Chapter 1

Introduction

1.1 Background

As per the surveys held, statistics stated by various governments of different countries and states, every year, road accidents rate is continuously climbing up due to increased traffic on the roads. The causality rate is progressively increasing year by year. Experts say that the increase in motorist population is one of the main reasons for it. Long working hours is one more major concern of the city people. The life is more and more stressful now a days. The above three points mentioned are predominantly known as the primary and most common reasons for the road accidents, and especially on highways in most of the states.

If we could alert the vehicle driver on the highway much ahead in time, could save many precious lives and leads to reduction in death rate due to highway accidents. It is quite common to fix up some sort of system on the highways which can detect the speed of the vehicle and convey to the driver that he is not in the permitted speed limit in a particular area. But in our solution, depending on the geographical location, transmitter systems are permanently set up to transmit the speed limit and no horn area kind of information, even further, if the automatic breaking system could be actuated on over speed would be an excellent feature. We have tried to attempt a simple solution which is of much similar to a prototype of its kind. We have designed and developed a prototype system of a transmitter and receiver modules.

1.2 Design Methodology

The main objective of this project is to alert the driver at danger zones and to activate the breaking system, if it is needed. This can be done easily by using RF communication system. The RF transmitter sections are placed at each and every danger zone such as school zones, speed limit areas and hospital areas etc. The RF receiver sections are placed each and every vehicles .The RF Transmitter and receiver will communicate by using electromagnetic waves in free space medium.

The Transmitter section contains the information of limitations of particular area and it transmits the information signals in to the air. The transmitter section consists of switches, encoder, RF transmitter. The Rx receiver section consists of Rf receiver, micro controller, dc- motor, LCD display, buzzer.

These sections are placed in vehicles, when the vehicle enters in to the transmitter region it receives the data signals from the transmitter. The data signal is in the form of electromagnetic waves. The RF receiver converts the them in to electrical data signals .The micro controllers is coded in such a way that it activates the particular action corresponding to the received signal. Coming to the power supply, this project uses regulated 5V, 750mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/18V step down transformer.

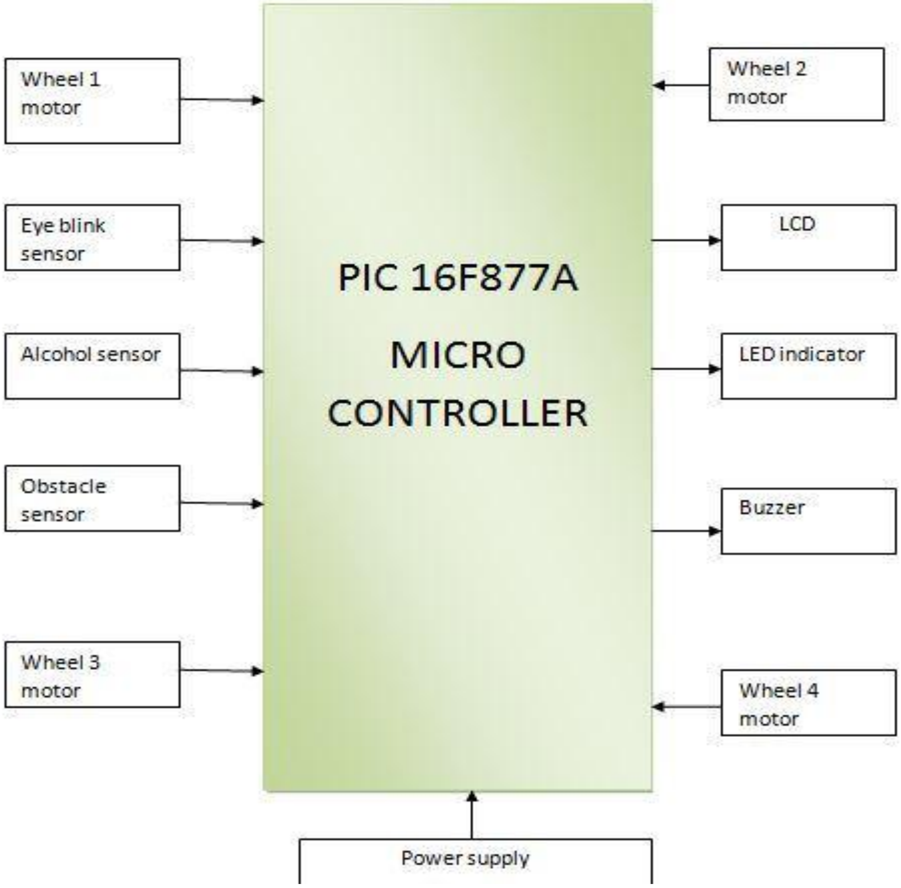


Fig. Functional block diagram

1.3 Transmitter Section

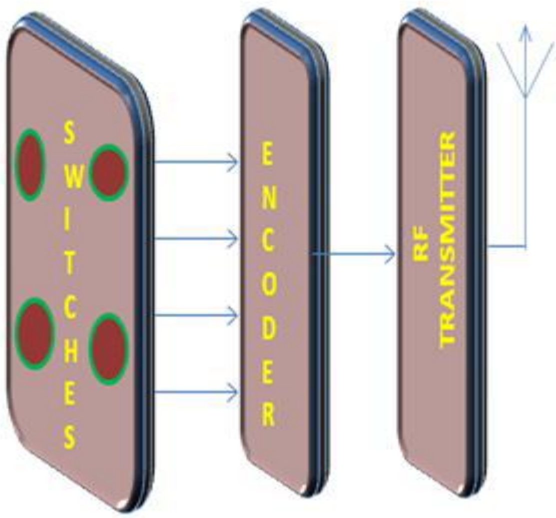


Fig.1.Block diagram of transmitter section

The block diagram of the transmitter section consists of switches connected to an encoder and RF transmitter. Four switches are provided for giving details regarding the speed limit of a particular zone in the highway. Switch 1 represents speed limit of 80kmph, switch 2 represents a speed limit of 40 kmph, switch 3 reprents a maximum speed limit of 20 kmph and finally switch 4 corresponds to a zone where blowing horn is prohibited. For the purpose of prototype we have combined 4 transmitters with above individual feature into a single transmitter to lower the prototype development cost.

1.4 Receiver Section

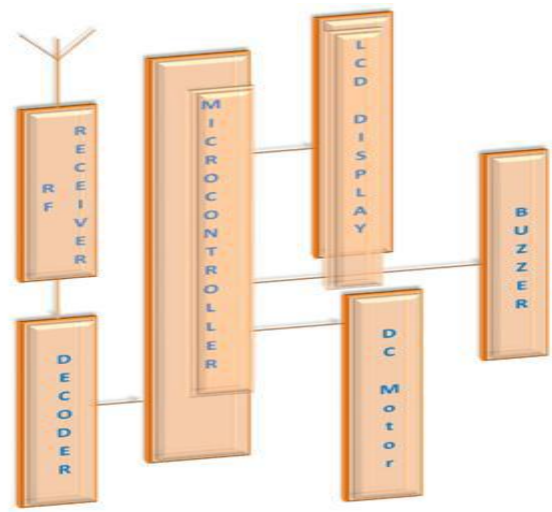


Fig.2.Block diagram of receiver section

The block diagram of the receiver section consists of a receiving antenna, a microcontroller, an LCD display, a DC motor and a buzzer as shown in the diagram. The antenna receives the transmitted speed limit information or no horn zone related data. It is fed to the decoder and the decoder decodes the information and gives it to the microcontroller. Depending on the received information, i.e. whether speed limit or no horn zone data, the microcontroller controls the speed of the DC motor and or activates the buzzer. The same information can also be seen on the 16x2 LCD display also. By observing the above or hearing the beep sound of the buzzer, the driver gets alerted

Chapter 2

Electrical and Electronic Components Analysis

2.1 Introduction

This chapter describes all the primary electrical and electronic components that have been used to develop the circuit of the Photoelectric Sensor. The major components include – PIC16F73 microcontroller with other basic components like crystal oscillators, resistors, ceramic capacitors, battery. Each component is discussed separately to provide a detailed concept in the following section.

2.2. Step down Transformers

A step-down transformer is one whose secondary voltage is less than its primary voltage. It is designed to reduce the voltage from the primary winding to the secondary winding. This kind of transformer “steps down” the voltage applied to it. As a step-down unit, the transformer converts high-voltage, low-current power into low-voltage, high-current power. The larger-gauge wire used in the secondary winding is necessary due to the increase in current. The primary winding, which doesn’t have to conduct as much current, may be made of smaller-gauge wire.

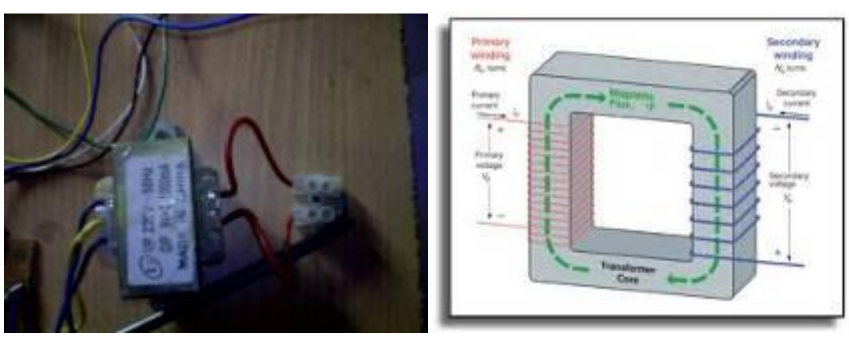


Fig: 2.1 Step down transformer

2.3 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal.

The relay circuit in the project was connected to four keys on the keypad. For experimentation purposes, the relay circuit was implemented on a breadboard. It could have also been implemented on a PCB board but due to the fixed connection characteristics of the PCB board if any error had occurred in the circuit it could not have been changed. Thus in order to allow the opportunity to check for errors and possibly improve the circuit setup, the experimental setup was put on a trainer board.

The relays, fired through MOSFETs to 'press the button' of the phone, took a lot of effort to be working flawlessly. Despite the circuitry being theoretically proper, the connections had to be re-done numerous times to have the phone's button pushed in the proper sequence and to give out the desired output. The relays were checked for further error by firing the external MOSFETs but no further error could be detected.

Fig: 2.2 Relay

2.4 Capacitor

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electro statically in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors separated by a dielectric (insulator); for example, one common construction consists of metal foils separated by a thin layer of insulating film. Capacitors are widely used as parts of electrical circuits in many common electrical devices.

