CHAPTER ONE

INTRODUCTION

1.1 General concept

With the widespread application of the internet and mobile networking technologies, the term ‘smart home’ is no longer alien to us as it was a few years ago. Alternatively referred to as Intelligent Homes, Automated Homes and several other terminologies over the years, the term smart homes simply indicates the automation of daily chores with reference to the equipments in the house. This could be simple remote control of lights or more complex functionalities such as remote viewing of the house interiors for surveillance purposes. Smart home technologies have been around for about 30 years, mostly relying on some proprietary technologies and applications. Some of the application such as remote control of lights, sprinklers and various home appliances may seem trivial, but they tend to be important in some growing businesses such as care delivery for elderly and patients with special needs. With the recent expansion of communication networks, smart home applications can be further enhanced with new dimension of capabilities that were not available before. The whole world is going to be automated and computerize in every life .

1.2 Problem statement

All the appliances is operated with an electrical energy. Manuel control for these appliance is very difficult ,this will cause increase the cost and energy consumption .Also the user can't control the appliances from a different locations.

1.3 Objective

The goal of the Smart Home project is to integrate lighting, temperature, media, and security systems into a central interface. This will give the user the ability to control light and temperature levels throughout the home while streaming audio to multiple zones and monitoring their house's security system. This functionality will be controlled by a graphical user interface located on the user's mobile. The product will include all necessary hardware and software for simple, unassisted user installation and use.

1.4 Methodology

The project can be made by a microcontroller which acts as the brain of the device to receive input signals, process them according to a program, make decisions and output signals. The temperature sensor used to sense ambient temperature and send the values to the microcontrollers then the microcontroller will continuously process and show it on the mobile phone at requested and comparing it to the required temperature which has been selected by the user then a decision made by the microcontroller for the output to respond to . And to remotely control the device a GSM is used as a medium between the brain of the device (microcontroller) and the user.

1.5 Project Layout

The project consists of five chapters:

Chapter one demonstrate the problem and the objective of the project. The main concepts of the project such as microcontroller and GSM discusses in chapter two. The description of some components of the project such as sensors and relays and its use is explained in chapter three. Chapter four demonstrates the functions and operation of the circuit. Chapter five contains the conclusion and recommendations .

CHAPTER TWO

MICROCONTROLLER AND GSM

2.1 Introduction

Automatic control has played a vital role in the advance of engineering and science. In addition to its extreme importance in space-vehicle systems, missile-guidance systems, robotic systems, and the like, automatic control has become an important and integral part of modern manufacturing and industrial processes. For example, automatic control is essential in the numerical control of machine tools in the manufacturing industries, in the design of autopilot systems in the aerospace industries, and in the design of cars and trucks in the automobile industries. It is also essential in such industrial operations as controlling pressure, temperature, humidity, viscosity, and flow in the process industries. Since advances in the theory and practice of automatic control provide the means for attaining optimal performance of dynamic systems, improving productivity, relieving the drudgery of many routine repetitive manual operations, and more, most engineers and scientists must now have a good understanding of this field.

The distinguishing feature of open-loop control is the open nature of its Action, that is, the output variable does not have any influence on the Input variable as shown in figure (2.1).

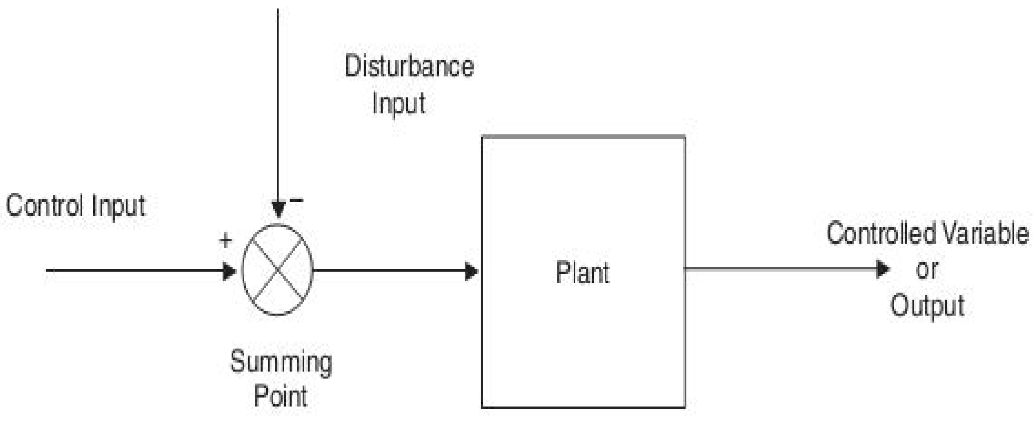

Figure 2.1: Open –loop control system

Closed loop control system is defined as a process where the control-Led variable is continuously monitored and compared with the reference Variable. Depending on the result of this comparison, the input variable for the system is influenced to adjust the output variable to the desired Value despite any disturbing influences. This feedback results in a Closed-loop action as shown in figure (2.2)[1].

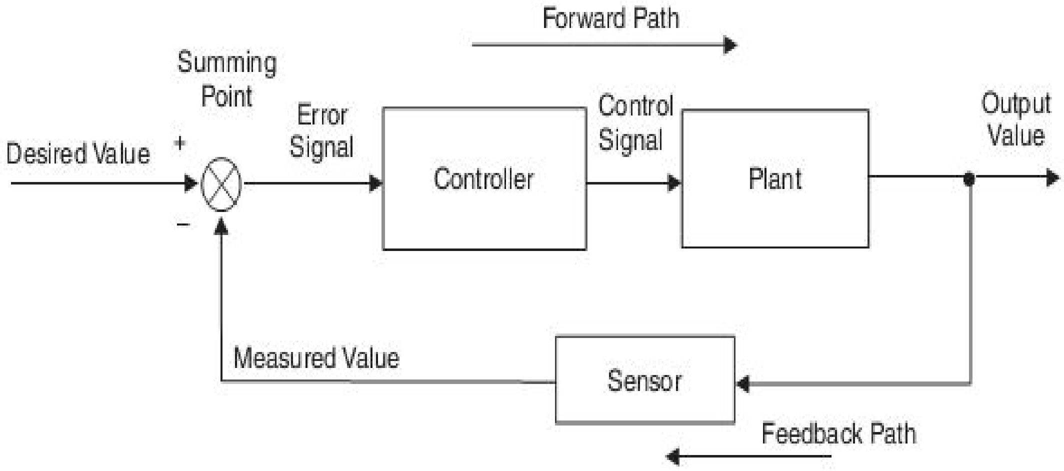

Figure 2.2: Close loop control system

2.2 Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

A microcontroller is a small, inexpensive computer, usually used for sensing input from the real world and controlling devices based on that input. Most electronic devices you use today have a microcontroller in them of some form or another. Microcontrollers are easy to use with simple sensors and output devices, and they can communicate with desktop computers fairly simply as well. Using a microcontroller is an excellent way to separate the customized part of a project from the part that’s best done on a desktop computer. They’re also very useful for when designing a simple interactive device that doesn’t need the full power of a desktop computer, but does need to be smaller or cheaper.

Like any other computer, a microcontroller has to have input ports to detect action by a user, and output ports through which it expresses the results of its programs. The pins sticking out of the microcontrollers are the inputs and outputs. Other devices, like light, heat, or motion sensors, motors, lights, sound devices, are attached to these pins to allow the microcontroller to be sensitive to the world and to express itself[6].

2.2.1 Microcontroller operation

Even though there is a large number of different types of microcontrollers and even more programs created for their use only, all of them have many things in common. A typical scenario on the basis of which it all functions is as follows:

- ❖ Power supply is turned off and everything is still…the program is loaded into the microcontroller, nothing indicates what is about to come.
- ❖ Power supply is turned on and everything starts to happen at high speed! The control logic unit keeps everything under control. It disables all other circuits except quartz crystal to operate. While the preparations are in progress, the first milliseconds go by.
- ❖ Power supply voltage reaches its maximum and oscillator frequency +becomes stable. SFRs are being filled with bits reflecting the state of all circuits within the microcontroller. All pins are configured as inputs. The overall electronics starts operation in rhythm with pulse sequence. From now on the time is measured in micro and nanoseconds.

- ❖ Program Counter is set to zero. Instruction from that address is sent to instruction decoder which recognizes it, after which it is executed with immediate effect.
- ❖ The value of the Program Counter is incremented by 1 and the whole process is repeated...several million times per second. Atypical inside a microcontroller is shown in figure (2.3).

