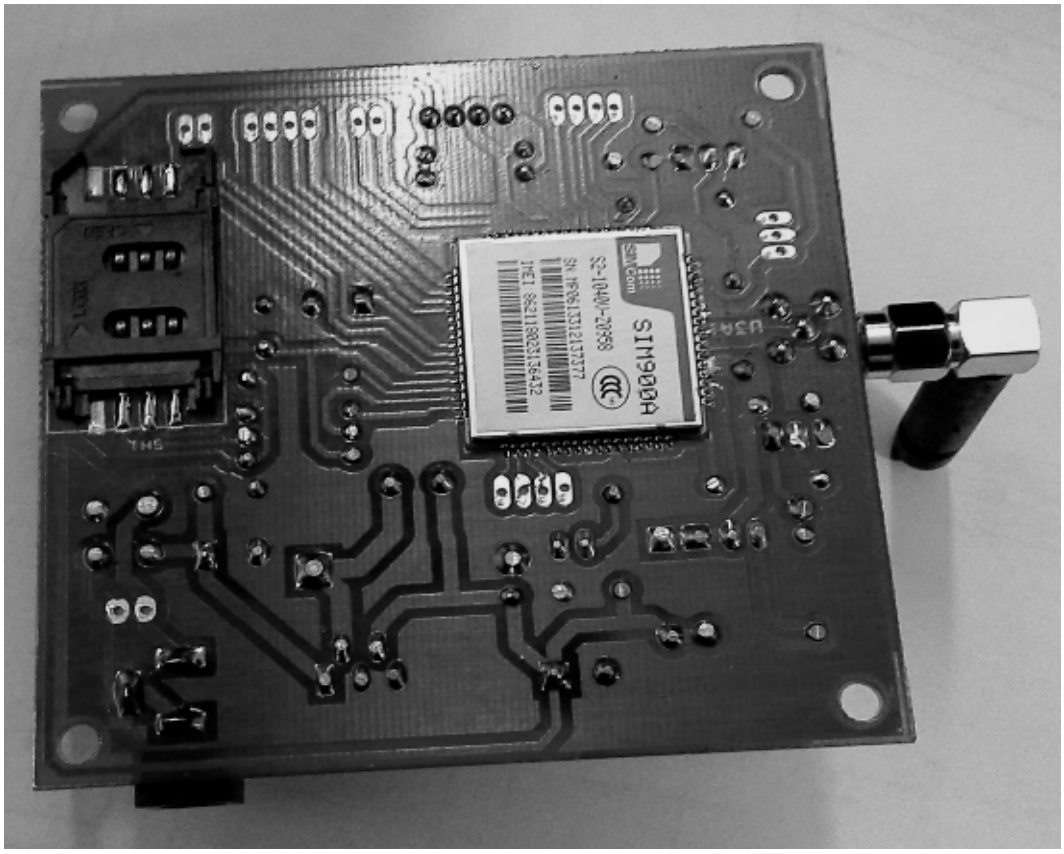


Fig.3 Bottom view of GSM modem

Note: Package included with Antenna and SMA Connector as in above picture

2.2.5 Features:

- Dual Band 900/1800 MHz
- GPRS Multi-Slot class 10/8
- GPRS Mobile station class B

- Compliant to GSM Phase 2/2+
- Class 4 (2W @900 MHz)
- Class 1 (1W @1800 MHz)
- AT commands (GSM07.07,07.05 & SIMCOM enhanced AT Commands)
- SIM application tool kit
- Direct connection to microcontroller

2.2.6 APPLICATIONS

- Security & Surveillance system
- Smart home system
- Data logging & transfer system
- Water pump control system
- Robot control system

2.2.7 MODEM SPECIFICATIONS:

- Supply Voltage Range : 7V to 38V
- Operation Temperature : -40 to +85 Degree C

PIN Name	PIN Information
DBX_RXD	Debug Receiver
DBX_TXD	Debug Transmitter
SPK_N	Speaker Negative
SPK_P	Speaker Positive
MIC_N	Microphone Negative

PIN Name	PIN Information
MIC_P	Microphone Positive
RESET	Reset
VDD_EXT	VDD External
5V	5 Volt Supply (OUT)
GND	Ground
RX	TTL Receiver
TX	TTL Transmitter
RTS	Request to send
CTS	Clear to send
RI	Ring
PWR_KEY	Power Key
Status	Status

2.3 POWER SUPPLY:

The PIC MCU is powered by 5V adaptor and the GSM Modem is powered by 12V adaptor. It can also be driven from Solar Panel (12V, 12W) connected with the rechargeable battery. 12V can be directly given from the battery to GMS Modem whereas 5V can be given to PIC MCU by connecting voltage regulator (SCR).

2.4 SOLAR PANEL:

A solar panel is usually mounted on a supporting structure and is device of the photovoltaic modules which are connected together, these are packaged together and then form a solar cell. The solar panel is used to supply electricity in commercial and residential areas, the photovoltaic modules are very efficient. The solar modules use the photovoltaic effect to generate electricity. Nowadays the third generation of solar modules are being used which use rigid thin film or flexible thin film modules. Solar cells are connected to form modules. They have many applications. Solar cells are used in many areas where the electricity supply is not available. To make practical use of the electricity is often fed to inverters in the stand alone systems and if the energy has to be stored then battery is used.

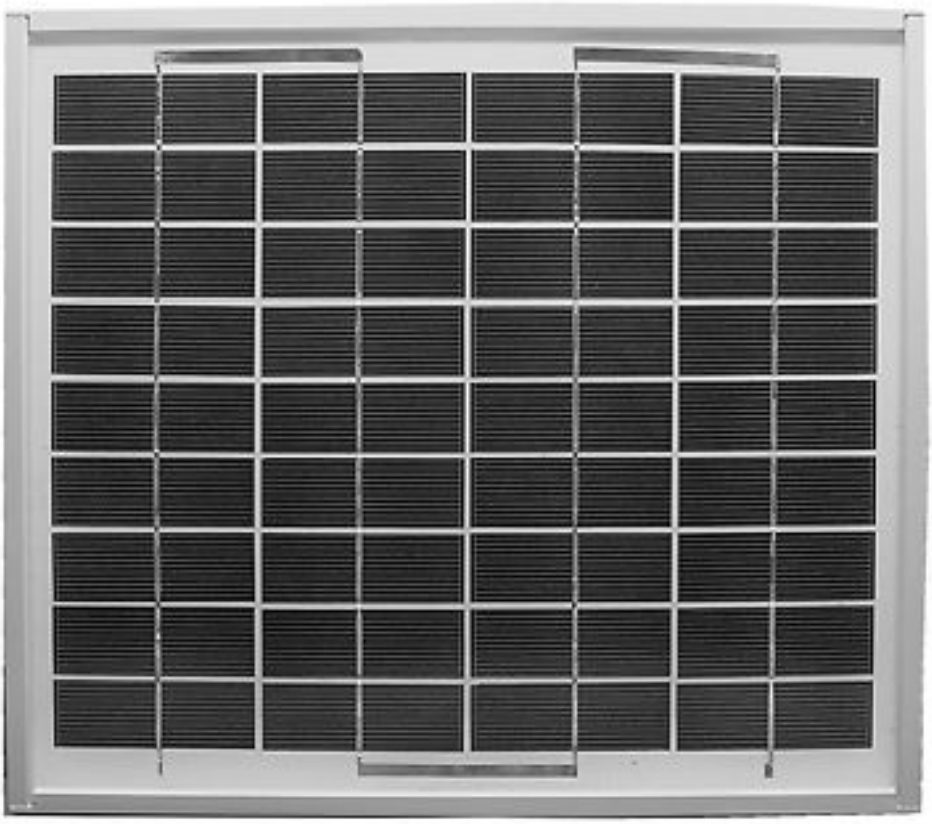


Fig.4 Top view of Solar Panel

2.5 RECHARGEABLE BATTERY:

A rechargeable battery is a kind of an electrical battery, its components are electrochemical cells and it is used for the storage of the electrochemical energy. The technical name for a rechargeable battery is a secondary cell because the reactions are electrically reversible.