Fig 2.3 Capacitor

2.5 Diode

In electronics, a diode is a two-terminal electronic component with asymmetric conductance; it has low (ideally zero) resistance to current flow in one direction, and high (ideally infinite) resistance in the other. Diodes were the first semiconductor electronic devices.

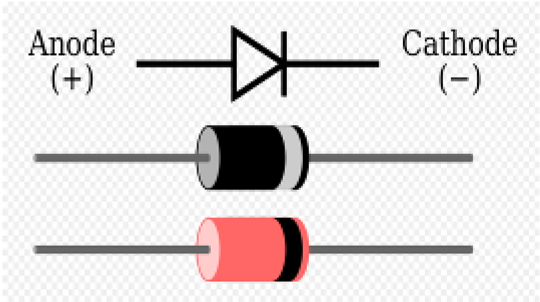


Fig 2.4 Diode

The discovery of crystals' rectifying abilities was made by German physicist Ferdinand Braun in 1874. The first semiconductor diodes, called cat's whisker diodes, developed around 1906, were made of mineral crystals such as galena. Today most diodes are made of silicon, but other semiconductors such as selenium or germanium are sometimes used. A **semiconductor diode**, the most common type today, is a crystalline piece of semiconductor material with a p–n junction connected to two electrical terminals. A vacuum tube diode has two electrodes, a plate (anode) and a heated cathode.

2.6 Photoelectric Sensor

A **photoelectric sensor**, or photo eye, is a device used to detect the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver. They are used extensively in industrial manufacturing. There are three different functional types: opposed (through beam), retro-reflective, and proximity-sensing (diffused).

Fig: 2.5 Photoelectric Sensors

2.6.1 Types of Photoelectric Sensor

A self-contained photoelectric sensor contains the optics, along with the electronics. It requires only a power source. The sensor performs its own modulation, demodulation, amplification and output switching. Some self-contained sensors provide such options as built-in control timers or counters. Because of technological progress, self-contained photoelectric sensors have become increasingly smaller. Remote photoelectric sensors used for remote sensing contain only the optical components of a sensor. The circuitry for power input, amplification, and output switching are located elsewhere, typically in a control panel. This allows the sensor, itself, to be very small. Also, the controls for the sensor are more accessible, since they may be bigger. When space is restricted or the environment too hostile even for remote sensors, fiber optics may be used. Fiber optics is passive mechanical sensing component. They may be used with either remote or self-contained sensors. They have no electrical circuitry and no moving parts, and can safely pipe light into and out of hostile environments.

2.6.2 Sensing modes

An opposed (through beam) arrangement consists of a receiver located within the line-of-sight of the transmitter. In this mode, an object is detected when the light beam is blocked from getting to the receiver from the transmitter. A retro-reflective arrangement places the transmitter and receiver at the same location and uses a reflector to bounce the light beam back from the transmitter to the receiver. An object is sensed when the beam is interrupted and fails to reach the receiver. A proximity-sensing (diffused) arrangement is one in which the transmitted radiation must reflect off the object in order to reach the receiver. In this mode, an object is detected when the receiver sees the transmitted source rather than when it fails to see it. Some photo eyes have two different operational types, light operate and dark operate. Light operate photo eyes become operational when the receiver "receives" the transmitter signal. Dark operate photo eyes become operational when the receiver "does not receive" the transmitter signal.

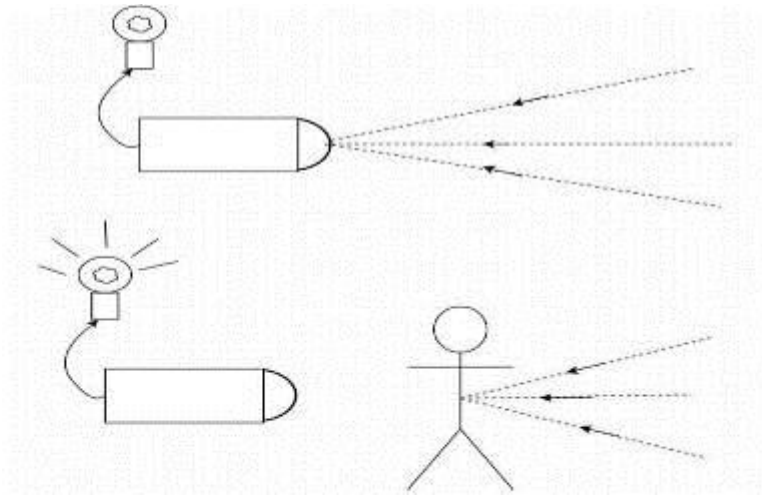


Figure 2.6 Operation of a Photoelectric Sensor

The detecting range of a photoelectric sensor is its "field of view", or the maximum distance the sensor can retrieve information from, minus the minimum distance. A minimum detectable object is the smallest object the sensor can detect. More accurate sensors can often have minimum detectable objects of minuscule size.

2.7 PIC microcontroller

2.7.1 Microcontroller

A microcontroller is a small, low-cost and self-contained computer-on-a-chip that can be used as an embedded system. A few microcontrollers may utilize four-bit expressions and work at clock rate frequencies, which usually include:

1. A 8 bit microprocessor.
2. A little measure of RAM.
3. Programmable ROM and flash memory.
4. Parallel and serial I/O.
5. Timers and signal generators.
6. Analog to Digital and Digital to Analog conversion.

Microcontrollers usually must have low-power requirements since many devices they control are battery-operated. Microcontrollers are used in many consumer electronics, car engines, computer peripherals and test or measurement equipment. And these are well suited for long lasting battery applications. The majority of microcontrollers in use today are embedded in other machinery.

2.8 PIC16F73 microcontroller

2.8.1 Specifications

The PIC16F73 is a single chip micro-controller created by Atmel and belongs to the mega AVR series The high-performance pic 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

2.8.2 Applications

Today the pic is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed. Perhaps the most common implementation of this chip is on the ever popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

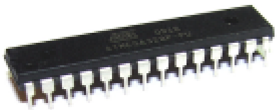


Fig: 2.7 PIC16F73

2.9 Resistor

A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor. All other factors being equal, in a direct-current (DC) circuit, the current through a resistor is inversely proportional to its resistance, and directly proportional to the voltage across it. This is the well-known Ohm's Law. In alternating-current (AC) circuits, this rule also applies as long as the resistor does not contain inductance or capacitance. Resistors can be fabricated in a variety of ways.

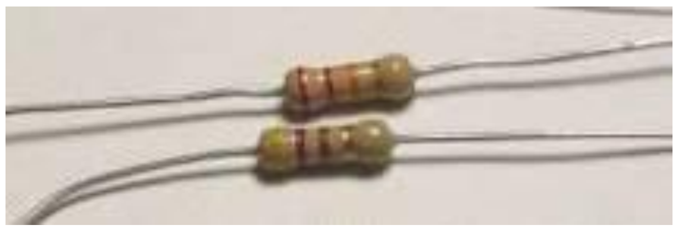
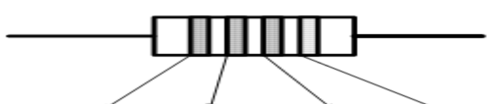


Fig: 2.8 Resistor

2.9.1 Resistance color coding:

You will need to select the resistors from the component drawers with the values as close as you can get to your selected theoretical values. You may decide to set them down on the table and loose track of which resistor is which. If you do you can determine the value by either measuring it with a meter, or looking at the color coded stripes on the package. The following table shows how to read this color code.



Color	1st dig(X)	2nd dig(Y)	Mult	Tolerance
Black	0	0	XY.0 ohm	
Brown	1	1	XY0 ohm	
Red	2	2	X.Y K ohm	
Orange	3	3	XY K ohm	
Yellow	4	4	XY0 Kohm	
Green	5	5	X.Y M ohm	
Blue	6	6	XY M ohm	
Violet	7	7	XY0 M ohm	
Gray	8	8	X.Y G ohm	
White	9	9	XY G ohm	
Gold			X.Y ohm	5%
Silver			0.XY ohm	10%
None				20%

Fig: 2.9 **Resistance color coding**

2.10 Transistor:

Operating point (Q) of BJT is very important for amplifiers, since a wrong 'Q' point selection increases amplifier distortion. It is imperative to have a stable 'Q' point, meaning that the operating point should not be sensitive to variation to temperature or BJT β, which can vary widely. In this experiment, four different circuits will be analyzed for two different β to check the stability of biasing points.

The analysis of the BJT circuits is a systematic process. Initially, the operating point of a transistor circuit is determined then the small signal BJT model parameters are calculated. Finally, the dc sources are eliminated, the BJT is replaced with an equivalent circuit model and the resulting circuit is analyzed to determine the voltage amplification (AV), current amplification (Ai), Input impedance (Zi), Output Impedance (Zo), and the phase relation between the input voltage (Vi) and the output voltage (Vo).

The main objectives of this experiment are to-

1. Establish the proper operating point
2. Study the stability of the operating point with respect to changing β in different biasing circuits

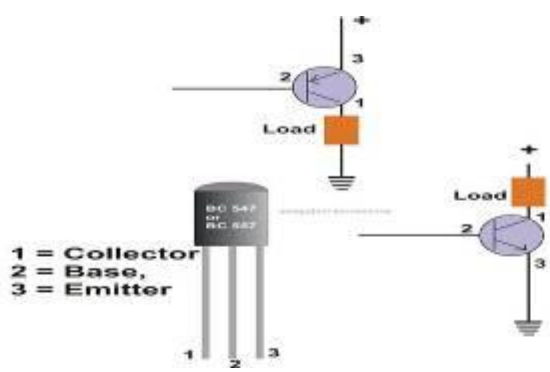


Fig: 2.10 Transistors

2.11 PCB

This chapter details the actual process of building each of the components and then assembling them together to build the filtering and relay circuit for this project. It details the hardware section of the implementation, where the PCB fabrication process. Once the circuit was built, it was tested, to check whether the required results were achieved or not.