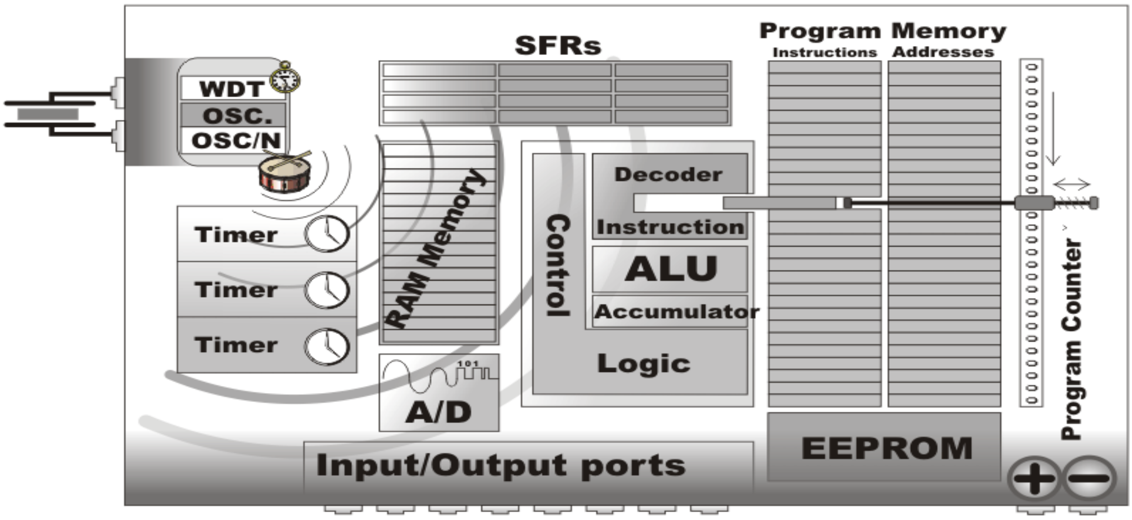

Figure 2.3 : Inside microcontroller

2.2.2 Types of microcontrollers

Many microcontroller and some of it is used in very narrow range of applications or are more like applications processors than microcontrollers. The microcontroller market is extremely fragmented, with numerous vendors, technologies, and markets. Note that many vendors sell or have sold multiple architectures[6].

2.2.3 Construction of microcontroller

All the operations within the microcontroller are performed at high speed and quite simply, but the microcontroller itself would not be so useful if there are not special circuits which make it complete.

❖ Read Only Memory (ROM)

Read Only Memory (ROM) is a type of memory used to permanently save the program being executed. The size of the program that can be written depends on the size of this memory. ROM can be built in the microcontroller or added as an external chip, which depends on the type of the microcontroller. Both options have some disadvantages. If ROM is added as an external chip, the microcontroller is cheaper and the program can be considerably longer. At the same time, a number of available pins is reduced as the microcontroller uses its own input/output ports for connection to the chip. The internal ROM is usually smaller and more expensive, but leaves more pins available for connecting to peripheral environment. The size of ROM ranges from 512B to 64KB.

❖ Random Access Memory (RAM)

Random Access Memory (RAM) is a type of memory used for temporary storing data and intermediate results created and used during the operation of the microcontrollers. The content of this memory is cleared once the power supply is off. For example, if the program performes an addition, it is necessary to have a register standing for what in everyday life is called the “sum” . For that purpose, one of the registers in RAM is called the "sum" and used for storing results of addition. The size of RAM goes up to a few KBs.

❖ Electrically Erasable Programmable ROM (EEPROM)

The EEPROM is a special type of memory not contained in all microcontrollers. Its contents may be changed during program execution (similar to RAM), but remains permanently saved even after the loss of power (similar to ROM). It is often used to store values, created and used during operation (such as calibration values, codes, values to count up to etc.), which must be saved after turning the power supply off. A disadvantage of this memory is that the process of programming is relatively slow. It is measured in milliseconds . figure (2.4) shows the RAM,EEPROM and CPU.

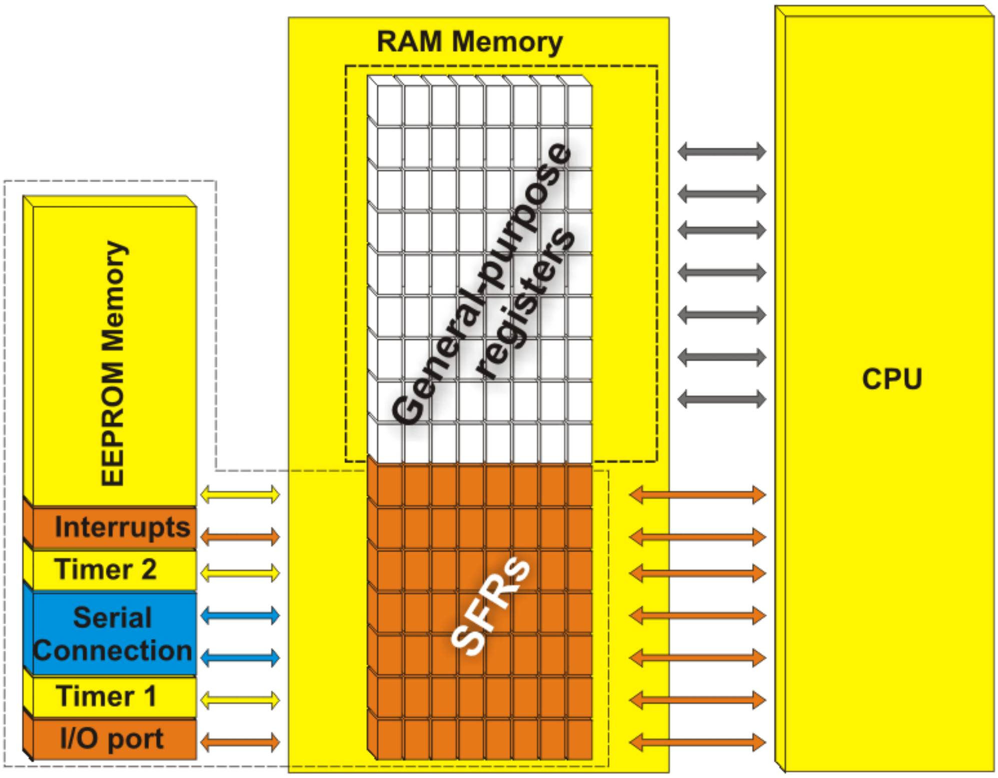

Figure 2.4 : ROM, EEPROM and CPU

❖ Special Function Registers (SFR)

Special function registers are part of RAM memory. Their purpose is predefined by the manufacturer and cannot be changed therefore. Since their bits are physically connected to particular circuits within the microcontroller, such as A/D converter, serial communication module etc., any change of their state directly affects the operation of the microcontroller or some of the circuits. For example, writing zero or one to the SFR controlling an input/output port causes the appropriate port pin to be configured as input or output. In other words, each bit of this register controls the function of one single pin.

❖ Program Counter

Program Counter is an engine running the program and points to the memory address containing the next instruction to execute. After each instruction execution, the value of the counter is incremented by 1. For this reason, the program executes only one instruction at a time just as it is written. However…the value of the program counter can be changed at any moment, which causes a “jump” to a new memory location. This is how subroutines and branch instructions are executed. After jumping, the counter resumes even and monotonous automatic counting +1, +1, +1…

❖ Central Processor Unit (CPU)

As its name suggests, this is a unit which monitors and controls all processes within the microcontroller and the user cannot affect its work. It consists of several smaller subunits, of which the most important are:

- Instruction decoder is a part of the electronics which recognizes program instructions and runs other circuits on the basis of that. The abilities of this circuit are expressed in the "instruction set" which is different for each microcontroller family.
- Arithmetical Logical Unit (ALU) performs all mathematical and logical operations upon data.
- Accumulator is an SFR closely related to the operation of ALU. It is a kind of working desk used for storing all data upon which some operations should be executed (addition, shift etc.). It also stores the results ready for use in further processing. One of the SFRs, called the Status Register, is closely related to the accumulator, showing at any given time the "status" of a number stored in the accumulator (the number is greater or less than zero etc.).

❖ Input/output ports (I/O Ports)

In order to make the microcontroller useful, it is necessary to connect it to peripheral devices. Each microcontroller has one or more registers (called a port) connected to the microcontroller pins. Figure (2.5) shows the I/O port .

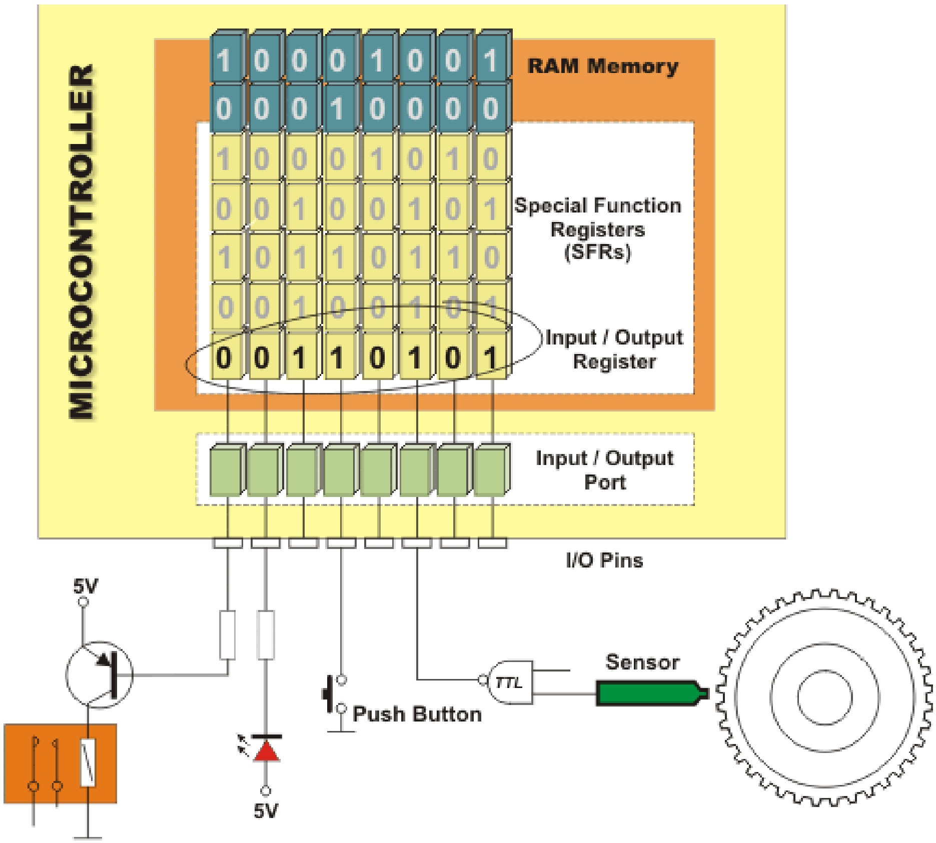

Figure 2.5 : input/ output ports

❖ Oscillator

Even pulses generated by the oscillator enable harmonic and synchronous operation of all circuits within the microcontroller. It is usually configured as to use quartz-crystal or ceramics resonator for frequency stabilization. It can also operate without elements for frequency stabilization (like RC oscillator). It is important to say that program instructions are not executed at the rate imposed by the oscillator itself, but several times slower. It happens because each instruction is executed in several steps. For some microcontrollers, the same number of cycles is needed to execute any instruction, while it's different for other microcontrollers. Accordingly, if the system uses quartz crystal with a frequency of 20MHz, the execution time of an instruction is not expected 50nS, but 200, 400 or even 800 nS, depending on the type of the microcontroller. Figure (2.6) show the oscillator.