These kind of batteries come in different sizes and shapes and can range from button cells to megawatt system and they are used to stabilize the electrical network.

The advantages of using rechargeable batteries are that the cost of using them is low and they have less impact on environment when they are disposed, though they have high initial costs but they can be recharged and reused many times.

Fig. 5 Rechargeable battery

2.6 MAX 232 :

The MAX232 is an IC, first created in 1987 by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

2.6.1 PIN DIAGRAM OF MAX232

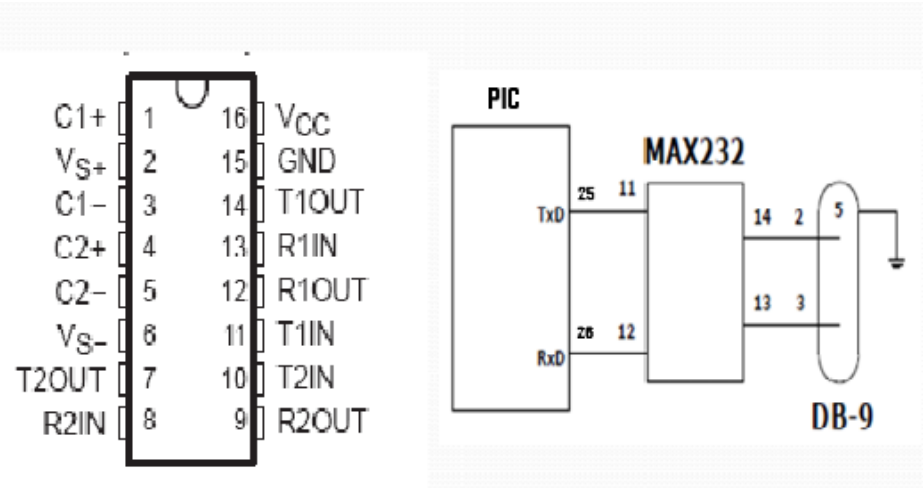


Fig.5 Pin diagram of MAX 232

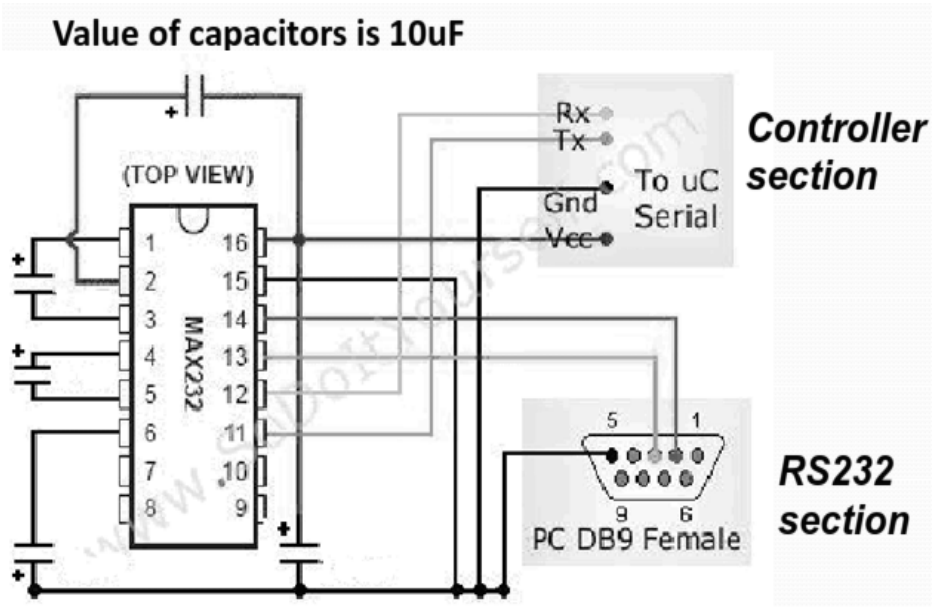


Fig.6 Connection of MAX232 with PIC MCU and DB9 Connector (RS232)

2.7 LCD:

Liquid crystal display is also used in project to display the value of temperature, humidity and pH data that is received from the sensor. It is a cheap and easy way to display text, display numbers, letters and fixed symbols. In this project we have used 16 x 2 LCD which will have 16 columns and 2 rows. It has following components inside.

- Integrated controller:

  It does the controlling computation within LCD.

- Data lines(DB7-DB0):

  These are Bi-directional/command pins.

  For transferring data and commands to the registers

- Instruction Register(IR):

  Information register corresponds to the register where you send commands to LCD example:

  LCD shift command, LCD clear

- Data Register: Data register is used for storing data which is to be displayed on LCD.

2.7.1 PIN INFORMATION OF LCD:

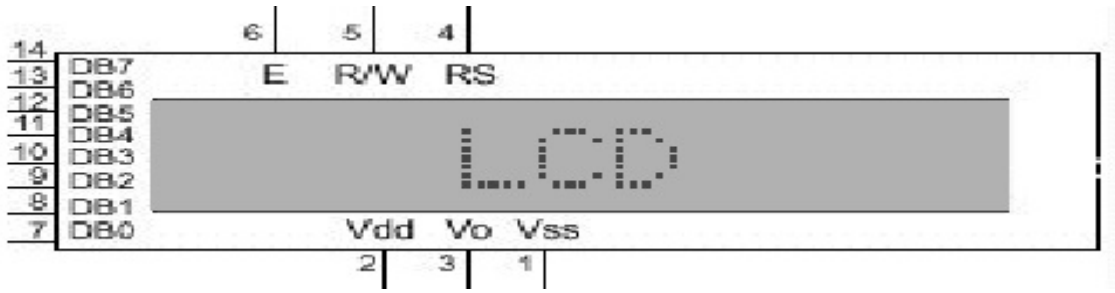
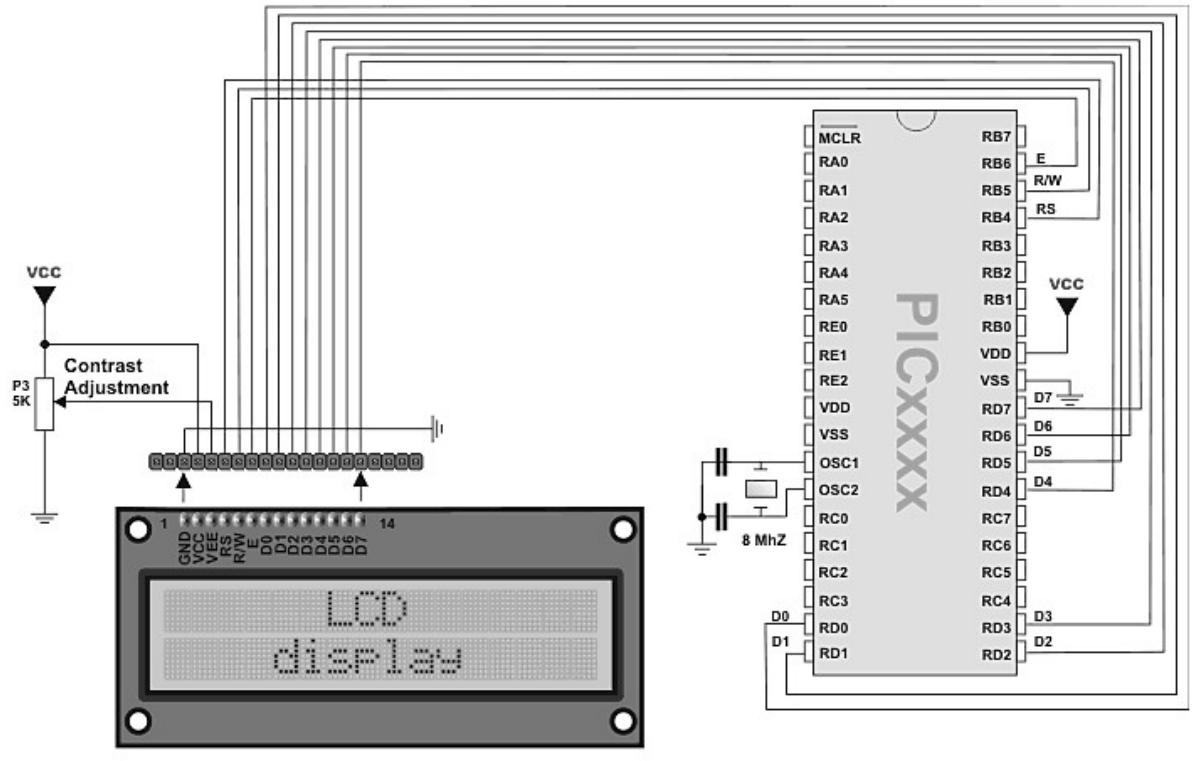