2.11.1 PCB Fabrication

Printed Circuit Board (PCB) fabrication is an assembly method for circuit boards used in computers and other electronics. In the fabrication process, the layers of the board are put together along with the specific surface pattern so it can be used in electronics manufacturing. Firms that produce PCBs may also make related products for their customers. Electronics manufacturers have a choice between in-house PCB fabrication or services contracted out to a third party that specializes in this aspect of production. Printed circuit boards are used in all but the simplest electronic products. Alternatives to PCBs include wire wrap and point-to-point construction. PCBs are more costly to design but allow automated manufacturing and assembly. Products are then faster and cheaper to manufacture, and potentially more reliable. Manufacturers use the Gerber file to program their equipment for PCB fabrication. Several techniques can be used, depending on the number of boards that need to be produced. Custom products tend to be more expensive because they require small production runs, while generic or standard formats are less costly. Prototypes, where a very limited number of boards are produced, can be very costly and in some cases are made in-house by preference to limit expenses and reduce the loss of proprietary information. A functional PCB is not a finished product. It will always require connections to the outside world to get power, exchange information, or display results. It will need to fit into a case or slide into a rack to perform its function. There may be areas that will require height restrictions on the board (such as a battery holder molded into the case or rails in a rack the board is supposed to slide into). Tooling holes and keep-out areas may be required in the board for assembly or manufacturing processes. All these outside factors need to be defined before the board can be designed, including the maximum dimensions of the board and the locations of connectors, displays, mounting brackets, or any other external features.

11.2 Types of PCB

There are three types of PCB. These are:

- Single sided Laminate
- Double sided Laminate
- Multi layer

➢ Single sided Laminate

One layer of copper. In one side of the board the components are placed.

Fig:2.11 Single Sided Laminate

➢ Double sided Laminate

Two layers of copper, one each side of the board. Both side of the board are used for placing components.

Fig:2.12 Double Sided Laminate

- **Multi-Layer**

  A PCB Laminate may be manufactured with more than two layers of copper tracks by using a sandwich construction. The extra layers may be used to route more complicated circuitry, and/or distribute the power supply more effectively.

Fig: 2.13 Multi-layers

2.11.3 Printing the Layout on the Board

Much of the electronics industry's PCB design, assembly, and quality control follow standards published by the IPC organization. The process starts with a design. Some PCB fabrication specialists can also design boards, using the specifications provides by clients. These provide information about what the board needs to do and the conditions where it will be used so the company can develop and test an appropriate schematic. In other cases, customers develop their own files and send them to the manufacturer. These are rendered in a format known as a Gerber file, an industry standard for recording the specific details of a PCB. The PCB layout can be drawn either manually or by ECAD (Electric-Computer Aid Design) software. For this project the layout was made using software called DIP trace. The fabrication drawing was made carefully to show a graphic presentation for each hole on the board, using a different symbol for each hole size and including a table showing the quantity of each hole size.The prepared PCB layout was then printed using a laser printer on a glossy paper. Laser printer is used because laser printer toner carries with it a very high percentage of pulverized plastic, which makes for an ideal etch resist. Then the image was laid face down on the PCB and was ironed for 5 or more minutes in medium heat. Then the PCB was washed with water to tear away the paper, so that only the printed part remains on the PCB.

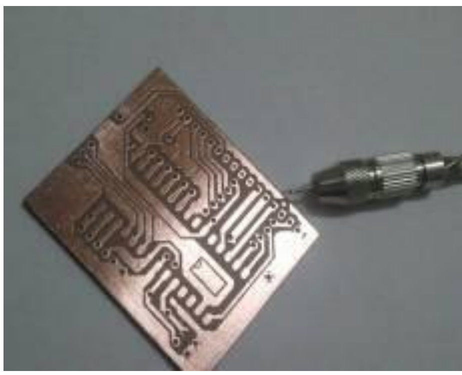


Fig: 2.14(a): PCB layout

Fig: 2.14(b): Ironing the layout

When the board has only copper connections and no embedded components it is more correctly called a *printed wiring board* (*PWB*) or *etched wiring board*. Although more accurate, the term printed wiring board has fallen into disuse. A PCB populated with electronic components is called a *printed circuit assembly* (*PCA*), *printed circuit board assembly* or *PCB assembly* (*PCBA*). The IPC preferred term for assembled boards is *circuit card assembly* (*CCA*), for assembled backplanes it is *backplane assemblies*. The term PCB is used informally both for bare and assembled boards.

2.12 Etching

Etching is the process of using strong acid or mordant to cut into the unprotected parts of a metal surface to create a design in intaglio in the metal (the original process—in modern manufacturing other chemicals may be used on other types of material). As an intaglio method of printmaking, it is, along with engraving, the most important technique for old master prints, and remains in wide use today. The etching was done in the simplest method, used for small scale production and often by hobbyists; called immersion etching**.** Etching is used in micro fabrication to chemically remove layers from the surface of a wafer during manufacturing. Etching is a critically important process module, and every wafer undergoes many etching steps before it is complete.For many etch steps, part of the wafer is protected from the etchant by a "masking" material which resists etching. In some cases, the masking material is a photo resist which has been patterned using photolithography. Other situations require a more durable mask, such as silicon nitride.

2.12.1 Types of Etching

In general, there are two classes of etching processes:

1. Wet etching where the material is dissolved when immersed in a chemical solution.
2. Dry etching where the material is sputtered or dissolved using reactive ions or a vapor phase etchant.

In the following, we will briefly discuss the most popular technologies for wet and dry etching.

- **Wet Etching**

This is the simplest etching technology. All it requires is a container with a liquid solution that will dissolve the material in question. Unfortunately, there are complications since usually a mask is desired to selectively etch the material. One must find a mask that will not dissolve or at least etches much slower than the material to be patterned. Secondly, some single crystal materials, such as silicon, exhibit anisotropic etching in certain chemicals. Anisotropic etching in contrast to isotropic etching means different etches rates in different directions in the material. The classic example of this is the <111> crystal plane sidewalls that appear when etching a hole in a <100> silicon wafer in a chemical such as potassium hydroxide (KOH). The result is a pyramid shaped hole instead of a hole with rounded sidewalls with a isotropic etchant.

- **Dry Etching**

The dry etching technology can split in three separate classes called reactive ion etching (RIE), sputter etching, and vapor phase etching.

In RIE, the substrate is placed inside a reactor in which several gases are introduced. Plasma is struck in the gas mixture using an RF power source, breaking the gas molecules into ions. The ions are accelerated towards, and react at, the surface of the material being etched, forming another gaseous material. This is known as the chemical part of reactive ion etching. There is also a physical part which is similar in nature to the sputtering deposition process. If the ions have high enough energy, they can knock atoms out of the material to be etched without a chemical reaction. It is a very complex task to develop dry etching processes that balance chemical and physical etching, since there are many parameters to adjust. By changing the balance it is possible to influence the anisotropy of the etching, since the chemical part is isotropic and the physical part highly anisotropic the combination can form sidewalls that have shapes from rounded to vertical.

A special subclass of RIE which continues to grow rapidly in popularity is deep RIE (DRIE). In this process, etch depths of hundreds of microns can be achieved with almost vertical sidewalls. The primary technology is based on the so-called "Bosch process", named after the German company Robert Bosch which filed the original patent, where two different gas compositions are alternated in the reactor. The first gas composition creates a polymer on the surface of the substrate, and the second gas composition etches the substrate. The polymer is immediately sputtered away by the physical part of the etching, but only on the horizontal surfaces and not the sidewalls. Since the polymer only dissolves very slowly in the chemical part of the etching, it builds up on the sidewalls and protects them from etching. As a result, etching aspect ratios of 50 to 1 can be achieved. The process can easily be used to etch completely through a silicon substrate, and etch rates are 3-4 times higher than wet etching. Sputter etching is essentially RIE without reactive ions. The systems used are very similar in principle to sputtering deposition systems. The big difference is that substrate is now subjected to the ion bombardment instead of the material target used in sputter deposition. Vapor phase etching is another dry etching method, which can be done with simpler equipment than what RIE requires. In this process the wafer to be etched is placed inside a chamber, in which one or more gases are introduced. The material to be etched is dissolved at the surface in a chemical reaction with the gas molecules. The two most common vapor phase etching technologies are silicon dioxide etching using hydrogen fluoride (HF) and silicon etching using xenon di-fluoride (XeF_2), both of which are isotropic in nature. Usually, care must be taken in the design of a vapor phase process to not have bi-products form in the chemical reaction that condense on the surface and interfere with the etching process.

2.12.2 When to Use Wet Etching

This is a simple technology, which will give good results if you can find the combination of etchant and mask material to suit your application. Wet etching works very well for etching thin films on substrates, and can also be used to etch the substrate itself. The problem with substrate etching is that isotropic processes will cause undercutting of the mask layer by the same distance as the etch depth. Anisotropic processes allow the etching to stop on certain crystal planes in the substrate, but still results in a loss of space, since these planes cannot be vertical to the surface when etching holes or cavities. If this is a limitation for us, we should consider dry etching of the substrate instead. However, keep in mind that the cost per wafer will be 1-2 orders of magnitude higher to perform the dry etching. If we are making very small features in thin films (comparable to the film thickness) we may also encounter problems with isotropic wet etching, since the undercutting will be at least equal to the film thickness. With dry etching it is possible etch almost straight down without undercutting, which provides much higher resolution.

2.12.3 When to Use dry Etching

The first thing you should note about this technology is that it is expensive to run compared to wet etching. If you are concerned with feature resolution in thin film structures or you need vertical sidewalls for deep etchings in the substrate, we have to consider dry etching. If we are concerned about the price of your process and device, we may want to minimize the use of dry etching. The IC industry has long since adopted dry etching to achieve small features, but in many cases feature size is not as critical in MEMS. Dry etching is an enabling technology, which comes at a sometimes high cost.

2.13 Drilling

Holes through a PCB are typically drilled with small-diameter drill bits made of solid coated tungsten carbide. Coated tungsten carbide is recommended since many board materials are very abrasive and drilling must be high RPM and high feed to be cost effective. Drill bits must also remain sharp so as not to mar or tear the traces. Drilling with high-speed-steel is simply not feasible since the drill bits will dull quickly and thus tear the copper and ruin the boards. The drilling is performed by automated drilling machines with placement controlled by a drill tape or drill file. These computer-generated files are also called numerically controlled drill (NCD) files or "Excellent". The drill file describes the location and size of each drilled hole. These holes are often filled with annular rings (hollow rivets) to create visa. Vias allow the electrical and thermal connection of conductors on opposite sides of the PCB. When very small vias are required, drilling with mechanical bits is costly because of high rates of wear and breakage. In this case, the vias may be evaporated by lasers. Laser-drilled vias typically have an inferior surface finish inside the hole. These holes are called micro vias. It is also possible with controlled-depth drilling, laser drilling, or by pre-drilling the individual sheets of the PCB before lamination, to produce holes that connect only some of the copper layers, rather than passing through the entire board. These holes are called blind vias when they connect an internal copper layer to an outer layer, or buried vias when they connect two or more internal copper layers and no outer layers. The hole walls for boards with 2 or more layers can be made conductive and then electroplated with copper to form plated-through holes. These holes electrically connect the conducting layers of the PCB. For multilayer boards, those with 3 layers or more, drilling typically produces a smear of the high temperature decomposition products of bonding agent in the laminate system. Before the holes can be plated through, this smear must be removed by a chemical de-smear process, or by plasma-etch. The de-smear process ensures that a good connection is made to the copper layers when the hole is plated through. On high reliability boards a process called etch-back is performed chemically with a potassium permanganate based etchant or plasma. The etch-back removes resin and the glass fibers so that the copper layers extend into the hole and as the hole is plated become integral with the deposited copper.