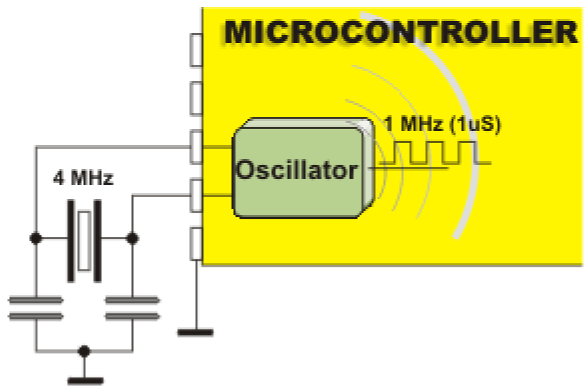

Figure 2.6 :The oscillator

❖ Timers and Counters

Most programs use these miniature electronic "stopwatches" in their operation. These are commonly 8- or 16-bit SFRs the contents of which is automatically incremented by each coming pulse. Once the register is completely loaded, an interrupt is generated!

If these registers use an internal quartz oscillator as a clock source, then it is possible to measure the time between two events (if the register value is T1 at the moment measurement has started, and T2 at the moment it has finished, then the elapsed time is equal to the result of subtraction T2-T1). If the registers use pulses coming from external source, then such a timer is turned into a counter.

This is only a simple explanation of the operation itself. It’s somehow more complicated in practice.

❖ **Watchdog timer**

The Watchdog Timer is a timer connected to a completely separate RC oscillator within the microcontroller.

If the watchdog timer is enabled, every time it counts up to the program end, the microcontroller reset occurs and program execution starts from the first instruction. The point is to prevent this from happening by using a special command. The whole idea is based on the fact that every program is executed in several longer or shorter loops.

If instructions resetting the watchdog timer are set at the appropriate program locations, besides commands being regularly executed, then the operation of the watchdog timer will not affect the program execution.

If for any reason (usually electrical noise in industry), the program counter "gets stuck" at some memory location from which there is no return, the watchdog will not be cleared, so the register’s value being constantly incremented will reach the maximum et voila! Reset occurs![6].

2.2.4 Power Supply Circuit

There are two things worth attention concerning the microcontroller power supply circuit

Brown out is a potentially dangerous state which occurs at the moment the microcontroller is being turned off or when power supply voltage drops to the lowest level due to electric noise. As the microcontroller consists of several circuits which have different operating voltage levels, this can cause its out of control performance. In order to prevent it, the microcontroller usually has a circuit for brown out reset built-in. This circuit immediately resets the whole electronics when the voltage level drops below the lower limit.

Reset pin is usually referred to as Master Clear Reset (MCLR) and serves for external reset of the microcontroller by applying logic zero (0) or one (1) depending on the type of the microcontroller. In case the brown out is not built in the microcontroller, a simple external circuit for brown out reset can be connected to this pin.

2.2.5 Serial communication

Parallel connections between the microcontroller and peripherals established over I/O ports are the ideal solution for shorter distances up to several meters. However, in other cases, when it is necessary to establish communication between two devices on longer distances it is obviously not possible to use parallel connections. Then, serial communication is the best solution.

Today, most microcontrollers have several different systems for serial communication built in as a standard equipment. One of the most important things concerning serial communication is the Protocol which should be strictly observed. It is a set of rules which must be applied in order that devices can correctly interpret data they mutually exchange. Fortunately, the microcontrollers automatically take care of this, so the work of the programmer/user is reduced to a simple write (data to be sent) and read (received data). Figure (2.7) show serial communication .

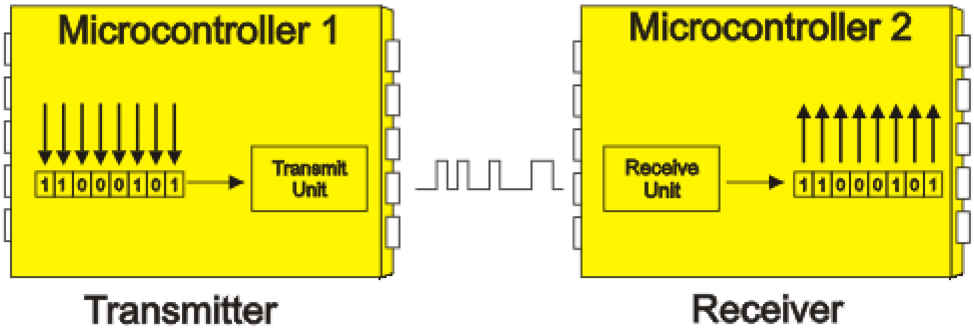

Figure 2.7 : serial communication

2.2.6 Program

Unlike other integrated circuits which only need to be connected to other components and turn the power supply on, the microcontrollers need to be programmed first. This is a so called "bitter pill" and the main reason why hardware-oriented electronics engineers stay away from microcontrollers. It is a trap causing huge losses because the process of programming the microcontroller is basically very simple.

In order to write a program for the microcontroller, several "low-level" programming languages can be used such as Assembly, C and Basic (and their versions as well). Writing program procedure consists of simple writing instructions in the order in which they should be executed. There are also many programs running in Windows environment used to facilitate the work providing additional visual tools.

2.3 GSM Modem

GSM stands for Global System for Mobile Communications . It is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones.

A Modem is a device which modulates and demodulates signals as required to meet the communication require ments. It modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.

A GSM Modem is a device that modulates and demodulates the GSM signals and in this particular case 2G signals. The modem we are using is SIMCOM SIM900. It is a Tri-band GSM/GPRS Modem as it can detect and operate at three frequencies.

Sim300 is a widely used many projects and hence many variants of development boards for this have been developed these development boards are equipped with various features to make it easy to communicate with the sim300 module some boards provide only TTL interface while some boards include an RS232 interface and some others include an USB interface if your PC has a send pord (DB9) you can buy a GSM modem that has both TTL and RS232 interfacings in economy .

Sim300 GSM module used here .consists of a TTL interfacings and an RS232 interface . the TTL interface allows us to directly interface with a microcontroller while the RS232 interface includes a MAX232 IC to enable communication with the PC .it also consists of a buzzer .antenna and SIM slot SIM300 in this application is used a DCE (data circuit-terminating equipment) and PC as a DTE (data terminal equipment)[7].

2.3.1 useful of GSM modem

GSM technology has grown so much , that literally there isn't a place on earth where there is no GSM signal. In such a scenario GSM provides us a wide scope in controlling things remotely from any place just with our finger tips, GSM also provides ease to easily communicate in a more robust way.

Sim300 GSM module can be used to send and receive SMS connecting it to a PC when a SIM is inserted the GSM modem can be send commands to send or receive SMS from the PC through a com port (serial port or an USB) . these commands are called as AT commands . through AT commands we can perform several actions like sending and receiving SMS ,MMS,etc.sim300 has anS232 interface and this can be used to communicate with the PC.sim300 usually operates at a baud rate of 9600 , with 1 stop bits , no parity ,no hardware control and 8 data bits. Some of the AT commands necessary for sending and receiving SMS.

AT commands are used to control MODEMs. AT is the abbreviation for Attention. These commands come from Hayes commands that were used by the Hayes smart modems[7].

2.3.2 GSM Modem Interfacing with Microcontroller

Nowadays, many projects like car security system, home automation, remote controlled industrial machines are controlled by an SMS using GSM modem. This modem uses a SIM card and operates through a subscription with the mobile operator. Many people they don’t know how GSM module interfacing with 8051 microcontroller. Therefore, the following steps explain the basics of how GSM modem interfacing with 8051 microcontroller. The GSM modem is a one type of modem, which uses the SIM card for communication. First, insert a SIM card into the modem which uses the same number/ account as the caller phone. It supports AT commands for handling the messages. These commands are programmed into the microcontroller ensures sending or receiving. The GSM modem comprises of two light emitting diodes like green and red LEDs, which are used for the network connection indication. If there is no network is available, then the red LED glows, and if a network is available, then the green LED glows so that one can observe the working of GSM modem. Connect a power supply to a GSM modem which contains a SIM card and wait till it registers in the GSM network. For the testing of the modem, you can send an SMS to the modem. If it receives the message from the mobile, it is working properly, or else it is damaged.GSM modem works with 12V DC and the microcontroller works with 5V. So, interfacing of this modem with microcontroller directly is not possible due to mismatch of voltage levels. GSM modem is interfaced with 8051 microcontroller through MAX232 with the help of RS232 cable for serial communication. MAX232 device is used to convert TTL logic level to RS232 level during serial communication of microcontroller to the GSM modem. The RS232 device is an interface between data terminal equipment and data communication equipment using serial binary data exchange. The RS232 cable is commonly available with the 9 or 25 pin wiring and has jumpers to provide handshaking pins for those devices that require it .Figure (2.8) show interface between the GSM and other device.