Fig.7 Pin diagram of LCD

2.7.2 CONNECTION OF LCD WITH PIC 18F452:



LCD HW connection by default initialization (using `Lcd8_Init`)

Fig.8 Connection of LCD with PIC MCU

2.8 RELAY:

It is an electromagnetic switch which operates on +5V switches to +12 or 220V. It has a wide range of applications such as in telephone exchanges, digital computers and automation systems. Its functioning is as follows:

- When there is no voltage applied on coil switch is open.
- When a voltage is applied on a coil, magnetic field is produced it attracts the armature towards the 2nd pin closing the switch

2.8.1 FUNCTIONING OF RELAY:

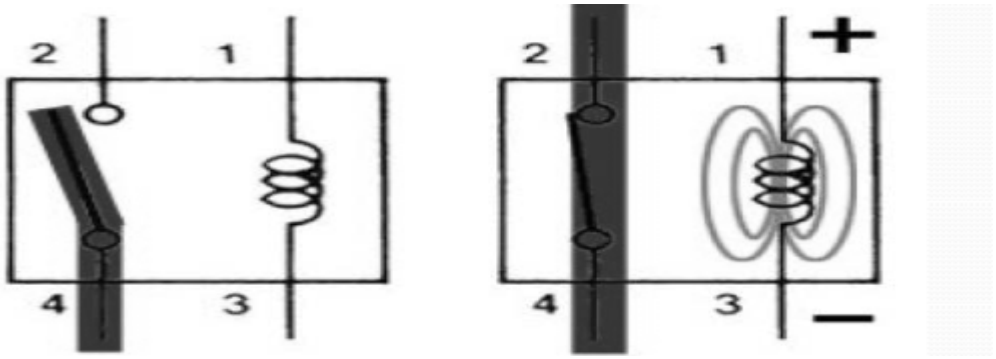


Fig.9 Internal view of Relay

2.9 TEMPERATURE SENSOR:

The LM35 is a precision linear temperature sensor that supplies 10mv per degree Celsius. The LM35 has three legs and looks like a transistor.

The temperature sensor is placed near to the controller to get the real time information of the temperature of the device. As excessive heating which is caused by continued working of device for a long period of time can damage the device. So, this temperature sensor will help us to analyze the temperature of the device and take preventive measure during excessive heating of the device.

2.9.1 PIN OUT FOR LM35 :

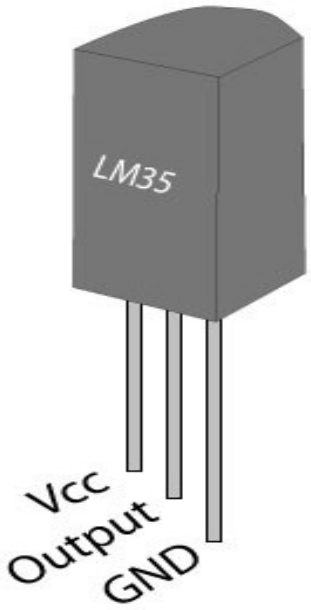


Fig.10 Temperature Sensor (LM35)

LM35 INTERFACED WITH PIC CONTROLLER :

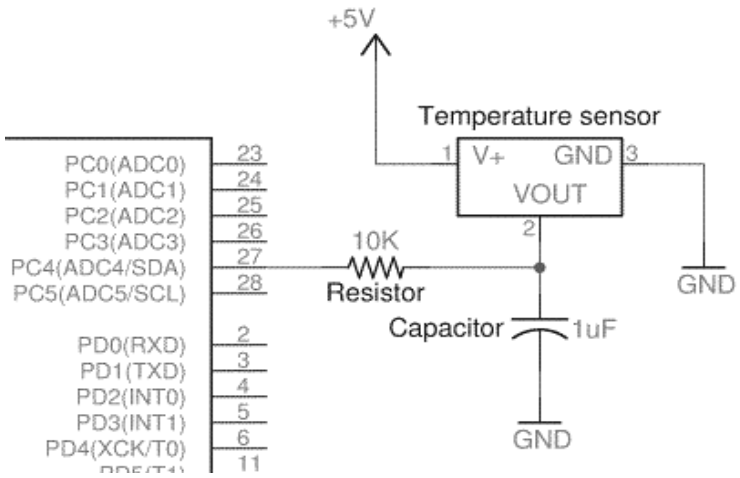


Fig.11 Connection of LM35 with PIC MCU

2.10 HUMIDITY SENSOR:

Humidity sensor contains a capacitor which has hygroscopic dielectric material. The dielectric constant of hygroscopic material depends upon the amount of water it absorbs.

Fig.12 Humidity Sensor

2.11 SOIL MOISTURE SENSOR:

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors.

Technologies commonly used in soil moisture sensors include:

- Frequency domain sensor such as a capacitance sensor.
- Neutron moisture gauges, utilize the moderator properties of water for neutrons.
- electrical resistance of the soil
- Time domain transmission (TDT) and time domain reflectometry (TDR); water has a high dielectric constant; a higher water concentration causes a higher average dielectric constant for the soil. The average dielectric constant can be sensed by measuring the speed of propagation along a buried transmission line.
- heat dissipative sensor; Heat dissipation sensors rely on the effective heat R-value (insulation) of soil. Soil with additional water conducts heat more readily than dry soil.
- The amount of water content present in the soil is known as soil moisture, it plays an important role in agriculture because the amount of transpiration in the plant is dependent

  on this factor so a soil moisture sensor is necessary for monitoring water content in the soil.

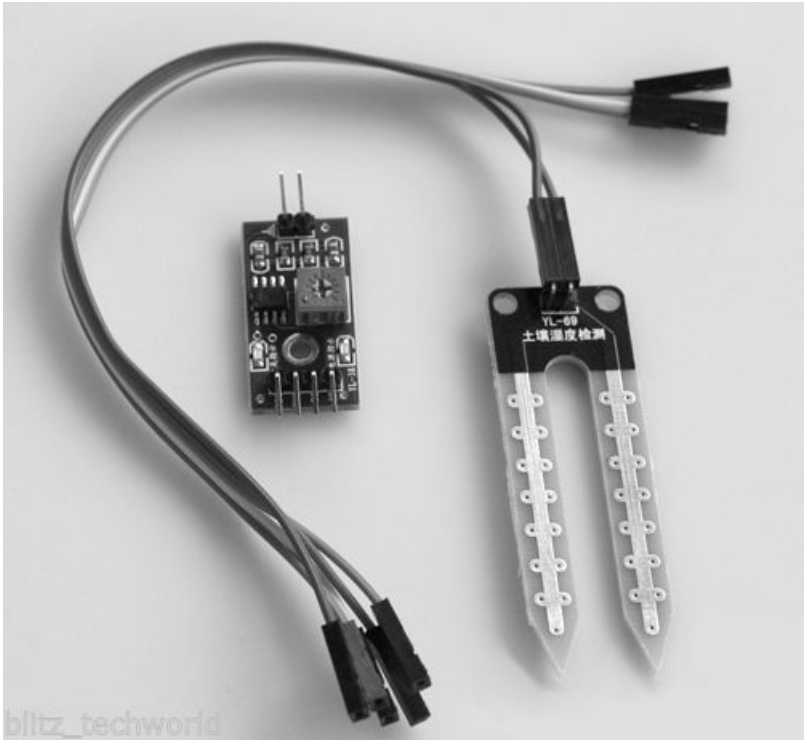


Fig.13 Soil Moisture Sensor

2.12 CRYSTAL OSCILLATOR:

In crystal oscillators, the usual electrical resonant circuit is replaced by a mechanically vibrating crystal. The crystal (usually quartz) has a high degree of stability in holding constant at whatever frequency the crystal is originally cut to operate. The crystal oscillators are, therefore, used whenever great stability is needed, for example, in communication transmitters, and receivers, digital clocks etc.