Fig:2.15 After drilling holes in the PCB.

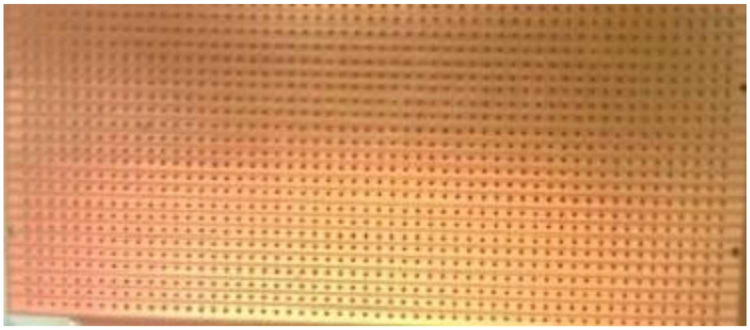


Fig: 2.16 PCB that is used in this project

2.14 Soldering

Soldering is defined as the joining of metals by a fusion of alloys which have relatively low melting points, how it works is that a metal is used that has a low mwlting point to adhere the surfaces to be soldered together. So, soldering is more like gluing with molten metal than anything else. But unlike gluing which works based on the mechanical attraction of the two surfaces, soldering changes the chemical properties of the metals involved. Solders typically do not provide high mechanical strength, given the soft nature of popular solder materials. Soldering is used extensively in the electronics industry printed circuit boards. It is also used in joining metals in industry such as cultery, tools, metal box making etc.In order to have a good soldering joint, one must form inter-metallic layers between the solder material and the base metal. Otherwise,the solder simply solidifies over the base metal without forming any bond. But as the joint is subjected to stress, thermal cycles, vibration, or shock, the inter-metallic layers are usually where it starts to fail. Since the inter-metallic layers are inevitable, it is best to keep in as thin as possible.Of all solder materials, tin based solders, in particular are especially aggressive dissolving metals.

2.14.1 Soldering the PCB

Turning to the actual techniques of soldering, firstly it's best to secure the work somehow so that it doesn't move during soldering and affect your accuracy. In the case of a printed circuit board, various holding frames are fairly popular especially with densely populated boards. The idea is to insert all the parts on one side (“stuffing” or “populating” the board) hold them in place with a special foam pad to prevent them falling out, turn the board over and then snip off the wires with cutters before making the joints. The frame saves an awful lot of turning the board over and over, especially with large boards.Solder joints may need to possess some degree of mechanical strength in some cases, especially with wires soldered to, say, potentiometer or switch tags, and this means that the wire should be looped through the tag and secured before solder is applied. The down side is that it is more difficult to de-solder the joint (see later) and remove the wire afterwards, if required. Otherwise, in the case of an ordinary circuit board, components' wires are bent to fit through the board, inserted flush against the board's surface, splayed outwards a little so that the part grips the board, and then soldered.

It’s generally better to snip the surplus wires leads off first, to make the joint more accessible and avoid applying a mechanical shock to the PCB joint. Integrated circuits can either be soldered directly into place if you are confident enough, or better, use a dual-in-line socket to prevent heat damage. The chip can then be swapped out if needed. The parts which become hot in operation (e.g. some resistors) are raised above the board slightly to allow air to circulate. Some components, especially large electrolytic capacitors, may require a mounting clip to be screwed down to the board first; otherwise the part may eventually break off due to vibration. The key factors affecting the quality of the joint are:

- Cleanliness
- Temperature
- Duration
- Adequate solder coverage

Firstly, and without exception, all parts - including the iron tip itself - must be clean and free from contamination. Solder just will not "take" to dirty parts Old components or copper board can be notoriously difficult to solder, because of the layer of oxidation which builds up on the surface of the leads. This repels the molten solder and this will soon be evident because the solder will "bead" into globules, going everywhere except where you need it. In the case of old resistors or capacitors, for example, where the leads have started to oxidize, use a small hand-held file or perhaps scrape a knife blade or rub a fine emery cloth over them to reveal fresh metal underneath. Strip board and copper printed circuit board will generally oxidize after a few months, especially if it has been fingerprinted, and the copper strips can be cleaned using an abrasive rubber block, like an aggressive eraser, to reveal fresh shiny copper underneath. Another step to successful soldering is to ensure that the temperature of all the parts is raised to roughly the same level before applying solder. Imagine, for instance, trying to solder a resistor into place on a printed circuit board: it's far better to heat both the copper.PCB and the resistor lead at the same time before applying solder, so that the solder will flow much more readily over the joint. Heating one part but not the other is far less satisfactory joint, so strive to ensure that the iron is in contact with all the components first, before touching the solder to it. The melting point of most solder is in the region of 188°C (370°F) and the iron tip temperature is typically 330-350°C (626°-662°F). Next, the joint should be heated with the bit for just the right amount of time - during which a short length of solder is applied to the joint. The joint should be heated with the tip of the iron, then continue heating whilst applying solder, then remove the iron and allow the joint to cool. This should take only a few seconds, with experience. The heating period depends on the temperature of your iron and size of the joint - and larger parts need more heat than smaller ones - but some parts (semiconductor diodes, transistors and ICs) are sensitive to heat and should not be heated for more than a few seconds. The final key to a successful solder joint is to apply an appropriate amount of solder. Too much solder is an unnecessary waste and may cause short circuits with adjacent joints. Too little and it may not support the component properly, or may not fully form a working joint. How much to apply, only really comes with practice. A few millimeters only, are enough for an "average" PCB joint.

2.15 Mobile phone:

Any form of conventional cell phone may have been used for this demonstration such as QWERTY keypad phone or a touch sensitive keypad phone but a 12 keypad cell phone was preferred. This is because a 12 keypad cell phone enables us to overcome certain drawbacks that are encountered when using other kinds of cell phones. For instance, in case of a touch-screen keypad, the keys are hypersensitive to any form of touch and thus the keypad maybe pressed accidentally or a signal may be sent unintentionally. Also there is the chance that the touch screen keypad of the phone may be damaged in some way due to presence of dust and dirt , therefore this would require the keypad to be changed immediately which would be quite problematic and would be much more costly. It is also difficult to externally trigger a touch sensitive keypad due to its sensitive characteristics.

On the other hand using a QWERTY keypad cell phone would have been unfavorable because of the infrastructure of the QWERTY keypad, as the QWERTY keypad is designed to consist of many keys therefore connection using a single wire would turn out to be quite an ordeal. As a suitable and more efficient alternative, the 12 key keypad phones provides us with optimum options which allow the maximization of the performance parameters and nullifies the drawbacks using the aforementioned designs. It is not as vulnerable to accidental touch or pressures that maybe fall using a touch screen keypad and therefore vastly increases the efficiency and it also consists of a simpler structural backbone that permits simpler connectivity and therefore optimized performance.

MMS was chosen as the opted method for data transfer due to many reasons. An alternative may have been using Bluetooth but there are some significant precursors that require being fulfilled. Initially, there must be a Bluetooth device which must always be turned on for uninterrupted data transfer. Even though the Bluetooth coverage may be overcome it is still limited by a vital criteria-range. Despite ensuring proper connectivity the Bluetooth device can only transfer data through only a very small range of distance. Thus it shall prove ineffective for long range data transfer even with highest network coverage.

Fig: 2.17 Mobile phone

Another method of data transfer is by means of e-mail. Similarly as for Bluetooth this method may present numerous drawbacks which may hamper the efficiency of the data transfer method. For starters, the first thing which is needed to be ensured is a continuous and unabated internet connection. An internet server is required to operate continuously in order to ensure proper connectivity at all times, which is not feasible for a project like this. This may prove to be difficult due to electrical power outages or network failures. Another essential requirement which is integral to the setup is the presence of an e-mail client. It is necessary that an e-mail client be set up, which in turn would be too complicated an effort to set up, or even to maintain by the end-user.

Thus viewing all the other options it is most efficient and cost-effective that connectivity throughout the entire operation be overseen by using MMS coverage.

Also the battery life of the cell phone is an essential factor in the completion of the entire operation. It is absolutely necessary that the battery does not die out. The cell phone used has sufficient battery life and the connection of the charger circuit is simple and cheap.

Another drawback of this system is the phone does not send MMS as designed unless the phone is in standby mode. The supposed 'flaw' in the circuit design is

2.16 LED

LED is used for showing the power supply of the circuit. We can easily confirm the power supply by this LED.

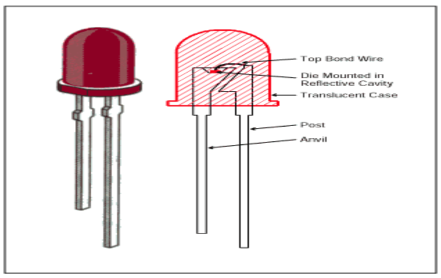


Fig: 2.18 LED

2.17 Power Cable & Socket

Power cable & socket are used for supply power at the circuit. After getting power the circuit LED indicated & all circuit of the project are active.