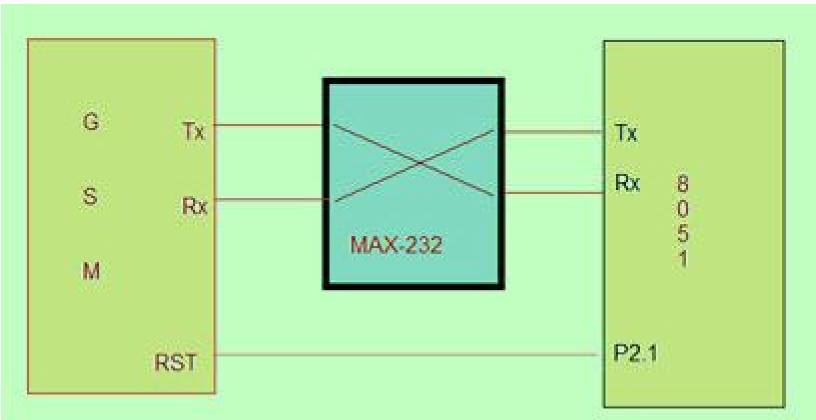

Figure 2.8 : GSM Modem Interfacing with Microcontroller

2.3.3 The Working Procedure of a GSM Modem

When the GSM modem is connected to the microcontroller, then it communicates with a mobile via a UART protocol. The GSM modem is connected to the microcontroller, it controls the industrial appliances through an SMS. As each load is assigned with a unique identifier number like load1 is assigned with 1111, load2 is 0000 is the program in the microcontroller. This modem always monitors the signals from the i/p. When the modem receives the SMS from an operational phone, serially that data is sent to the microcontroller. This microcontroller compares this data with the stored data. If the compared data match with the stored data, then the microcontroller generates corresponding signals to control the load.

2.3.4 Applications of GSM Modem

The applications of GSM modem mainly involve supply chain management, weather stations, security applications and GPRS mode remote data logging and GSM based projects[7].

CHAPTER THREE

RELAY AND SENSOR

3.1 Relays

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability. Relays are used in a wide variety of applications throughout industry, such as in telephone exchanges, digital computers and automation systems. Highly sophisticated relays are utilized to protect electric power systems against trouble and power blackouts as well as to regulate and control the generation and distribution of power. In the home, relays are used in refrigerators, washing machines and dishwashers, and heating and air-conditioning controls. Although relays are generally associated with electrical circuitry, there are many other types, such as pneumatic and hydraulic. Input may be electrical and output directly mechanical, or vice verse[2].

3.1.1 Types of Relays

There are two basic classifications of relays Electromechanical and Solid State. In electromechanical relays (EMR) contacts are open or close by magnetic force with solid state relays (SSR) there are no contacts and switching is totally electronic .the decision to use electromechanical relays or solid state relays depends on an application's electrical requirements cost constraints and life expectancy although solid state relays have become very popular, electromechanical relays remain common .many of the functions performed by heave duty equipment need the switching capabilities of electromechanical relays . solid state relays switching the current using non moving electronic devices such as silicon controlled rectifiers . these differences in the two types of relays result in advantages and disadvantages with each system.

Because solid state relays do not have to either energize a coil or open contacts ,less voltage is required to turn solid state relays on or off .similarly solid state relays turn on or off faster because there are no physical parts to move .although the absence of contacts and moving parts means that solid state relays are not subject to arcing and do not wear out .

Contacts on electromechanical relays can be replaced ,whereas entire solid state relays must be replaced when any part becomes defective because of the construction of solid state relays there is residual electrical resistance and\ or current leakage whether switches are open and close . the small voltage drops that created are not usually a problem however electromechanical relays provide a cleaner on or off condition because of the relatively large distance between contacts which acts as a form of insulation .

❖ **Electromechanical relays**

The basic parts and functions of electromechanical relays include:

- **frame** : heavy duty frame that contains and supports the parts
- of the relay.
- **Coil** : wire is wound around a metal core .the coil of wire causes an electromagnetic field.
- **armature** : a relay moving part. The armature opens and closes the contacts .an attached spring returns the armature to its original position .
- **contacts** : the conducting part of the switch that makes closes or breaks opens a circuit.

Relays involve two circuits : the energizing circuit and the contact circuit the coil is on the energizing side and the relay contacts on the contact side. When a relay coil is energized current flow through the coil creates a magnetic field whether in a dc unit where the polarity is fixed or in an ac unit where the polarity changes 120 times per second the basic function remains the same which that the magnetic coil attracts a ferrous plate which is part of the armature on the end of armature is attached to the metal frame which is formed so that the armature can pivot while the other end opens and close contacts .

❖ Solid State Relay

One of the main disadvantages of an Electromechanical Relay (EMR) is that it is a "mechanical device", that is it has moving parts. Over a period of time these parts will fail, or that the contact resistance through the constant arcing and erosion may make the relay unusable and it will therefore need to be replaced. Also, they are electrically noisy with the contacts suffering from contact bounce which may affect any electronic circuits to which they are connected. There is another type of relay called a Solid State Relay or (SSR) for short which is a solid state contactless, pure electronic relay. It has no moving parts with the contacts being replaced by transistors, thyristors or triacs. The electrical separation between the input control signal and the output load voltage is accomplished with the aid of an optocoupler type light sensor.

The Solid State Relay provides a high degree of reliability, long life and reduced electromagnetic interference (EMI), (no arcing contacts or magnetic fields), together with a much faster response, as compared to the conventional electromechanical relay. Also the input control power requirements of the solid state relay are generally low enough to make them compatible with most IC logic families without the need for additional buffers, drivers or amplifiers. However, being a semiconductor device they must be mounted onto suitable heat sinks to prevent the output switching semiconductor device from overheating.

3.1.2 Relay operation

All relays operate using the same basic principle a commonly used 4-pin relay have two circuits a control circuit (shown in green) and load circuit (shown in red) the control circuit has a small control coil while the load circuit has a switch the coil controls the operation of the switch ,as shown in figure (3.1) .

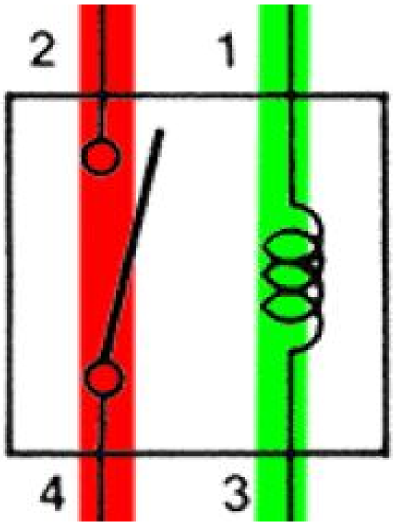

Figure 3.1:befor magnetic field

switch current flowing through the control circuit coil (pin1 and pin3) creates a magnetic field which causes the switch to close (pin2 and pin4) which is part of the load circuit is used to control an electrical circuit that connect to it .current now flows through pins 2 and 4 when relay is energized as shown in figure (3.2)

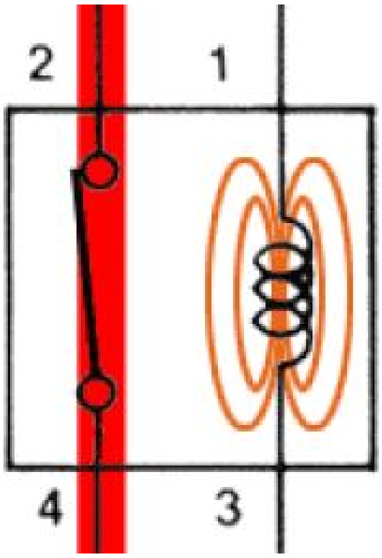

Figure 3.2: after magnetic field

When current stop flowing through the control circuit(pin 1 and pin 3) the relay becomes de energized .and without magnetic field the switch opens and current is prevented from flowing through pins 2 and 4 and now relay off as shown in figure (3.3)

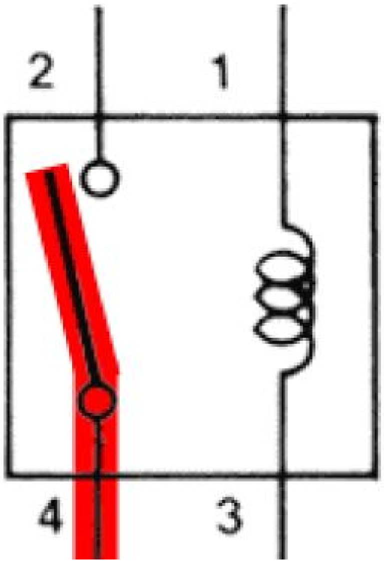

Figure 3.3: de energized relay

3.1.3 Relay design

Relay are either normally open or normally closed, normally open relays have a switch that remains open until energized (on) while normally closed relay are close until energized relays always shown in the de-energized position (no current flowing through control circuit) and normally open relay are the most common and that shown in figure (3.4)