A quartz crystal exhibits a very important property known as piezo-electric effect. When a mechanical pressure is applied across the faces of the crystal, a voltage proportional to the applied mechanical pressure appears across the crystal. Conversely, when a voltage is applied across the crystal surfaces, the crystal is distorted by an amount proportional to the applied voltage. An alternating voltage applied to a crystal causes it to vibrate at its natural frequency.

Besides quartz, the other substances that exhibit the piezo-electric effect are Rochelle salt and tourmaline. Rochelle salt exhibits the greatest piezoelectric effect, but its applications are limited to manufacture of microphones, headsets and loudspeakers.

Crystal and ceramic resonator-based oscillators typically provide very high initial accuracy and a moderately low temperature coefficient.

2.12.1 INTERFACING OF CRYSTAL OSCILLATOR WITH A MICROCONTROLLER:

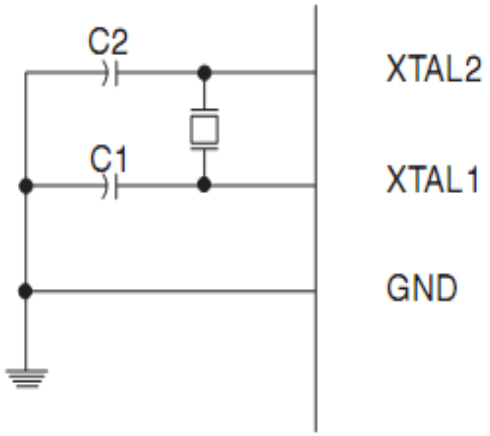


Fig.14 Connection of Crystal Oscillator with PIC MCU

2.13 PRINTED CIRCUIT BOARD (PCB):

The use of a printed circuit board (PCB) is for mechanically supporting and electrically connecting the various components using the features of copper sheets such as conductive tracks and these are laminated into a non conductive substrate.

PCB's are of three types

One is single sided, double sided, or multisided the difference is that the number of copper layers in single sided is one while there are two copper layers in double sided while there are are more than two copper layers in multisided.

The advanced PCB's may contain the following components such as capacitors, resistors or active devices which are embedded in the substrate.

The uses of Printed circuit boards are that they are used in even the simple electronic products.

The disadvantages of PCBs are that they are more costly to design but they do allow automated manufacturing and assembly. Products which use PCB are therefore faster and cheaper to manufacture and potentially more reliable.

When the printed circuit board has only copper connections and no embedded components it is then called a printed wiring board (PWB) or etched wiring board.

In this project we have used a PCB which has been specially designed for PIC 18F452.

2.13.1 PCB FOR PIC:

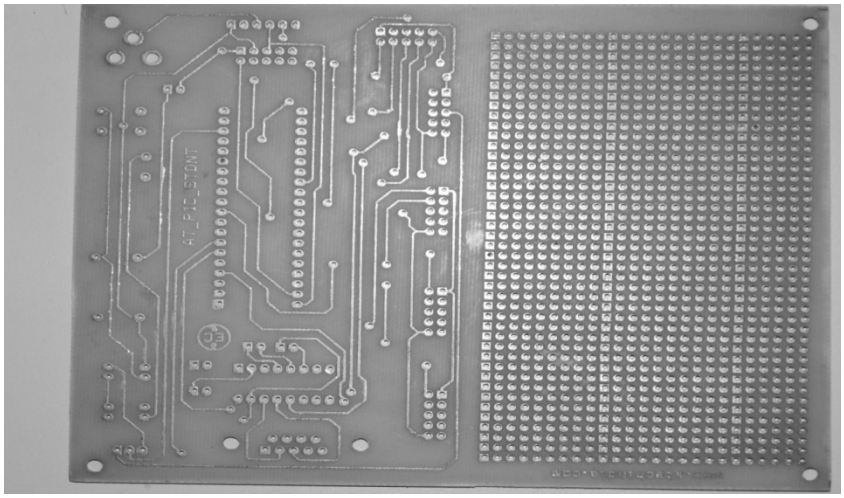


Fig.15 PCB for PIC MCU

2.14 RESISTORS:

The resistor's function is to reduce the flow of electric current. There are two classes of resistors; fixed resistors and the variable resistors. They are also classified according to the material from which they are made. The typical resistor is made of either carbon film or metal film. There are other types as well, but these are the most common. The resistance value of the resistor is not the only thing to consider when selecting a resistor for use in a circuit. The "tolerance" and the electric power ratings of the resistor are also important. The tolerance of a resistor denotes how close it is to the actual rated resistance value. For example, a ±5% tolerance would indicate a resistor that is within ±5% of the specified resistance value.

2.14.1 FIXED RESISTORS:

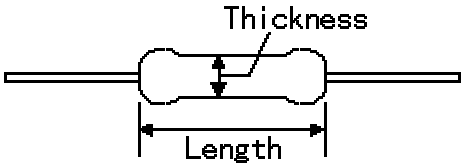
A fixed resistor is one in which the value of its resistance cannot change.

2.14.2 CARBON FILM RESISTORS:

This is the most general purpose, cheap resistor. Usually the tolerance of the resistance value is ±5%. Power rating of 1/8W, 1/4W and 1/2W are frequently used.

Carbon film resistors have a disadvantage; they tend to be electrically noisy. Metal film resistors are recommended for use in analog circuits. However, I have never experienced any problems with this noise. The physical size of the different resistors is as follows.

From the top of the photograph
1/8W
1/4W
1/2W



Rough size

Rating power (W)	Thickness (mm)	Length (mm)
1/8	2	3
¼	2	6
½	3	9

Fig.16 Physical size of the different resistors

2.14.3 VARIABLE RESISTORS:

There are two general ways in which variable resistors are used. One is the variable resistor which value is easily changed, like the volume adjustment of Radio. The other is semi-fixed resistor that is not meant to be adjusted by anyone but a technician. It is used to adjust the operating condition of the circuit by the technician. Semi-fixed resistors are used to compensate for the inaccuracies of the resistors, and to fine-tune a circuit. The rotation angle of the variable resistor is usually about 300 degrees. Some variable resistors must be turned many times to use the whole range of resistance they offer. This allows for very precise adjustments of their value.

These are called "Potentiometers" or "Trimmer Potentiometers."

Fig 17. VARIABLE RESISTORS

In the photograph to the left, the variable resistor typically used for volume controls can e seen on the far right. Its value is very easy to adjust. The four resistors at the center of the photograph are the semi-fixed type. These ones are mounted on the printed circuit board. The two resistors on the left are the trimmer potentiometers.

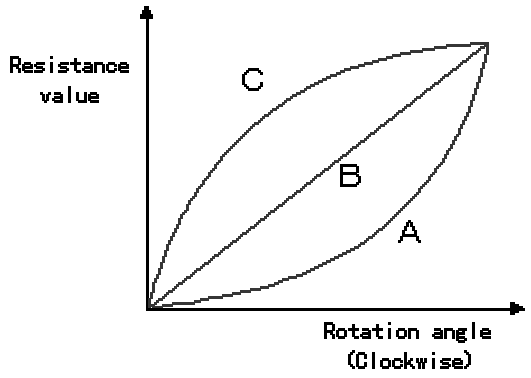


Fig 18. Resistance value vs. Rotation angle

There are three ways in which a variable resistor's value can change according to the rotation angle of its axis.