Fig:2.19 Power cable & Socket

Chapter 3

Circuit Diagram

3.1 Functional Block Diagram

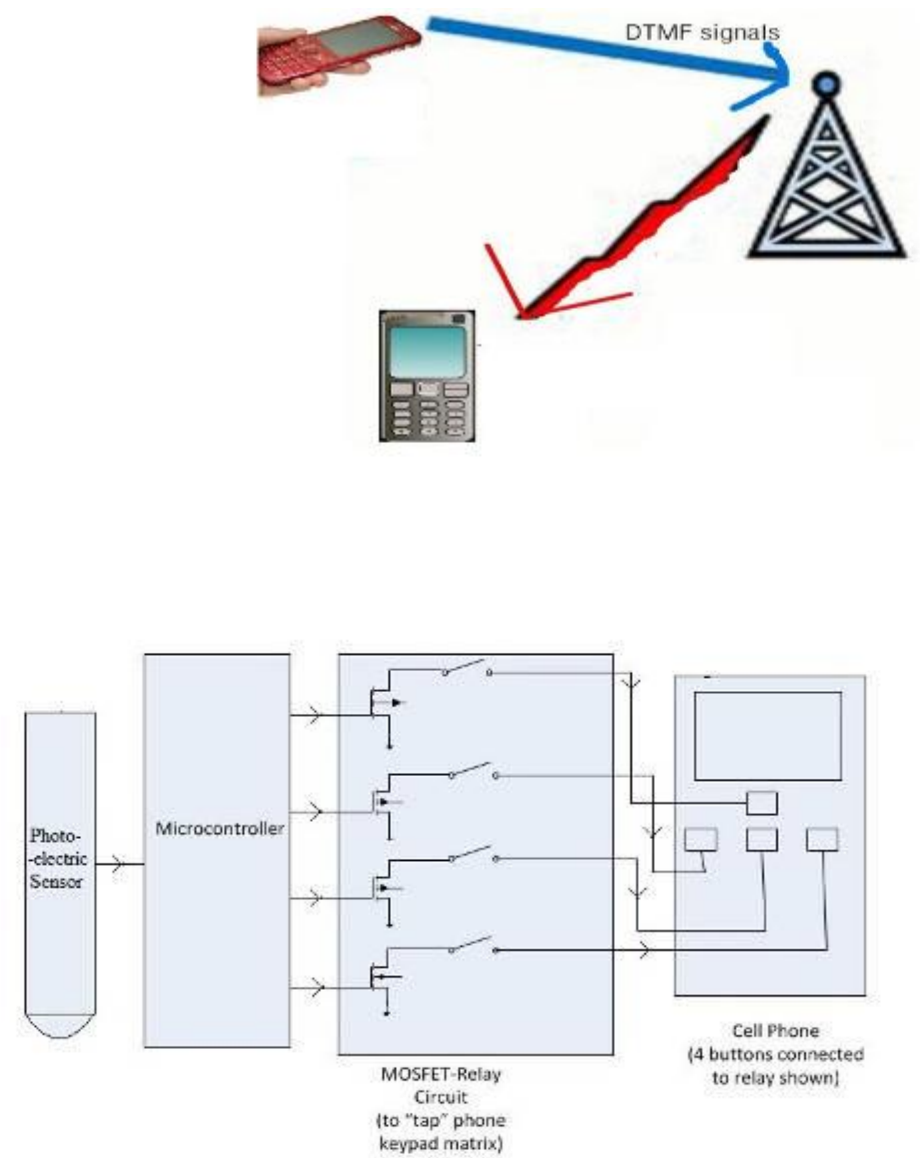


Fig: 3.1 Block Diagram of mobile based home security system.

3.2 Description

At first we supply power for active the circuit. When the circuit active photo sensor will operated by the microcontroller & the microcontroller will active the mobile phone by the relay .When the relay active emergency call will send to the honor. The design of the surveillance device was based on a simple principle; first we formed a ‘human’ concept of what we wanted to do -- which is for a person to be hiding at a corner of a room, and if they see someone enter the room, take a photo using a cell phone and send it via MMS to the concerned person. Then what we did, we replaced all the human parts with machines. The person’s eyes (to see the intruder) were electronically replaced by a photoelectric sensor; the fingers to press the buttons on the cell phone were replaced by a MOSFET-relay couple circuit that could electrically ‘press the buttons’ needed to take a photo, attach it to a message, and send it to a designated number; and finally, the brain of the person, to know when the eye (sensor) has sensed the presence of an intruder, and press the buttons of the cell phone at a specific sequence and interval to send the message, could be replaced by a microcontroller.

3.3 Circuit Diagram

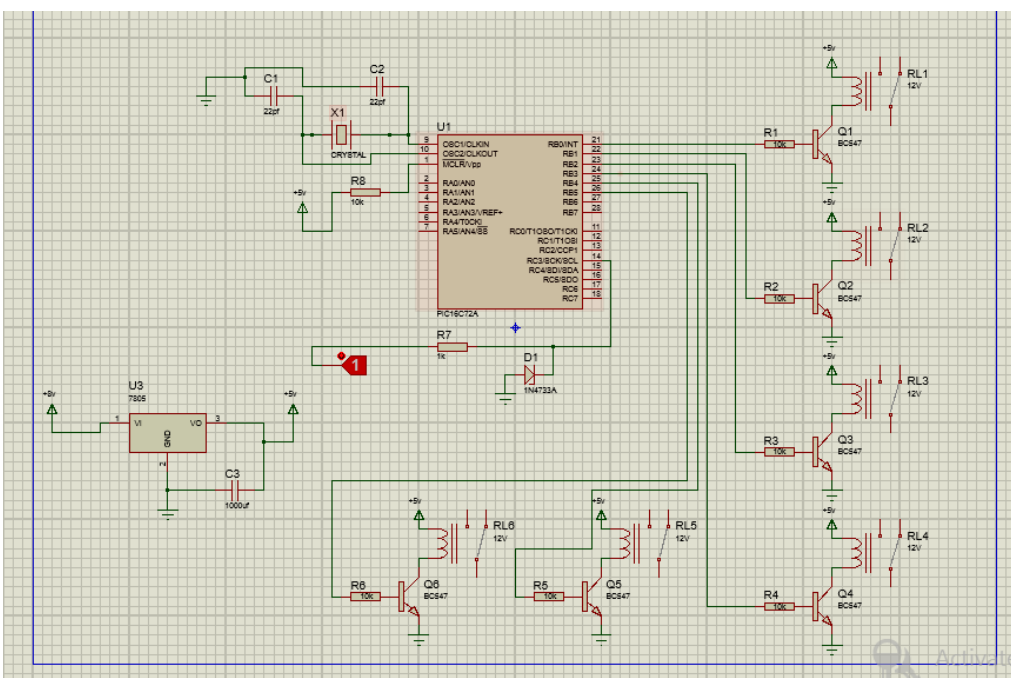


Fig: 3.2 Ccircuit Diagram

3.4 Description of Circuit Diagram

To Cell the elbow to Mobile clockwise pin c4 and c 5 has been used. When the c4 is pressed b0 gives high then another BC547 takes high in his IN1 pin and out1 gives a high and out2 gives low. Then Mobile the Cell clockwise direction. When the c5is pressed b1 gives high then BC547 takes high in his IN2 pin and out1 gives a low and out2 gives a high. Then the motor rotates anticlockwise direction.

For the movement of Jaw previous procedure has been followed. To rotate the arm Mobile Phone pin c6 and c7 has been used. When the c6 is pressed b2 gives high then BC547 takes high in his IN3 pin out3 gives a high and out4 gives low. Then the Mobile Phone clockwise direction. When the c7 is pressed b3 gives high then BC547 takes high in his IN4 pin and out3 gives a low and out4 gives a high. Then the Mobile Phone anticlockwise direction.

On the above circuit Vss(pin no 1) of the Mobile is connected to zero voltage and Vdd (pin no 2)is connected to a +5v power source which is fixed for this . VEE (pin no 3) controls the brightness of the display and it is connected to a variable resister for regulating the brightness. Function of RS(pin no 4) is to read/take command from the program which was build on Micro Pro C, will basically show on the display and it is connected to the RD0 (pin no 19) of PIC16f73. R/W (pin no 5) is also connected to the pot and operation of this pin is to write.

Pin no.6 is the EN pin which connected to RD1 (pin no 20) of PIC16f73A. EN pin enables the data bus line from D0 to D7. Data can be sent in 4bit-2 operations or 8 bit-1 operation. This is why it can use both the 4 and 8 bit MPU. When in only 4 bits long, data transferred using only 4 buses of D4 to D7 and D0 to D3 are not used.

On the other side when interface data is 8 bits long, data is transferred using of d0 to d7. Here data has been transferred through only 4 buses D4, D5 , D6 , D7 which are connected corresponding to RD2(pin no.21),RD3(pin no.22), RD4(pin no.23) ,RD5(pin no.24). And the rest of the buses D0, D1, D2, and D3 kept grounded. So interface data is 4 bits long.

3.5 Project Over View:

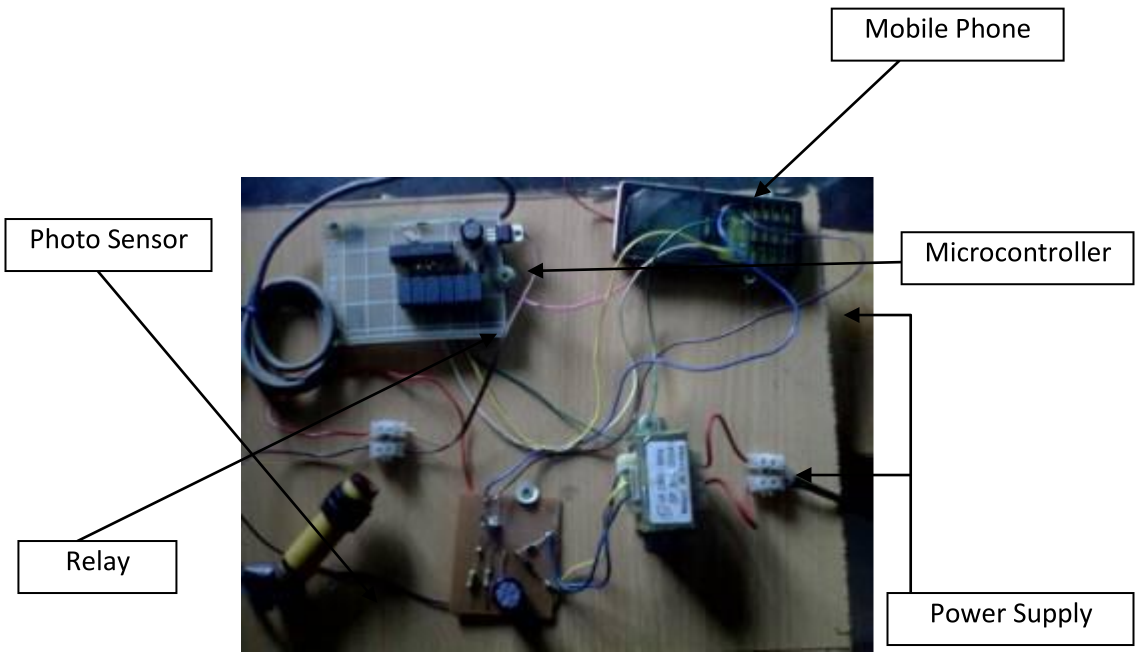


Fig: 3.3 Total Arrangement of project

This project is just a framework prototype of what was intended; a surveillance and alarm system that could instantly deliver images of a surveillance area to a remote location. Most components used in it are very basic, just enough to ensure operational end of the principle of the work. In terms of functionality, there are a lot of things that can be done to improve and develop this project into a truly intuitive, reliable and intelligent security system. But that would require research and development work on it, along the lines of how it was built.