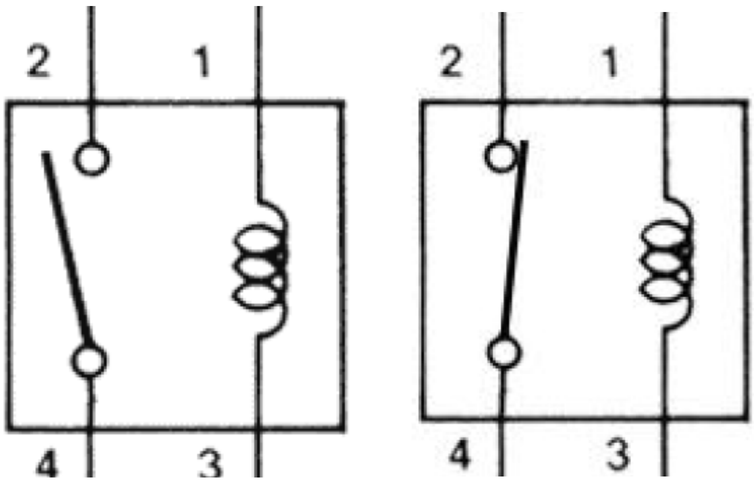

Figure 3.4 :normally open and normally close relays

3.1.4 Actual relay design

Current flows through the control coil which is wrapped around an iron core and the iron core intensifies the magnetic field the magnetic field attracts the upper contact arm and pulls it down closing the contact and allowing power from the power source to go to the load as shown in figure 3.5

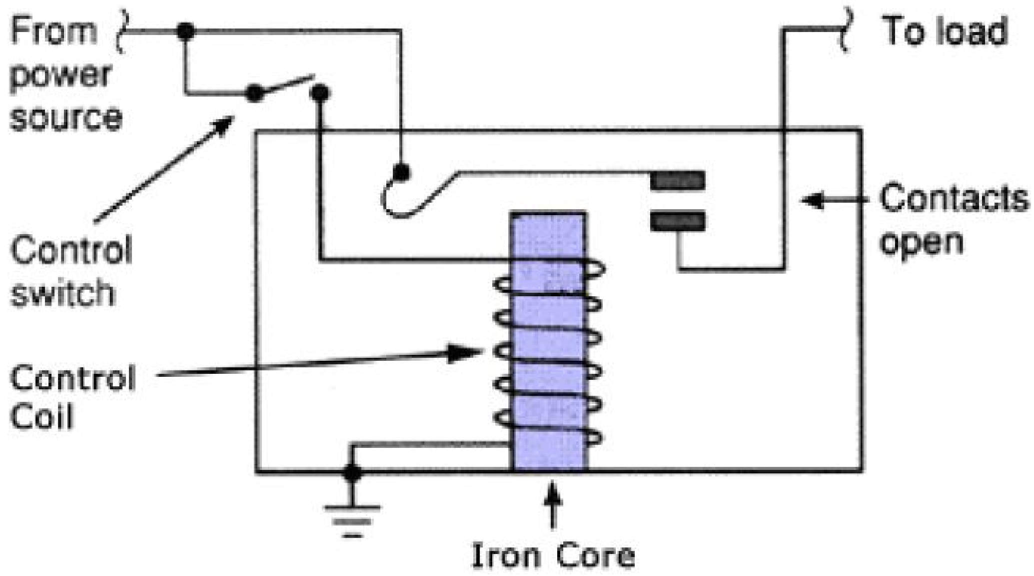

figure 3.5: actual relay

3.1.5 Relay variations

Other relay variations include three and five pin relays a 3_pin relay instead of two input source this type of relays has on input source at pin 1 current splits inside the relay supplying power to both the control and the load circuits .a 5_pin relay has single control circuit but two separate current paths for the switch one when the relay is de-energizer (off_ no current is flowing through the control circuit) and the other one when the energized (on_ current is flowing through the control circuit) when the relay is de-energizer (off) pins 4 and 5 have continuity and when the relay energized (on) pins 3and 5 have continuity and all of that shown in figure (3.6)

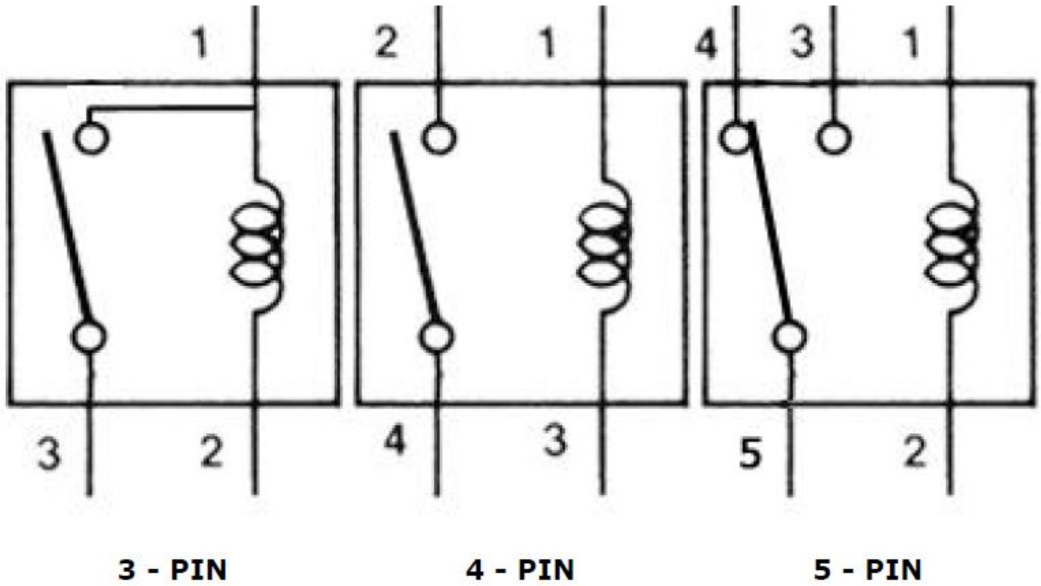

Figure 3.6: variations of Relays

3.2 Sensor

A sensor is a device that receives a stimulus and responds with an electrical Signal The stimulus is the quantity, property, or condition that is received and converted into an electrical signal. The purpose of a sensor is to respond to some kind of an input physical property (stimulus) and to convert it into an electrical signal that is compatible with electronic circuits .A sensor is a translator of a generally nonelectrical value into an electrical value. A signal can be channeled, amplified, and modified by electronic devices. The sensor’s output signal may be in the form of voltage, current, or charge. These may be further described in terms of amplitude, polarity, frequency, phase, or digital code. This set of characteristics is called the output signal format. Therefore, a sensor has input properties (of any kind) and electrical output properties. Any sensor is an energy converter. Always deal with energy transfer from the object of measurement to the sensor. The process of sensing is a particular case of information transfer, and any transmission of information requires transmission of energy. of course, one should not be confused by an obvious fact that transmission of energy can flow both ways it may be with a positive sign as well as with a negative sign; that is, energy can flow either from an object to the sensor or from the sensor to the object. A special case is when the net energy flow is zero, which also carries information about existence of that particular case. The term sensor should be distinguished from transducer. The latter is a converter of any one type of energy into another, whereas the former converts any type of energy into electrical energy Sensor classification schemes range from very simple to the complex Depending on the classification purpose One of the several practical ways to look at the sensors is all sensors may be one of two kinds: passive and active. A passive sensor does not need any additional energy source and directly generates an electric signal in response to an external stimulus. That is, the input stimulus energy is converted by the sensor into the output signal. The examples are a thermocouple, a photodiode, and a piezoelectric sensor.

The active sensors require external power for their operation, which is called an excitation signal. That signal is modified by the sensor to produce the output signal .The active sensors sometimes are called parametric because their own properties change in response to an external effect and these properties can be subsequently converted into electric signals. It can be stated that a sensor’s parameter modulates the excitation signal and that modulation carries information of the measured value. For example, a thermistor is a temperature sensitive resistor. It does not generate any electric signal, but by passing an electric current through it (excitation signal) its resistance can be measured by detecting variations in current and/or voltage across the thermistor. These variations (presented in ohms) directly relate to temperature through a known transfer function[3].

3.2.1 Temperature sensors

Because temperature can have such a significant effect on materials and processes at the molecular level, it is the most widely sensed of all variables. Temperature is defined as a specific degree of hotness or coldness as referenced to a specific scale. It can also be defined as the amount of heat energy in an object or system. Heat energy is directly related to molecular energy Temperature sensors detect a change in a physical parameter such as resistance or output voltage that corresponds to a temperature change There are many different types of Temperature Sensors available and all have different characteristics depending upon their actual application. Temperature sensors consist of two basic physical types[4]:

- **Contact Types** : These types of temperatures sensors are required to be in physical contact with the object being sensed and uses conduction to monitor changes in temperature. They can be used to detect solids, liquids or gases over a wide range of temperatures.
- **Non-contact Types** : These types of temperatures sensors detect the Radiant Energy being transmitted from the object in the form of Infra-red radiation. They can be used with any solid or liquid that emits radiant energy.