When type "A" rotates clockwise, at first, the resistance value changes slowly and then in the second half of its axis, it changes very quickly. The "A" type variable resistor is typically used for the volume control of a radio, for example. It is well suited to adjust a low sound subtly. It suits the characteristics of the ear. The ear hears low sound changes well, but isn't as sensitive to small changes in loud sounds. A larger change is needed as the volume is increased. These "A" type variable resistors are sometimes called "audio taper" potentiometers.

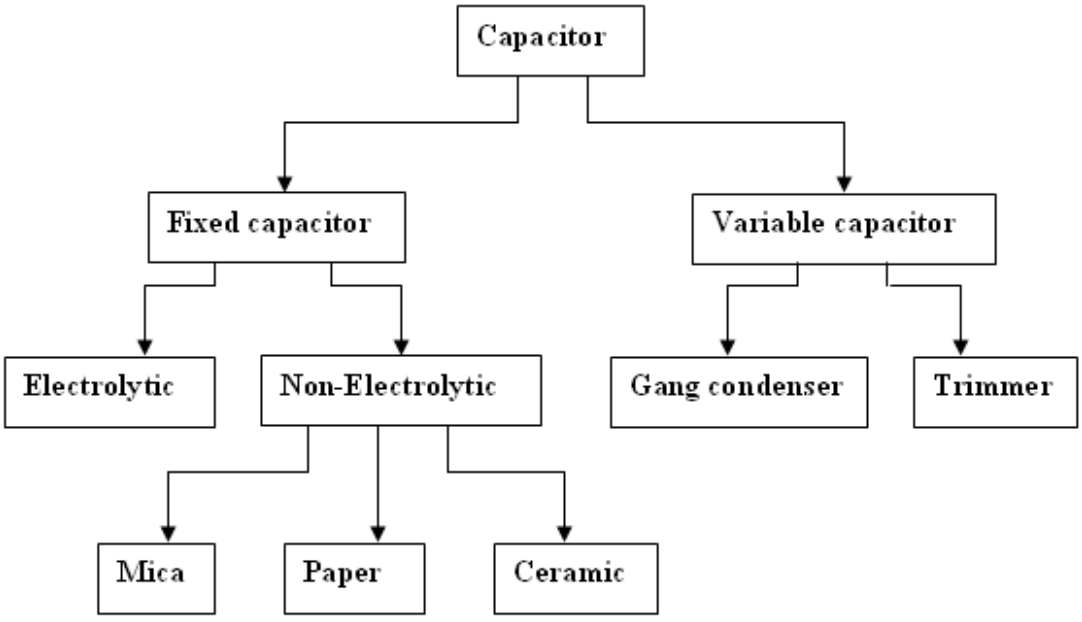
As for type "B", the rotation of the axis and the change of the resistance value are directly related. The rate of change is the same, or linear, throughout the sweep of the axis. This type suits a resistance value adjustment in a circuit, a balance circuit and so on.

They are sometimes called "linear taper" potentiometers. Type "C" changes exactly the opposite way to type "A". In the early stages of the rotation of the axis, the resistance value changes rapidly, and in the second half, the change occurs more slowly. This type isn't too much used. It is a special use. As for the variable resistor, most are type "A" or type "B".

2.15 CAPACITORS:

The capacitor's function is to store electricity, or electrical energy. The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC). This symbol 'F' is used to indicate a capacitor in a circuit diagram. The capacitor is constructed with two electrode plates facing each other, but separated by an insulator. When DC voltage is applied to the capacitor, *an electric charge* is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor has fully charged.

2.15.1 TYPES OF CAPACITORS:



2.15.2 BREAKDOWN VOLTAGE

when using a capacitor, we must pay attention to the maximum voltage which can be used. This is the "breakdown voltage." The breakdown voltage depends on the kind of capacitor being used. We must be especially careful with electrolytic capacitors because the breakdown voltage is comparatively low. The breakdown voltage of electrolytic capacitors is displayed as Working Voltage. The breakdown voltage is the voltage that when exceeded will cause the dielectric (insulator) inside the capacitor to break down and conduct. When this happens, the failure can be catastrophic.

2.15.3 ELECTROLYTIC CAPACITORS (ELECTROCHEMICAL TYPE CAPACITORS):

Aluminum is used for the electrodes by using a thin oxidization membrane. Large values of capacitance can be obtained in comparison with the size of the capacitor, because the dielectric used is very thin. The most important characteristic of electrolytic capacitors is that they have polarity. They have a positive and a negative electrode. [Polarized] This means that it is very important which way round they are connected. If the capacitor is subjected to voltage exceeding its working voltage, or if it is connected with incorrect polarity, it may burst. It is extremely dangerous, because it can quite literally explode. Make absolutely no mistakes. Generally, in the circuit diagram, the positive side is indicated by a "+" (plus) symbol. Electrolytic capacitors range in value from about 1μF to thousands of μF. Mainly this type of capacitor is used as a ripple filter in a power supply circuit, or as a filter to bypass low frequency signals, etc. Because this type of capacitor is comparatively similar to the nature of a coil in construction, it isn't possible to use for high-frequency circuits. (It is said that the frequency characteristic is bad.) The photograph on the left is an example of the different values of electrolytic capacitors in which the capacitance and voltage differ.

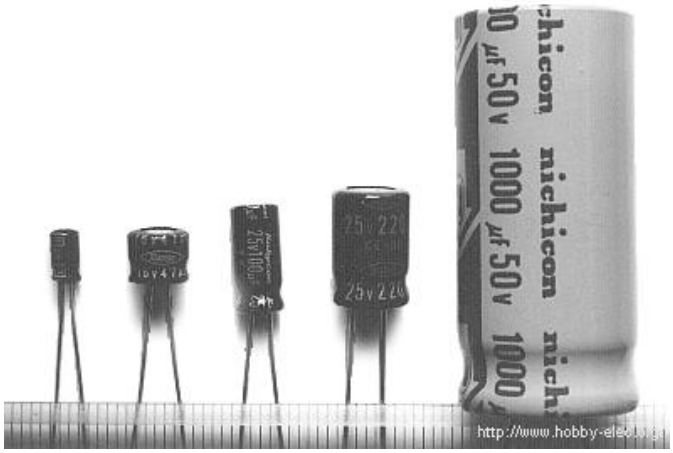


Fig 19. Electrolytic Capacitors

- From the left to right:
- 1µF (50V) [diameter 5 mm, high 12 mm]
- 47µF (16V) [diameter 6 mm, high 5 mm]
- 100µF (25V) [diameter 5 mm, high 11 mm]
- 220µF (25V) [diameter 8 mm, high 12 mm]
- 1000µF (50V) [diameter 18 mm, high 40 mm]

The size of the capacitor sometimes depends on the manufacturer. So the sizes shown here on this page are just examples.

2.15.4 CERAMIC CAPACITORS:

Ceramic capacitors are constructed with materials such as titanium acid barium used as the dielectric. Internally, these capacitors are not constructed as a coil, so they can be used in high frequency applications. Typically, they are used in circuits which bypass high frequency signals to ground. These capacitors have the shape of a disk. Their capacitance is comparatively small. The capacitor on the left is a 100pF capacitor with a diameter of about 3 mm. The capacitor on the right side is printed with 103, so 10 x 10^3pF becomes 0.01 µF. The diameter of the disk is about 6 mm. Ceramic capacitors have no polarity. Ceramic capacitors should not be used for analog circuits, because they can distort the signal.

Fig 20. CERAMIC CAPACITORS

2.15.5 VARIABLE CAPACITORTS:

Variable capacitors are used for adjustment etc. of frequency mainly. On the left in the photograph is a "trimmer," which uses ceramic as the dielectric. Next to it on the right is one that uses polyester film for the dielectric. The pictured components are meant to be mounted on a printed circuit board.