Chapter 4

Microcontroller

4.1 Microcontroller

A microcontroller is a small, low-cost and self-contained computer-on-a-chip that can be used as an embedded system. A few microcontrollers may utilize four-bit expressions and work at clock rate frequencies, which usually include:

1. A 8 bit microprocessor.
2. A little measure of RAM.
3. Programmable ROM and flash memory.
4. Parallel and serial I/O.
5. Timers and signal generators.
6. Analog to Digital and Digital to Analog conversion.

Microcontrollers usually must have low-power requirements since many devices they control are battery-operated. Microcontrollers are used in many consumer electronics, car engines, computer peripherals and test or measurement equipment. And these are well suited for long lasting battery applications. The majority of microcontrollers in use today are embedded in other machinery.

4.2 Types of Microcontroller

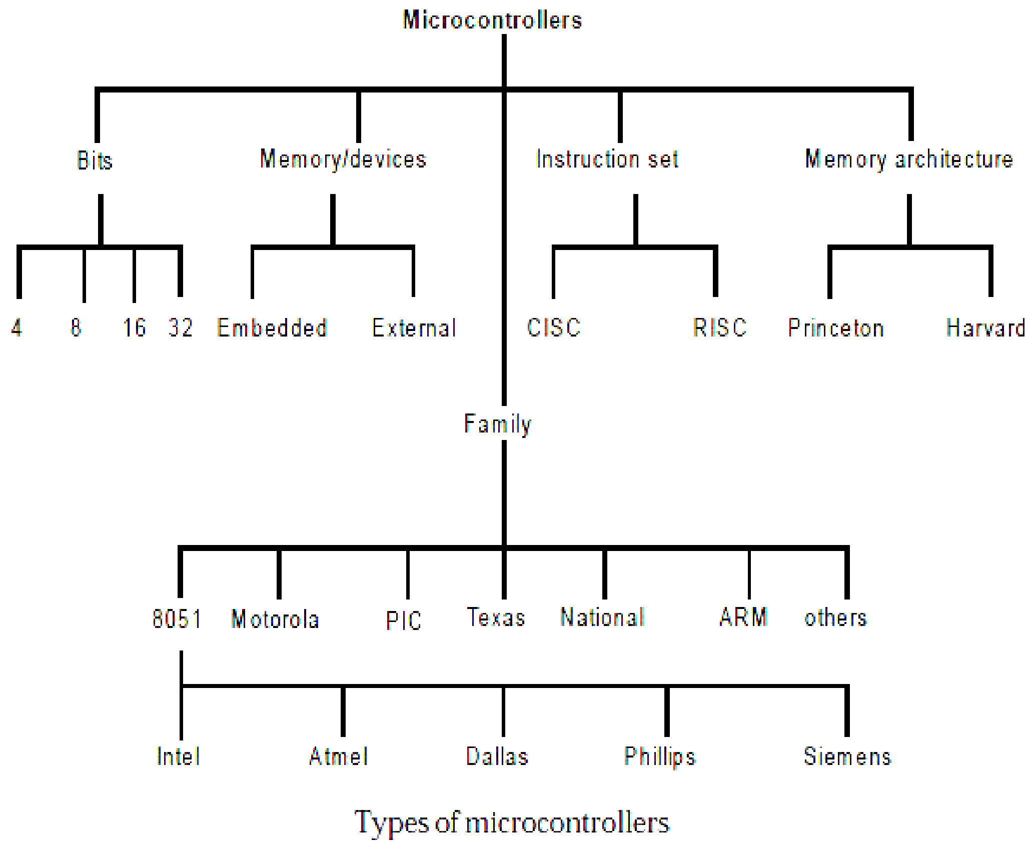


Fig:4.1 Classification of Microcontroller

The types of microcontrollers are shown in the characterized by their bits, memory architecture, memory/devices and instruction set.

4.3 Applications of Microcontrollers

Microcontrollers have many applications in electronic equipments:

- Mobile Phones
- Auto Mobiles
- Washing Machines
- Cameras
- Security alarms

4.4 PIC16F73 microcontroller

4.4.1 Specifications

The PIC16F73 is a single chip micro-controller created by Atmel and belongs to the mega AVR series The high-performance pic 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

4.4.2 Applications

Today the pic is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed. Perhaps the most common implementation of this chip is on the ever popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

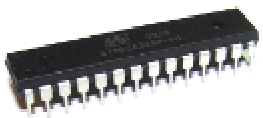


Fig:4.2 PIC16F73

4.4.3 Block diagram of PIC16F73

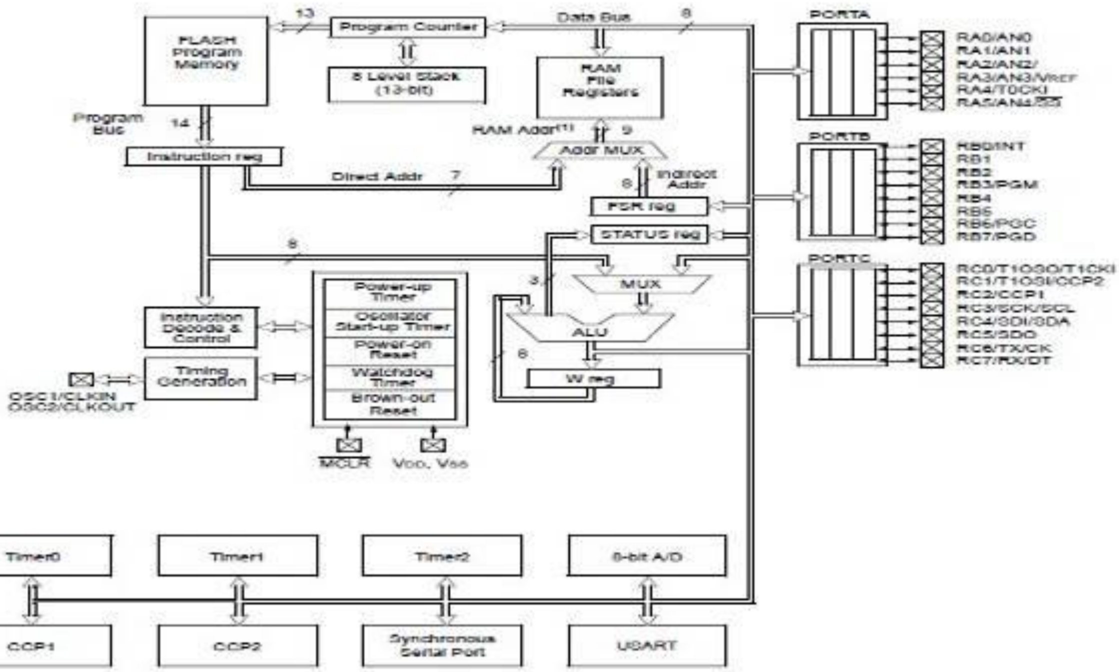


Fig: 4.3 Block Diagram of PIC1673 microcontroller

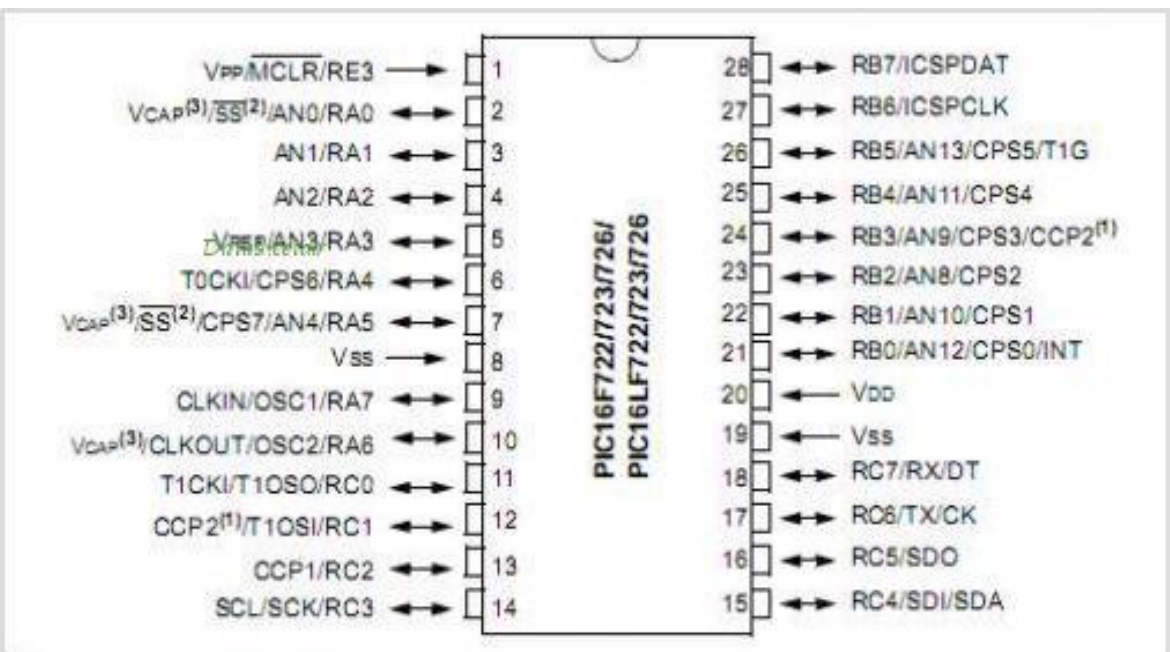


Fig: 4.4 PIC1673 microcontrollers

4.5 Programming and Application Software

4.5.1 Introduction

Machines cannot understand human language. It only understands Binary O and 1. But writing a long code in 0s and 1s can be difficult for humans. So another language that is in between the two is used. These languages are called high level languages. The codes written in high level languages are then translated into the machine language using software. Then these instructions can be executed by a computer. This chapter discusses the high level programming language that has been used to write the codes, the software that converts it to machine language and finally burnt into the microcontroller.