The two basic types of contact or even non-contact temperature sensors can also be sub-divided into the following 3 groups of sensors, Electro-mechanical, Resistive and Electronic and all three types are discussed below[4].

3.2.2 Types of temperature sensors

- **Thermocouple :**Thermocouples are formed when two electrical conductors of dissimilar metals or alloys are joined at one end of a circuit. Thermocouples do not have sensing elements, so they are less limited than resistive temperature devices (RTDs) in terms of materials used and can handle much higher temperatures.All thermocouples have what are referred to as a “hot” (or measurement) junction and a “cold” (or reference) junction. One end of the conductor (the measurement junction) is exposed to the process temperature, while the other end is maintained at a known reference temperature. When the ends are subjected to different temperatures, a current will flow in the wires proportional to their temperature difference. Temperature at the measurement junction is determined by knowing the type of thermocouple used, the magnitude of the mill volt potential, and the temperature of the reference junction.

- **Thermistor:** Thermistors (or thermally sensitive resistors) are devices that change their electrical resistance in relation to their temperature. They typically consist of a combination of two or three metal oxides that are sintered in a ceramic base material and have lead wires soldered to a semiconductor wafer or chip, which are covered with epoxy or glass. Thermistors are available in two different types: positive temperature coefficient (PTC) and negative temperature coefficient (NTC). PTC devices exhibit a positive change or increase in resistance as temperature rises, while NTC devices exhibit a negative change or decrease in resistance when temperature increases. The change inresistance of NTC devices is typically quite large, providing a high degree of sensitivity.
- **Resistive temperature devices:** RTDs (resistive temperature devices), like thermistors, employ a change in electrical resistance to measure or control temperature. RTDs consist of a sensing element, connection wires between the element and measurement instrument, and a support for positioning the element in the process. The metal sensing element is an electrical resistor that changes resistance with temperature
- **Silicon sensors:** Silicon sensors are available in a wide variety of designs, outputs, and costs. Temperature ranges are available from the cryogenic (1.4K) to 200°C. With high sensitivity integrated-circuit(IC) versions are available with on-chip signal conditioning for direct voltage or current output to controllers or meters. Because they have memory, IC-types can be very accurately calibrated. They work effectively in multi-sensor environments such as communications networks. The output value of most IC sensors is proportional with temperature over a specific range. Standard accuracy is usually assigned, but can often be calibrated at a specific

temperature. Along with basic temperature control and indication, various temperature compensation functions are often directly incorporated in printed circuits.

and In general all sensor types are useful temperature measurement options, but each has its advantages and disadvantages. For example:

Thermistors provide high resolution, have the widest range of applications, are the most sensitive, and are low cost, but are nonlinear and have limited temperature range.

Thermocouples have the highest temperature region and are durable for high vibration and high-shock applications, but require special extension wire.

RTDs are nearly linear and are highly accurate and stable, but they are large and expensive

Silicon types are low cost and nearly linear, but have a limited temperature range[4].

3.3 LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade

scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance ,linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10°with improved accuracy).

3.3.1 Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C Ensured Accuracy (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical
- Low impedance output, 0.1 for 1 mA load

figure (3.7) shown LM35 sensor

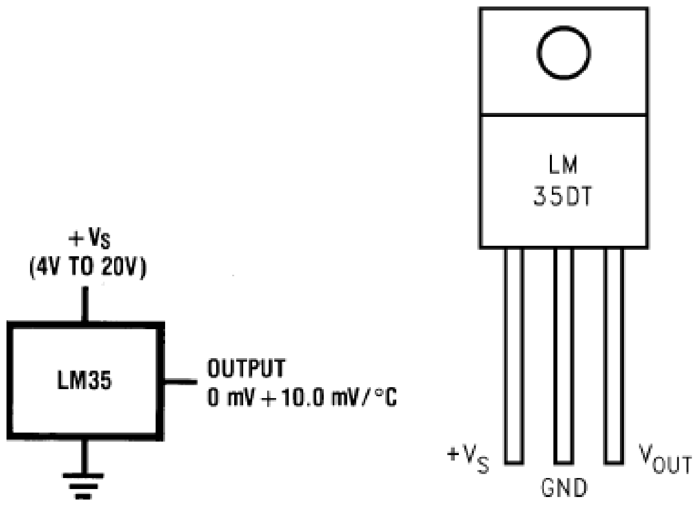

figure 3.7:LM35 sensor

CHAPTER FOUR

APPLICATION

4.1 Introduction

The development of digital information has led the rapid change in human lifestyle. The use of electricity is very important as one of the main source of energy that is vital in today modern life. Some kinds of mechanism using available technology could be used to reduce wastage in electricity usage. Thus a prototype based on a microcontroller device using SMS is developed. It can automatically control any electrical equipment at home remotely using mobile phone. Hence the electrical energy saving in daily life can be made more efficient and effective.

As the technology grows, SMS technology has been widely accepted as a part of medium of communication . The purpose of using SMS is to provide widest coverage at minimal cost. Therefore the use of SMS would facilitate in controlling the electrical device at home from long distance and low in maintenance and independent from any physical geographical boundary.

At the present time, people use electrical energy as one of the main source of power of energy to operate any electrical device or appliance. Most of the people turn on the light for 24 hours per day when they are away from home. Leaving the light turned on continuously, lead to energy waste. Thus this project is proposed to develop a system is to facilitate the home owner to optimize usage of electricity remotely using SMS.

Light turned on continuously and it lead to energy waste. Thus this research is carried out to provide a mechanism through the development of a prototype to provide a service to the home owner to optimize the usage of electricity through SMS services.

4.2 Block diagram

The flowing figure (4.1) show the main components of sequence operation .

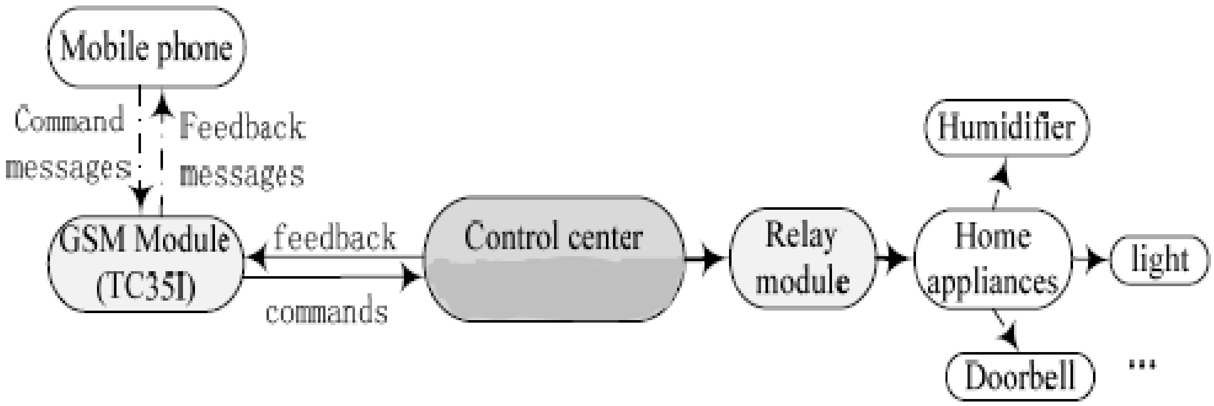

Figure 4.1: main components

In this system, GSM module plays the communication role. Microcontroller bears the task of a control center. The relay module connected to home appliances is the object to be controlled. There are several channels of relays on the module. Each connects to a different home appliance. The GSM module with a smart card is responsible for receiving text messages from the GSM network and transmitting the short message from the local MCU to the GSM network. It also receives message command from user's mobile and sends the cor- responding command to the control center microcontroller. The controller analysis the command and conducts the relay to open or close the anticipated cannel, such to open or close the related appliance. After this, the control center indicates the GSM module to send feedback message to the user terminal.

4.3 Hardware structure

There were main important components used in the project. The hardware consists of power supply circuit ,GSM module ,microcontroller circuit, Regulator AMS1117 ,ULN 2003,LED, relay and sensor .

4.3.1 Power Supply Circuit

Power supply circuit is built to supply the power or voltage to the circuit. The circuit needs only 5V voltage supply. Input supply for this circuit consists of 12V. Therefore Voltage regulator is used to provide 3.3V DC regulated voltage from the unregulated 5V input voltage. AMS1117 is used as the voltage regulator for the circuit. AMS1117 is chosen to filter the 5V voltage for the circuits. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. Hence, two capacitors are used to stabilize the voltage supply and to reduce the ripples of the voltage source.

4.3.2 Regulator AMS1117

The AMS1117 series of adjustable and fixed voltage regulators are designed to provide 1A output current and to operate down to 1V input-to-output differential. The dropout voltage of the device is guaranteed maximum 1.3V at maximum output current, decreasing at lower load currents .On-chip trimming adjusts the reference voltage to 1.5%. Current limit is also trimmed, minimizing the stress under overload conditions on both the regulator and power source circuitry. Figure (4.2) shows the AMS1117 that has been used.

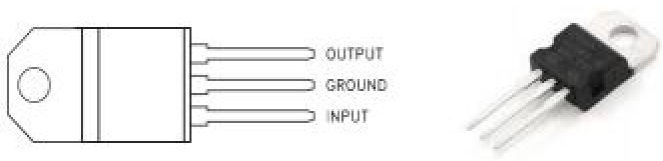

Figure 4.2 : AMS1117 circuit

4.3.3 Microcontroller circuit

The microcontroller circuit is the main circuit that consist the extension. The microcontroller circuit is used as a controller that control the input and output signal and used to convert the analog signal to a digital signal. figure (4.3) shows the microcontroller that has been used.