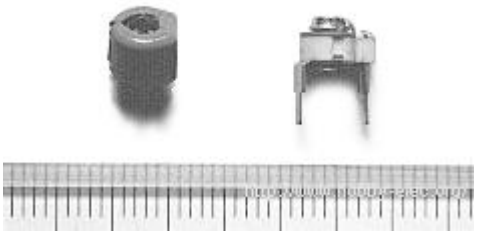


Fig 21. VARIABLE CAPACITORS

When adjusting the value of a variable capacitor, it is advisable to be careful. One of the component's leads is connected to the adjustment screw of the capacitor. This means that the value of the capacitor can be affected by the capacitance of the screwdriver in your hand. It is better to use a special screwdriver to adjust these components.

2.16 LED:

- 1 Watt LED Full intensity 350mA, Maximum current 500mA
- 2.8V Volt drop @ 350mA
- Watt LED Full intensity 700mA, Maximum current 1A
- 4.3V Volt drop @ 700mA
- 5 Watt LED (multi-die package)Full intensity 700mA, Maximum current 1A
- 7.1V Volt drop @ 700mA
- 5 Watt LED (single-die)Full intensity 1.5A

2.16.1 CHARACTERISTICS OF LEDs

- They are in many applications such as indicators and signs, data communication and signalling.
- The current depends exponentially on the voltage.
- There are many advantages of using LEDs such as efficiency, size and lifetime for use.

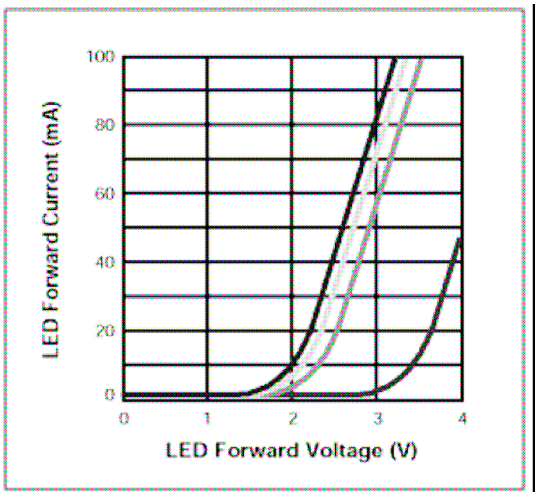


Fig. 22 Graph representing Voltage vs. Current

2.17 PUMPING MOTOR:

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps.

Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water-cooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers. In the medical industry, pumps are used for biochemical processes in developing and manufacturing medicine, and as artificial replacements for body parts, in particular the artificial heart and penile prosthesis.

Fig. 23 DC Pumping Motor

CHAPTER 3

SERIAL COMMUNICATION, PROGRAMMER, PIC MICROCONTROLLER

In this chapter we have described about PIC microcontroller including all its features ,pin diagram and we have given a description of the software used for programming the PIC microcontroller and use of programmer to store the program to PIC microcontroller

3.1 SERIAL COMMUNICATION:

3.1.1 Initialization:

The baud rate of the modem was set to be 9600 bps using the HyperTerminal, The ECHO from the modem was turned off using the command ATE0 at the HyperTerminal. For serial transmission and reception to be possible both the DTE and DCE should have same operational baud rates. Hence to set the microcontroller at a baud rate of 9600bps, I set terminal count of Timer 1 at 0FFh (clock frequency = 1.8432). The TCON and SCON registers were set accordingly.

3.1.2 Serial Transfer using Ti and Ri Flags:

After setting the baud rates of the two devices both the devices are now ready to transmit and receive data in form of characters. Transmission is done when TI flag is set and similarly data is known to be received when the Rx flag is set. The microcontroller then sends an AT command to the modem in form of string of characters serially just when the TI flag is set. After reception of a character in the SBUF register of the microcontroller (response of MODEM with the read message in its default format or ERROR message or OK message), the RI flag is set and the received character is moved into the physical memory of the microcontroller.

3.2 PROGRAMMER:

When we have to learn about a new computer we have to familiarize about the machine capability we are using, and we can do it by studying the internal hardware design (devices architecture), and also to know about the size, number and the size of the registers.

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 following picture describes a general block diagram of microcontroller.

3.2.1 AVR Studio (Cross Compiler)

The AVR Studio IDE from Atmel combines project management, make facilities, source code editing, program debugging, and complete simulation in one powerful environment. The AVR Studio development platform is easy-to-use and helping you quickly create embedded programs that work. The AVR Studio editor and debugger are integrated in a single application that provides a seamless embedded project development environment.

3.2.2 Embedded C (Programming Language)

We use C language to develop logic for the functioning.

3.3 PIC MICROCONTROLLER:

- PIC stands for Peripheral Interface Controller
- Different characteristics of PIC are that it has separate code and data spaces, it uses RISC which stands for Reduced Instruction set Computing in which there are reduced instructions.
- PIC has a set of registers that have a general purpose RAM.

PIC MICROCONTROLLER CHARACTERISTICS

- Power – on reset

- Brown out reset
- Simplified instruction set
- High speed execution
- Up to 25mA output pin drive
- Programming of microcontroller by synchronous serial pins
- Watchdog timer
- Parallel Slave Port (PSP)
- SPI (Serial Peripheral Interface) called MSSP (Master Slave Serial Port)
- USART
- Analog input ports

3.3.1 DIFFERENCE BETWEEN AND PIC:

8051	PIC
8051 is CISC (Complex Instruction Set Computer)	PIC is a RISC (Reduced Instruction Set Computer) that means that it has a reduced set of instructions, more precisely 35 instructions
No internal I²C, SPI	Internal I²C, SPI
No internal ADC	Internal ADC
Internal USART	Internal USART/SCI
No internal PSP	Internal PSP

3.3.2 PIC 18F452

- High performance and flash memory
- 32 kb of code space, 1536 bytes of RAM
- 256 bytes of EEPROM
- Runs up to 40 MHz clock speed

- PLL option is available which can be enabled/disabled via programming. With the use of PLL the clock frequency get multiplied by four. In this case maximum frequency for external crystal is 10MHz.

3.3.3 PERIPHERAL FEATURES:

- High current sink/source 25mA/25mA
- Three external interrupt pins
- Timer 0 module: 8-bits/16-bits timer/counter with 8-bit programmable pre-scaler
- Timer 1 module: 16-bits timer/counter
- Timer 2 module: 8-bits timer with 8-bits period register
- Timer 3 module: 16-bits timer/counter
- Secondary oscillator clock option – Timer1/Timer3
- Two Capture/Compare/PWM (CCP) modules. CCP pins that can be configured as:
    - Capture input: capture is 16-bit, max. resolution 6.25 ns
    - Compare is 16-bit, max. resolution 100 ns
    - PWM output: PWM resolution is 1 to 10-bit, max.
    - PWM freq. : 8-bit resolution = 156 kHz (~ 6.4 us)
        - 10-bit resolution = 39 kHz (~ 25.6 us)
- Two modes of operation:
    - 3-wire SPI (supports all 4 SPI modes)
    - I^2C Master and Slave mode
- Addressable USART module:
    - Supports RS-485 and RS-232
- Parallel Slave Port (PSP) module
- Compatible 10-bit Analogue-to-Digital Converter module (A/D) with:
    - Fast sampling rate
    - Conversion available during SLEEP
- Programmable Brown-out Reset (BOR), Power-on Reset (POR), Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)

- Watchdog Timer (WDT)
- Programmable code protection
- Power saving SLEEP mode
- 100,000 erase/write cycle Enhanced FLASH program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory
- Flash/Data EEPROM retention: > 40 years
- Programming of microcontroller by synchronous serial pins