4.5.2 The C programming Language

C (pronounced like the letter C) is a general-purpose computer programming language developed between 1969 and 1973 by Dennis Ritchieat the Bell Telephone Laboratories for use with the Unix operating system. Although C was designed for implementing system software, it is also widely used for developing portable application software. C is one of the most widely used programming languages of all time and there are very few computer architectures for which a C compiler does not exist. C has greatly influenced many other popular programming languages, most notably C++, which began as an extension to C. C is an imperative (procedural) systems implementation language. It was designed to be compiled using a relatively straight forward compiler, to provide low-level access to memory, to provide language constructs that map efficiently to machine instructions, and to require minimal run-time support. C has therefore useful for many applications that had formerly been coded in assembly language. Despite its low-level capabilities, the language was designed to encourage cross platform programming. A standards-compliant and portably written C program can be compiled for a very wide variety of computer platforms and operating systems with few hangs to its source code. The language has become available on a very wide range of platforms, from embedded microcontrollers to super computers. C is often used for "system programming", including implementing operating systems embedded system applications, due to a combination of desirable characteristics such as code portability and efficiency, ability to access specific hardware addresses, ability to pun types to match externally imposed data access requirements, and low run-time demand on system resources. C can also be used for website programming using CGI as a "gateway" for information between the Web application, the server, and the browser. Some reasons for choosing C over interpreted languages are its speed, stability, and near-universal availability. Due to its thin layer of abstraction and low overhead, C allows efficient implementations of algorithms and data structures, which is useful for programs that perform a lot of computations. For example, the GNU Multi-Precision Library, the GNU Scientific Library, Mathematical and MATLAB are completely or partially written in C.C has also been widely used to implement end-user applications, but of that development has shifted to newer languages. In those project, the software is written in C language. The source program is well commented and easy to understand. First, the register name is defined specifically for Atmega16 and variables were declared.

4.5.3 Code Vision AVR C Compiler

C was designed as a programming language and not as a compiler target language. Since we know that the code must be translated into machine language, we need a compiler to do this task. The compiler we are using is called

Code Vision AVR C compiler. This computer converts the source program into hex code which is downloaded to the microcontroller. Code Vision AVR is a complete set of tools designed for rapid and efficient software development for the Atmel AVR microcontrollers. It is the only IDE on the market that features an Automated Program Generator (Code Wizard AVR) for the new AT mega devices and the only C compiler that supports the reduced core (ATtiny4, ATtiny5, ATtiny9, ATtiny10, ATtiny20, ATtiny40) chips. Some features of Code Vision AVR are:

- Integrated Development Environment.
- Bit level access to I/O registers.
- Interrupt Support.
- Possibly to insert assembler code directly in the C source file.
- Fully compatible with Atmel's In-Circuit Emulators.
- C Source level debugging, with COFF symbol file generation, allows variable watching in Atmel's AVR Studio Debugger.
- Very efficient use of RAM- Constant character strings are stored only in FLASH memory and aren't copied to RAM, like in other compilers for the AVR.

4.5.4 Top Win Version 5.49

Top Win, a type of software developed for TOP series programmers, adapts to the TOP hardware products of a new generation. Top Win has abandoned its method of one type of software matching for one mode of TOP product by operating different mode of hardware units. Top Win supports automatic identification of hardware mode and function. Once Top Win connects to hardware unit successfully, the name of hardware unit will appear at the bottom of window. The current basic modes that Top Win supported include TOP853, TOP2004, TOP2005 and TOP2048. Product of new mode developed in the future will be supported by new version of Top Win software. Top Win supports multi-window operation, namely, it can connect multiple programmers on a computer to write device without any interference. Mode of programmer can be same or different. Top Win opens all devices in order of Alignment. In theory, the number of connected devices is out of limitation. Top Win supports Windows98se/Me/2000/XP. In this project, the programmer used is Universal TOP2005+ programmer and the software is Top Win ver 5.49. The write-in device of the software is to write the data of the buffer into a device. The default values of File start Address and Device start Address are 0, which implies writing data into all the units of the **device**. While the length of the data can be up to six bits hexadecimal (HEX) numerals and the maximal address space is 8M. If necessary, user can follow required conditions to modify start address, so as to fulfill the intention to write in. The procedures to write in device are usually displayed via a progress bar. If confront with some units fail to write in, it will exit from the write-in procedures and display fault address, data in buffer and contents of device data.

4.5.5 Functions of the Applications

The programming section for the robot was performed in three major steps:-

- At first, the program codes were written according to the project requirements in C programming language.
- Then the codes were compiled using a C compiler called Code Vision AVR, which produces a. hex file containing the codes in machine language (hexadecimal) which the microcontroller understands.
- This.hex file is then burnt or downloaded onto the microcontroller using Top Win Version 5.49.