Figure 4.3: microcontroller circuit

4.3.4 Analog to Digital Converter

An Analog to Digital Converter (ADC) is a very useful feature that converts an analog voltage on a pin to a digital number. By converting from the analog world to the digital world, we can begin to use electronics to interface to the analog world around us. The ADC reports a ratio metric value. This means that the ADC assumes 5V is 1023 and anything less than 5V will be a ratio between 5V and 1023.Equation (4.1) explain ADC equation .

$$\frac{\text{Resolution of the ADC}}{\text{system voltage}} = \frac{\text{ADC reading}}{\text{Analog Voltage Measured}} \qquad (4.1)$$

Analog to digital conversions are dependent on the system voltage. Because we predominantly use the 10-bit ADC of the microcontroller on a 5V system, we can simplify this equation slightly:

$$\frac{1023}{5} = \frac{ADC\ Reading}{Analog\ voltage\ measured}$$

4.3.5 GSM module

A Modem is a device which modulates and demodulates signals as required to meet the communication requirements .It modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information. Figure (4.4) shows the GSM that has been used.

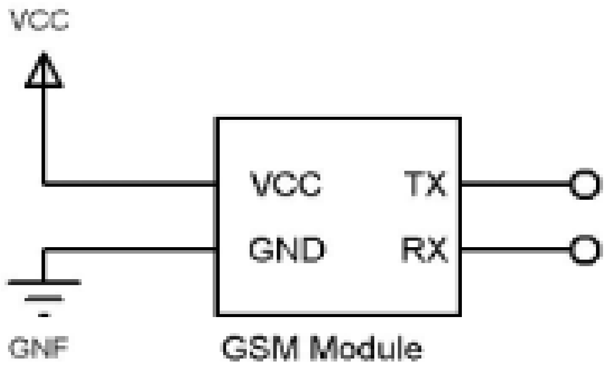

Figure 4.4: GSM module

4.3.6 The driver type ULN2003

It is a monolithic IC consists of seven NPN Darlington transistor pairs with high voltage and current capability. It is commonly used for applications such as relay drivers, motor, display drivers, led lamp drivers, logic buffers, line drivers, hammer drivers and other high voltage current applications. It consists of common cathode clamp diodes for each NPN Darlington pair which makes this driver IC useful for switching inductive loads.

The output of the driver is open collector and the collector current rating of each Darlington pair is 500mA. Darlington pairs may be paralleled if higher current is required. The driver IC also consists of a 2.7KΩ base resistor for each Darlington pair. Thus each darling on pair can be operated directly with TTL or 5V devices. This driver IC can be used for high voltage applications up to 50V Note that the driver provides open collector output, so it can only sink current, cannot source. Thus when a 5V is given to 1B terminal, 1C terminal will be connected to ground via Darlington pair and the maximum current that it can handle is 500A. From the above logic diagram we can see that cathode of protection diodes are shorted to 9th pin called COM. So for driving inductive loads, it must connected In this project the ULN is used to interfacing between the microcontroller and the relay by modifying the microcontroller current . Figure (4.5) shows the ULN2003 that has been used.

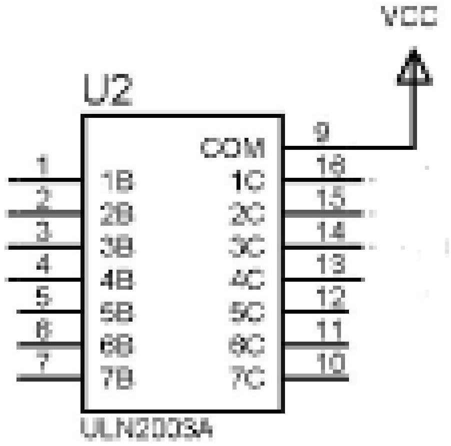

Figure 4.5: ULN2003

4.3.7 Relay

Relay is used in the circuit because it is an electrical operated switch that connected to the output. A relay in this system is an electrical switch that opens and closes under the control of microcontroller. The relay switch connections are usually labeled as Common (COM), Normally Closed (NC) and Normally Open (NO). The circuit is connected to COM and NO if it is switched to ON when relay coil in ON while to switch OFF the circuit connect the COM and NC together and then the relay coil is in OFF state. Therefore, the output was connected to COM and NO. As a result the relay contacts when it detect signal from the AVR circuit. Figure 5 shows the relay that has been used for this project. This relay needs 12 V DC supply for the coil voltage. Figure (4.6) shows the relay that has been used.

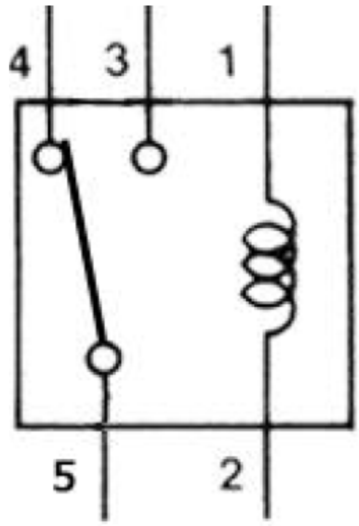

Figure 4.6: Relay

4.3.8 Sensor

A sensor is used to sense a continuous temperature degree as analog signal and convert to digital signal through ADC device which is in microcontroller. figure (4.7) shows the LM35DT that has been used.

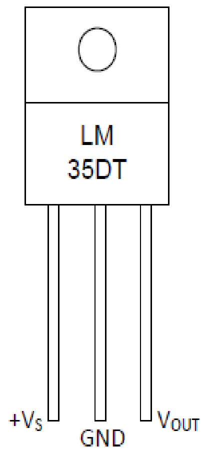

Figure 4.7: lm35 sensor

4.3.9 Led indicators

in this circuit we have indicators to explain the power flowing in the circuit .if the indicator is ON that meaning the power is received.

4.4 Software

The software is classified into attention command AT and serial communication type RS232

4.4.1 AT Commands

MCU communicate with GSM module through AT (Attention Commands). AT command set is the interface standard between TE (terminal equipment) and TA (terminal adaptor), as well as between DTE (data terminal equipment) and DCE (data circuit terminal equipment). In the early 1990s, AT command set is only used in the operation of modem. With a series of evolution, AT commands are added GSM07.05 standards. Up to now, Most of the GSM modules support this standard.

4.4.2 Serial communication – RS232

A popular way to transfer commands and data between a personal computer and a microcontroller is the use of standard interface.

An example will be presented showing the processing of commands received through RS232 interface, and sending of a string of numbers using the same interface. The protocol RS232 defines the signals used in communication, and the hardware to transfer signals between devices. The time diagram of the typical signal used to transfer character ‘A’ from device A to device B is given in Figure(4.9) .and would appear on the upper line TX -> RX between devices. figure (4.8) shows the serial communication.

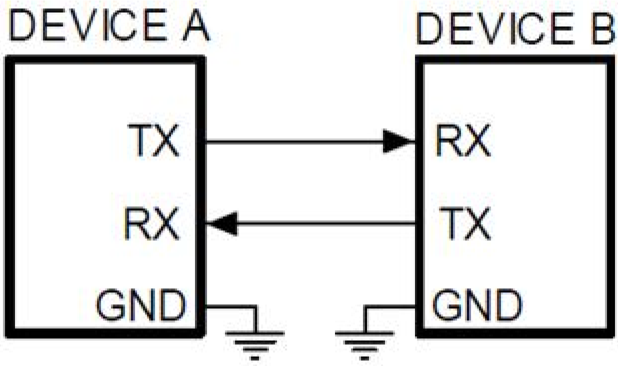

Figure 4.8 : serial communication

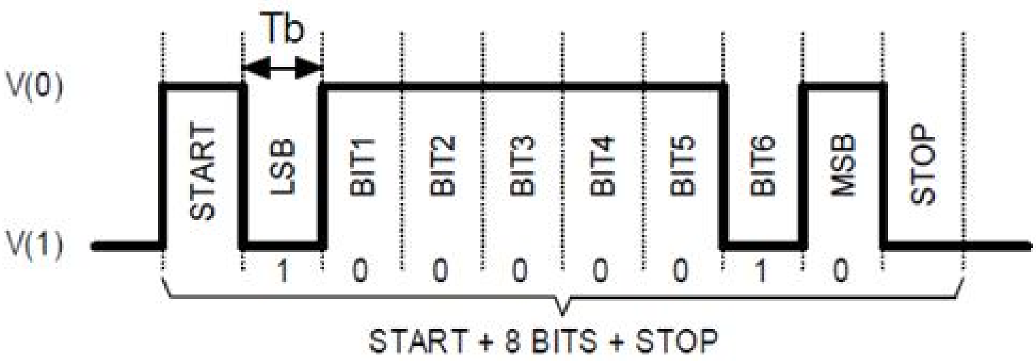

Figure 4.9 : The time diagram

4.5 operation of circuit

When the GSM is receiving the message from mobile phone ,It's going to send the message to the Microcontroller through the point of TX according to the Serial Protocol . The microcontroller is receiving the message through point of RX at the pin 14 The Microcontroller is going to transfer the message into a machine language. according to operation mechanism the Microcontroller will send a signal to device ULN2003A which give enough current to operate the Relay that to control the appliance . when the then send the signal to the Microcontroller through Analoge to digital converter (ADC) to make the Microcontroller be able to deal with the signal sensor is sensing temperature and transfer it to equivalent voltage . Figure (4.10) the practical circuit and the figure (4.11) the circuit.