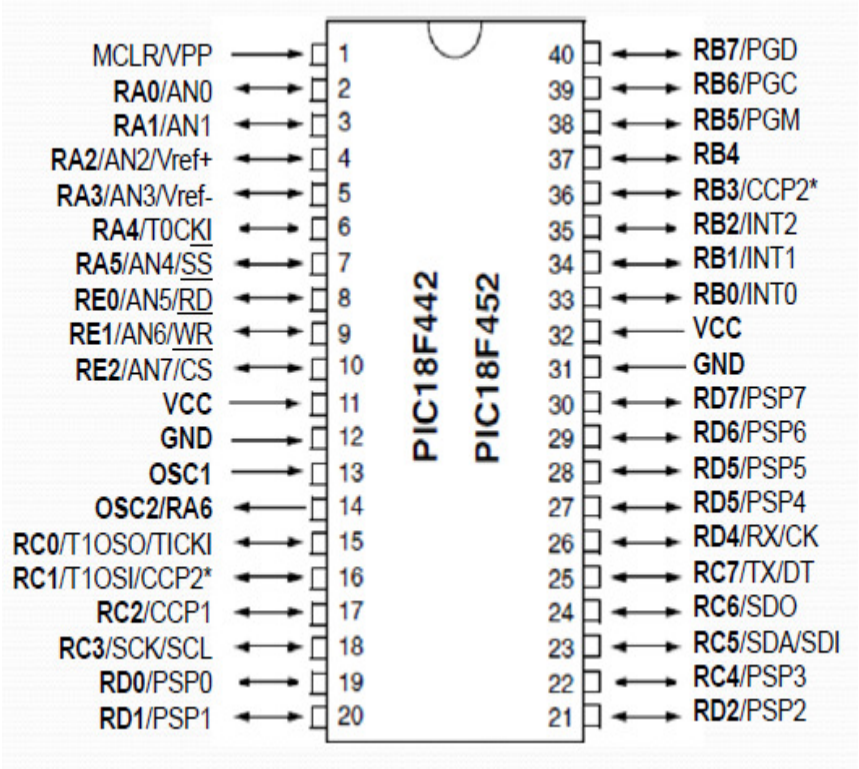


Fig.24 Pin diagram of PIC MCU

3.3.4 PIN DESCRIPTION OF PIC MICROCONTROLLER:

PIN NAME	**PIN No.**	**DESCRIPTION**
MCLR/VPP MCLR VPP	1	Master clear (input) or programming voltage (output) Master clear rest Programming voltage input
OSC1/CLK1 OSC1 CLK1	13	Oscillator crystal Oscillator crystal input Clock Output
OSC2/CLKO/RA6 OSC2 CLK0 RA6	14	Oscillator crystal output or clock output Oscillator crystal output In RC mode OSC pin outputs clock General purpose pin
RA0/AN0 RA0 AN0	2	 Digital I/O Analog Input 0
RA1/AN1 RA1 AN1	3	 Digital I/O Analog Input 1
RA2/AN2 RA2 AN2 VREF-	4	 Digital I/O Analog Input 2 A/D reference voltage(low)
RA3/AN3 RA3 AN3 VREF+	5	 Digital I/O Analog Input 3 A/D reference voltage(high)
RA4/TOCK1 RA4 TOCK1	6	 Digital I/O-Open drain when configured Timer 0 external clock I/P
RA5/AN4/SS RA5 AN4	7	 Digital I/O Analog Input 4

SS		Slave select I/P
RB0/INT0 RB0 INT0	33	Digital I/O External interrupt 0
RB1/INT1 RB1 INT1	34	Digital I/O External interrupt 1
RB2/INT2 RB2 INT2	35	Digital I/O External interrupt 2
RB3/CCP2 RB3 CCP2	36	Digital I/O Capture 2 I/P, Compare 2 O/P
RB4	37	Digital I/O
RB5/PGM RB5 PGM	38	Digital I/O Low voltage ICSP programmable pin
RB6/PGC RB6 PGC	39	Digital I/O In Circuit debugger and ICSP clock
RB7/PGD RB7 PGD	40	Digital I/O In Circuit debugger and ICSP programming data
RC0/T1OSO/T1CKI RC0 T1OSO T1CKI	15	Digital I/O Timer 1 oscillator O/P Timer 1 external clock I/P
RC1/T1OSI/T1CK2 RC1 T1OSI T1CK2	16	Digital I/O Timer 1 oscillator O/P Capture 2 I/P, Compare 2 O/P
RC2/ CCP1 RC2 CCP1	17	Digital I/O Capture 1 I/P, Compare 1 O/P
RC3/SCK/SCL RC3 SCK	18	Digital I/O Synchronous serial clock

SCL		I/P,O/P for SPI mode Synchronous serial clock I/P,O/P for I2C mode
RC4/SDI/SDA RC4 SDI SDA	23	 Digital I/O SPI DATA IN I2C DATA IN
RC4/ SDO RC5 SDO	24	 Digital I/O SPI DATA OUT
RC6/ TX/CK RC6 TX CK	25	 Digital I/O USART asynchronous transmit USART synchronous clock
RC7/ RX/DT RC7 RX DT	26	 Digital I/O USART asynchronous receive USART synchronous data
RD0/PSP0 RD0 PSP0	19	 Digital I/O Parallel slave port data
RD1/PSP1 RD0 PSP1	20	 Digital I/O Parallel slave port data
RD2/PSP2 RD2 PSP2	21	 Digital I/O Parallel slave port data
RD3/PSP3 RD3 PSP3	22	 Digital I/O Parallel slave port data
RD4/PSP4 RD4 PSP4	27	 Digital I/O Parallel slave port data
RD5/PSP5 RD5 PSP5	28	 Digital I/O Parallel slave port data
RD6/PSP6 RD6 PSP6	29	 Digital I/O Parallel slave port data
RD6/PSP6	30	

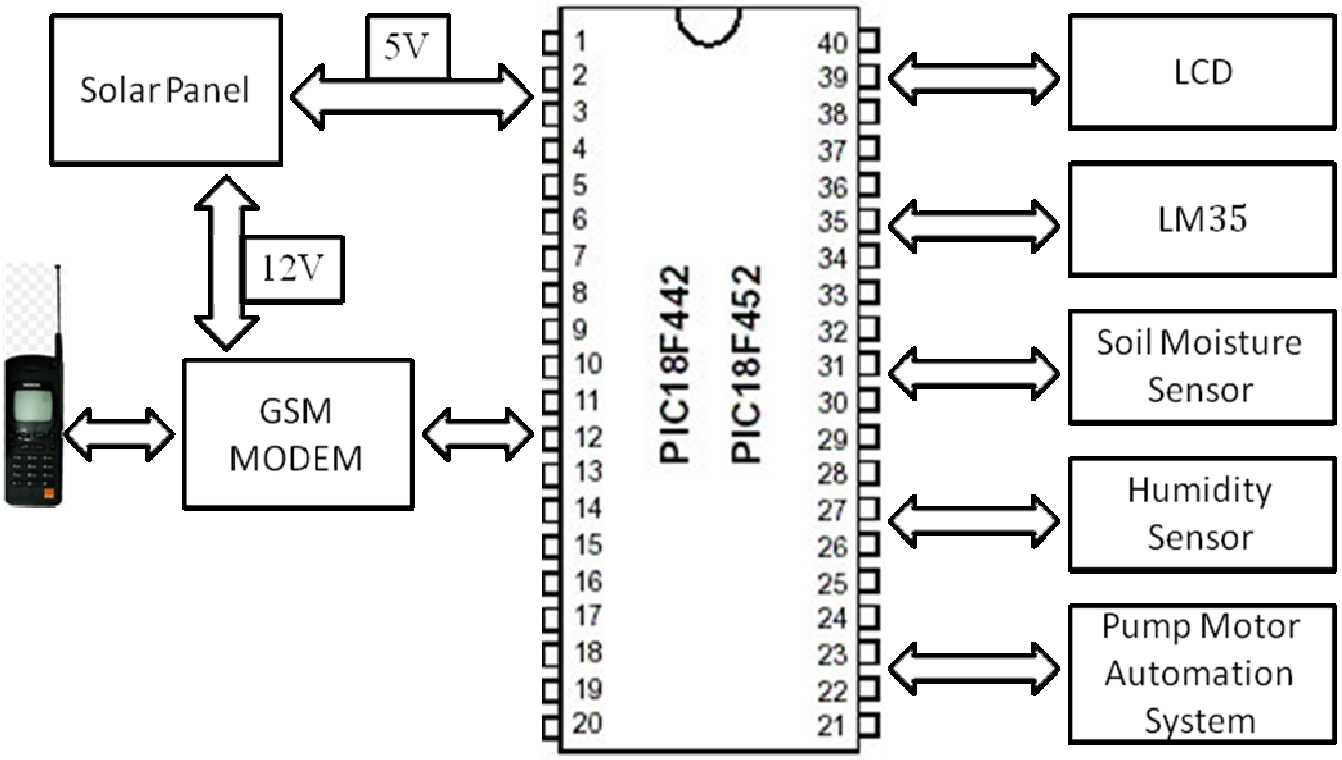
RD6 PSP6		Digital I/O Parallel slave port data
RE0/RD/ AN5 RE0 RD AN5	8	 Digital I/O Read control for PSP Analog I/P 5
RE1/WR/ AN5 RE1 WR AN6	9	 Digital I/O Write control for PSP Analog I/P 6
RE2/CS/ AN7 RE0 CS AN7	10	 Digital I/O Chip select control for PSP Analog I/P 7
VSS	12,31	Ground Reference for I/P,O/P pins
VDD	11,32	Positive supply for I/P,O/P pins

CHAPTER 4

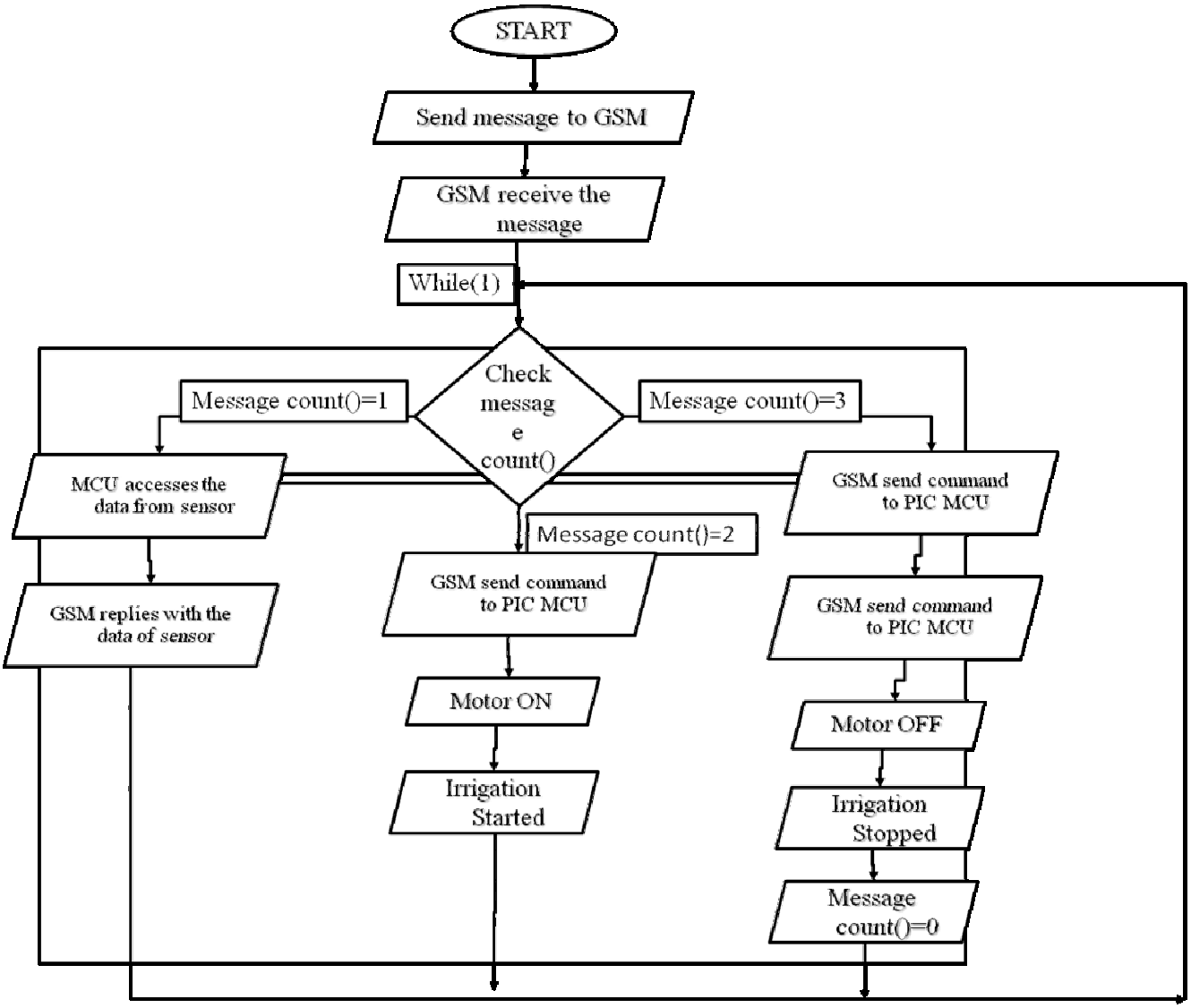
LOGICAL DESIGN OF THE PROJECT

In this chapter we have described the flow diagram of our project and the block diagram as well and we have described the algorithm which gives information about we made the project.

4.1 BLOCK DIAGRAM:



4.2 FLOW DIAGRAM:



4.3 ALGORITHM:

Step 1: Begin

Step 2: Mobile sends message to GSM modem.

Step 3: GSM modem receive the message.

Step 4: GSM Modem checks :

If (message count()=1)

{

- MCU accesses the data from the sensor
- GSM Modem send the data in form of reply to the mobile

}

Else if (message count()=2)

{

- GSM Modem sends the command to MCU for switching ON the motor
- Irrigation starts

}

Else if (message count()=3)

{

- GSM Modem sends command to MCU for switching OFF the motor.
- Motor gets OFF
- Irrigation Stops
- Message count() set to 0

Step 5: Return to Step 4 (infinite loop being executed)

CHAPTER 5

CONCLUSION AND CHALLENGES

5.1 CONCLUSION:

In the recent past our primary sector has undergone through significant changes such as Green Revolution which emphasized on the use of HYV seeds, modification in the agriculture processes, uses of chemical fertilizers etc. With advent of electronic generation it will be beneficial that we integrate the current technology with existing agriculture techniques.

In this project we have try to harness the benefits of the new technology and to use our knowledge for the betterment of our society.

This project is based on GSM platform which would allow a user to have a control over a microcontroller and various set of pumping motors attached to it through a mobile phone. The user will get the status of the environment (Soil) and he will then decide whether to irrigate, provide fertilizers to the field or not.

This whole project is powered by solar panel (12V,12 W) which is the sustainable source of energy and helps in reducing the carbon footprints.

5.2 CHALLENGES OF PROJECT:

The main limitations in our project are:

5.2.1 GSM MODEM HACKING:

GSM modem hacking is possible. An unknown person can send the message to the GSM modem's SIM and can control the device from his mobile.

Solution of this challenge is:

We will try to introduce a special type of programming which will require a password from the person who will try to access the device.

5.2.2 SPAM CALL ON GSM MODEM:

The working of GSM monitoring system will stop temporarily if someone call on the SIM present in GSM modem. As there are many spam calls from the telecommunication companies.

So, to prevent it we will try to program it in such a way that it reject all Spam calls.

5.2.3 HEATING OF DEVICES:

As heating is common in all the electronic devices, heating problem is prevalent in our project also and it can damage components present on the device.

To prevent it, device is needed to switch off for sometime after regular intervals.

5.3 FUTURE PROSPECTS:

This project in future can be develop on the large scale and it can also be integrated with internet, internet applets, android and iOS platform based applications for smart phone which will allow farmers to get access of the field from anywhere and anytime all over the world.Also in Future it can be linked to weather forecast so that it can automatically take the appropriate actions regarding controlling the supply of water in the field based on weather conditions.

CHAPTER 6

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