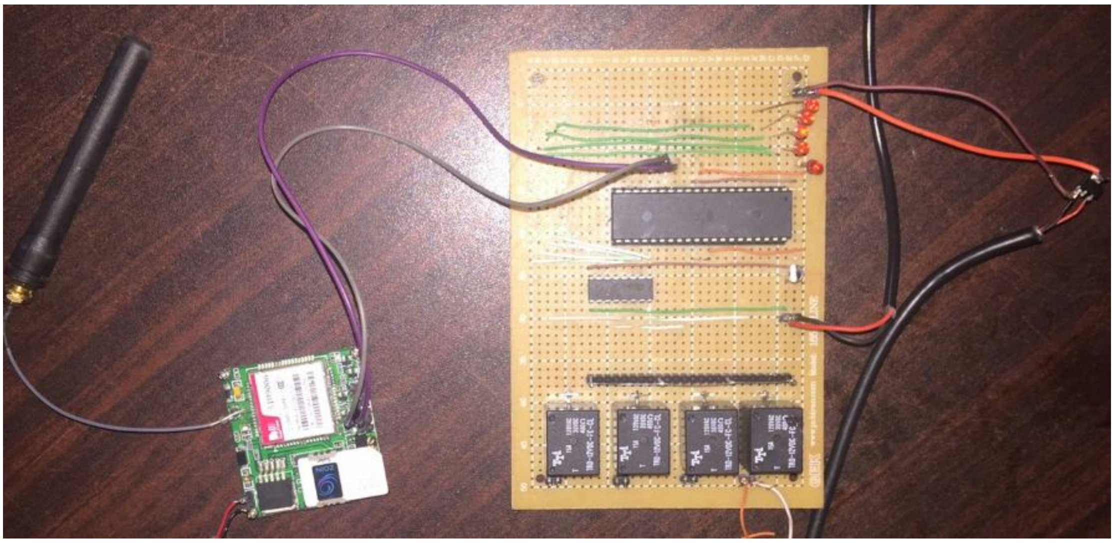

Figure 4.10 : the practical circuit

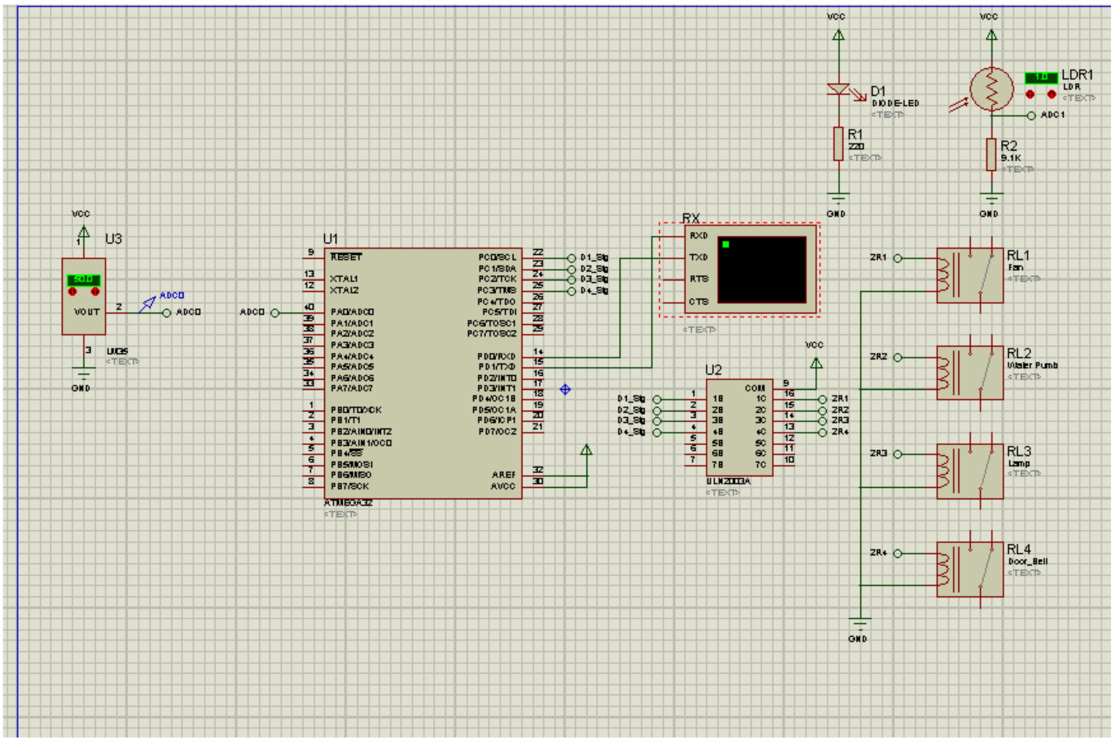

Figure 4.11 : The circuit

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

At the end of project The prototype was successfully developed and met the three stated objectives. The system can automatically switch ON and OFF the extension and lamp remotely using SMS. The integration of software and hardware has performed a good task in producing the SMS system. However, there are several weaknesses had been identified which can be further improved in the future such as the system could provide better performance by intelligently send notification upon power failure, provide a flexible function by supporting both manual and automatic control as well as provide an option for the user to control the appliance through web-based system. In addition, the system is very practical when the user is away from home due to it can control the electrical home appliances remotely as long as the mobile phone gets the coverage.

5.2 Recommendations

- As the prevailing trend of (Internet of Things) covering the global, smart house could find its way in the trend. All control and communication method dashed into this area GSM, WIFI, RF and Bluetooth, it could solve those problems in this smart world .
- Also adding monitor and control the house appliances through the multimedia application software through mobile phone. There should be video, sound or word messages interact with smart house devices also using the smart program such as android could make the interact with smart house so much easier
- For more control in output , also can be add the fuzzy controller

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❖APPENDANCES

APPENDEX A: Program Code

```
void main() {
char SerialData[200];
char i=0;
char code_index=0;
char data_0=0;
char Flag=0;
char temperature;    // reading temperature
float temperature_f;
char temperature_t[2];


DDRC = 0xFF; // Port C working as output
PORTC = 0x00;


UART1_Init(9600);


UART1_Write_Text("AT+CMGF=1");
UART1_Write(0x0D);
```

```
UART1_Write(0x0A);
delay_ms(1000);



    while(1)
    {

    do{

    if (UART1_Data_Ready() == 1)
    {
    SerialData[i] = UART1_Read();

    if (SerialData[i++] == '#')
    {

        code_index = i-4;
        i = 100;
        UART1_Write_Text("OK");
    }
    }

    }
    while(i<100);
    i=0;
```

```
//DEVICE 1 ------------------------------------------------------------------
-----------------

if (SerialData[code_index]=='*' && SerialData[code_index+1]=='0' &&
SerialData[code_index+2]=='0' )

  PORTC.F0 = 0;


if (SerialData[code_index]=='*' && SerialData[code_index+1]=='0' &&
SerialData[code_index+2]=='1' )

  PORTC.F0 = 1;

//DEVICE 2 ------------------------------------------------------------------
-----------------

if (SerialData[code_index]=='*' && SerialData[code_index+1]=='1' &&
SerialData[code_index+2]=='0' )

  PORTC.F1 = 0;


if (SerialData[code_index]=='*' && SerialData[code_index+1]=='1' &&
SerialData[code_index+2]=='1' )

  PORTC.F1 = 1;

//DEVICE 3 ------------------------------------------------------------------
-----------------

if (SerialData[code_index]=='*' && SerialData[code_index+1]=='2' &&
SerialData[code_index+2]=='0' )

  PORTC.F2 = 0;


if (SerialData[code_index]=='*' && SerialData[code_index+1]=='2' &&
SerialData[code_index+2]=='1' )
```

```
PORTC.F2 = 1;

//DEVICE 4 -------------------------------------------------------------------
-----------------

if (SerialData[code_index]=='*' && SerialData[code_index+1]=='3' &&
SerialData[code_index+2]=='0' )

PORTC.F3 = 0;


if (SerialData[code_index]=='*' && SerialData[code_index+1]=='3' &&
SerialData[code_index+2]=='1' )

PORTC.F3 = 1;


if (SerialData[code_index]=='*' && SerialData[code_index+1]=='5' &&
SerialData[code_index+2]=='5' )

{


temperature = ADC_Read(0);

temperature_f = (temperature*5.0/1024.0)*100.0;

FloatToStr(temperature_f, temperature_t);

//Send the temperature to the user


//B. Send user's phone (AT+CMGS="090------")

UART1_Write_Text("AT+CMGS=");

UART1_Write('"');

UART1_Write_Text("0922901827");

UART1_Write('"');

UART1_Write(0x0D);

UART1_Write(0x0A);
```

```
    delay_ms(2000);
    //C. Write the SMS message and send
       UART1_Write_Text("Temperature now is: ");
       UART1_Write_Text(temperature_t);
       UART1_Write(0x0D);
       UART1_Write(0x0A);
       delay_ms(2000);
       UART1_Write(0x1A); //ctrl + z
       UART1_Write(0x0D);
       UART1_Write(0x0A);
    }
  }

}
```