Chapter 5

Output Analysis and calculator of cost

5.1 Total Implementation

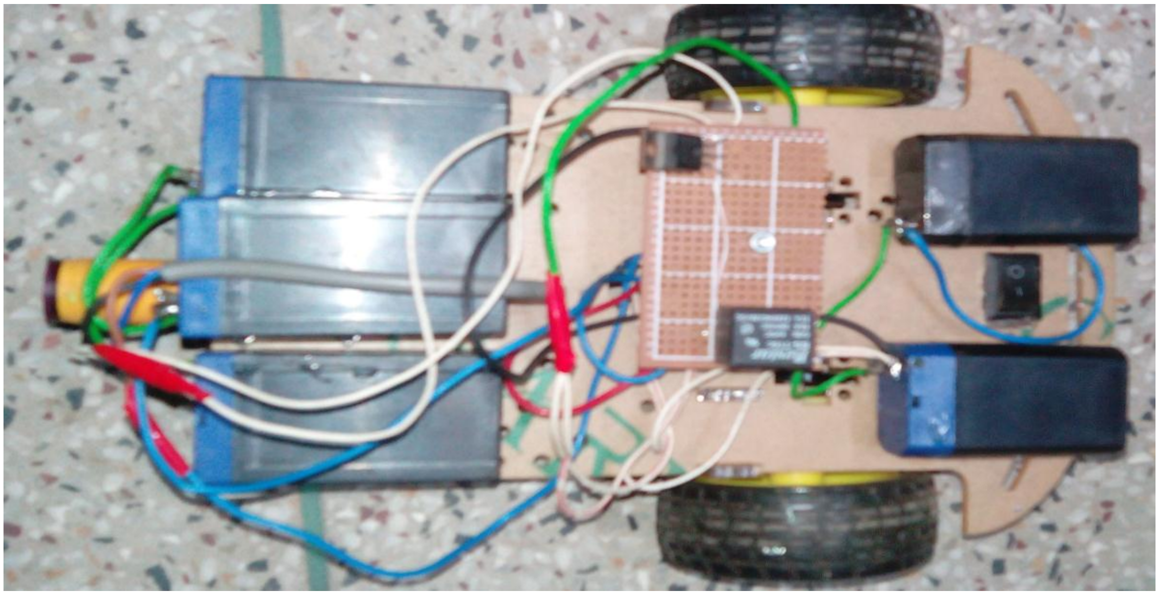


Fig: 5.1Total circuit implementation

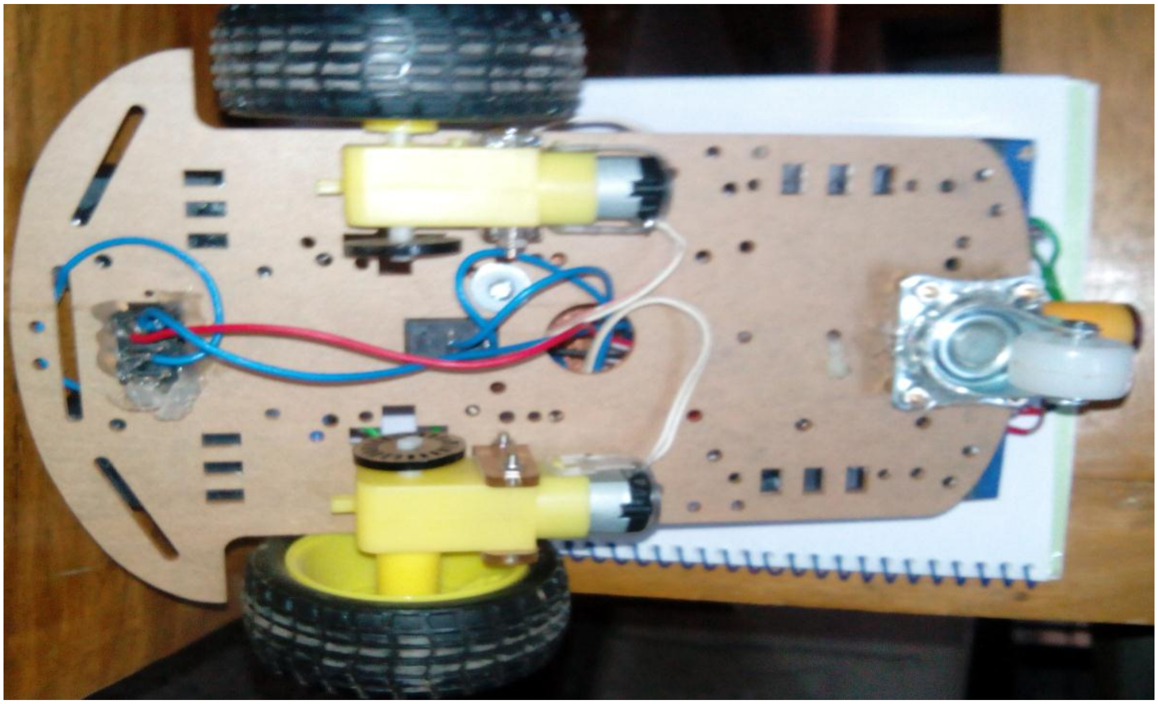


Fig. 5.2 Bottom level of the system

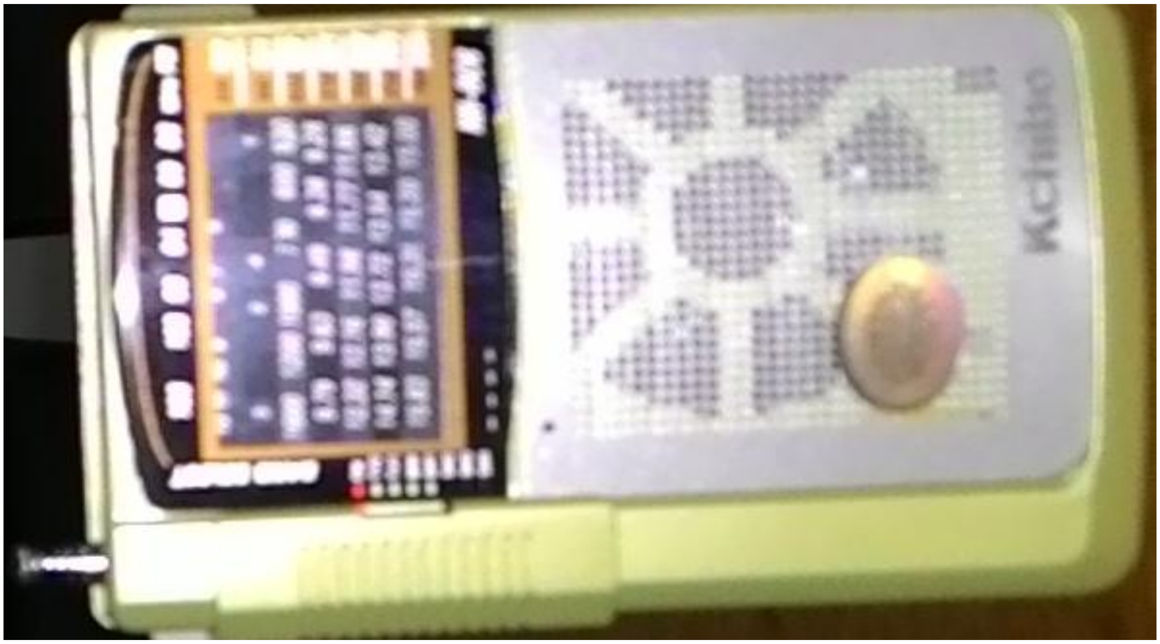


Fig. 5.3 Receiver Module of the system

5.2 Cost Calculation

Sl.	Name of Parts	Qty.	Unit	Unit Price	Amount
01	Transformer	01	pc	80.00	80.00
02	Photoelectric Sensor	01	pc	550.00	550.00
03	Relay	06	pcs	30.00	180.00
04	Microcontroller (PIC16F73)	01	pc	1000.00	1000.00
05	Cell Phone	01	pc	2500.00	2500.00
06	Mobile SIM (GP)	01	pc	300.00	300.00
07	Resistor	07	pcs	2.00	14.00
08	Transistor	07	pcs	15.00	105.00
09	Diode	05	pcs	3.00	15.00
10	Ziner Diode	01	pc	10.00	10.00
11	LED	02	pcs	2.00	4.00
12	Capacitor	02	pcs	20.00	40.00
13	PIC (Printed Circuit Board)	02	pcs	60.00	120.00
14	Off/On Switch	01	pc	15.00	15.00
15	Flexible Cable	03	meter	25.00	75.00
16	Sensor Cable	08	meter	35.00	280.00
17	Power Cable	01	pc	80.00	80.00
18	2 Pin Combined Socket	01	pc	250.00	250.00
19	Others	01	lot	382.00	382.00
				Total Amount=	**6,000.00**

5.3 Analysis and Discussion

Photo sensor was used in this project which provides electrical isolation to the user. Simple operational amplifier with inverting and non-inverting configurations was used to amplify and filter the signal from sensor which narrowed the detecting range of sensing mode. Better configuration of instrumentation amplifier and other filters like Butterworth and Chebyshev filters with higher order can be used for better signal conditioning compromising to the complexity of the amplifier and filter circuit. PIC16F73 microcontroller contains in-built Analog to Digital Converter (ADC). So, extra Analog to Digital Converter device is not necessary. RF transmitter and receiver were preferred over IR transmitter and receiver as RF transmitter and receiver is superior over infrared device in many ways. The power supply was measured with the help of bright LED. Both the data were processed in the microcontroller and sent to the mobile phone. In this controlling side two relay are used for find out the contact phone number and send a voice call to the contact phone number. To save our house, office, bank etc. without present of inside personnel it is very effective technology. It is more effective to save money & time. The controlling system is very easy & the system is easily removable.

5.4 Possible Improvement

5.4.1 Smaller Circuit Size

The circuit may be improved a great deal by use of PCB instead of a breadboard.

A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. It is also referred to as printed wiring board (PWB) or etched wiring board. Printed circuit boards are used in virtually all but the simplest commercially produced electronic devices.

Since the project was involved design, using a PCB would be counterproductive because a PCB, after printing and etching, cannot be rearranged or rectified. However, for further production of the circuit, a PCB can easily be designed, which will not only bring down the size of the whole project, but also make much more secured connections that will be at no risk of being disrupted.

5.4.2 Better Imaging

The image produced by the camera on the project does not give a very clear image, because it is not of very high-resolution or high-quality. A more expensive phone would provide better quality photos. Having said that, the size of a high-resolution and high-quality photo would be larger and might be above the MMS size limit of the carrier or recipient phone. A better-branded phone could, however, produce clearer photos without bulking up the image size, but that is a task left out for further R&D of the project.

5.4.3 Better Motion Detection

The motion sensor used for the experimental setup is OMRON E3F-DS10B1, a cheap, low-range photoelectric sensor. It has an effective range is up to 10cm at most, limiting the circuit's practicality as it is. However, just by replacing the sensor with a higher-range and higher-sensitivity sensor will greatly improve the performance of this project. Going further on that, the use of multiple sensors (can be patched on the circuit with virtually zero difficulty) can also greatly increase the dimensions of surveillance, and cover a much wider, and more importantly, omni-directional range of surveillance.

5.4.4 Wider Surveillance Outreach

A simple change in the programming code (no need to hook in extra wires on the phone) and pre-programming of the phone can allow the circuit to send the image to multiple recipients; e.g. to multiple owners of the house, or even one to a nearby police station or security firm. That way, even if a person misses seeing the message immediately, others will. The only issue would be a slight increase in costing from the phone's SIM card for sending multiple messages with one instance of intrusion.

5.4.5 Uninterrupted Service

In a country like ours, where power failure is a common phenomenon, one simple tweak to the power supply chain could ensure that even if the power supply is out, it does not interrupt the surveillance and alarm system. Since the whole circuit is powered from a single mains source, if that source is connected through a UPS, it could provide uninterrupted surveillance. This would be a worthy improvement on the project, as any good surveillance and/or alarm system has a power backup and independence factor in its favor in case an intruder purposefully disrupts power before trespassing.

5.5 Drawbacks /Limitation

The drawbacks of our implementation of the surveillance and alarm system and possible improvement involved are a concern of this chapter. The chapter focuses on the method of data transfer and the difficult areas that it treads on. It also includes information on the available cell phone technologies that could be considered for surveillance and their associated problems. Suggestions for improvement provided here about the range of the sensor, durability and robustness of the circuit try to relate the advantages in order to enhance the functionality of the existing design.

Conclusion

This project is just a framework prototype of what was intended; a surveillance and alarm system that could instantly deliver images of a surveillance area to a remote location. Most components used in it are very basic, just enough to ensure operational end of the principle of the work. In terms of functionality, there are a lot of things that can be done to improve and develop this project into a truly intuitive, reliable and intelligent security system. But that would require research and development work on it, along the lines of how it was built.

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Appendices:

Appendix A

Technical specifications for the Mobile Base Security System device:

Price	TK. 2500.00
Frequency	GSM 850 / 900 / 1800 / 1900 ; HSDPA 2100
Phone Style	Bar Style
Dimensions	116.7mm x 52mm x 20.3mm
Weight	TBC
Bluetooth (A2DP 2.2v)	Yes
Additional Memory	Up to 8GB
Messaging	SMS / MMS
Screen Size	6.1cms, QVGA
Camera	2-megapixels
Music Player	Yes
Speakers	Yes
Music Formats	MP3, WAV, AAC
Radio	FM radio
Games	Yes
Battery	Li-Ion 1000 mAh
Standby Time	Up to 13 days
Talk Time	Up to 4 hours

Appendix B

Technical specification of PIC 16F73:

Microcontroller	PIC16F73
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM Output)
Analog Input Pins	6

DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB of which 0.5 KB used by boot loader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

Appendix C

Technical specification of photo electric sensor:

Item	Content
Model number	E3F-DS10(30) series
External dimensions	M18x1x67.5
Sensing method	Diffuse reflective
Setting distance	10cm±10%
Sensing object	Transparent/Opaque object
Sensitivity adjustment	Adjustable
Response frequency	300Hz
Response time	1.5ms max
Light source	Infrared LED (660 nm)
Supply voltage-DC	12-24Vdc (6-36V), pulsation (p-p) below 10%;
Supply voltage-AC	110-220Vac (90-250Vac) 50/60Hz
Leakage current	N.P Type: 20mA max; A Type: 1.7mA max
Control output	N.P Type: 300mA max; A Type: 400mA; J type: 2A max (contact life: 100000 times)
Protection circuit-DC	Reverse polarity protection, Surge suppressor, Short-circuit protection

Protection circuit-AC	Surge suppressor
Insulation resistance	50 MΩ min. at 500 V DC between energized parts and case
Dielectric strength	1000 VAC max., 50 / 60 Hz for 1 min between energized parts and case
Temperature influence-1	±10% max. of sensing distance at 23°C within temperature range of -25°C to 60°C
Temperature influence-2	±15% max. of sensing distance at 23°C within temperature range of -30°C to 65°C
Voltage influence	±10% max. of sensing distance in rated voltage range ±15%
IP Rating	IP67
Material	Case: ABS; Sensing surface (lens): PMMA
Operating temperature	-30 to 65 °C (with no icing or condensation)
Operating humidity Storage:	35% to 95% (without condensation)

Appendix D

Technical specification of Mobile Phone:

Manufacturer:	TECNO
Transistor Polarity:	N-Channel
Drain-Source Breakdown voltage	100 V
Gate-Source Breakdown Voltage:	20 V
Continuous Drain Current:	33 A
Mounting Style:	Through Hole
Package / Case:	TO-220AB
Packaging:	Tube
Gate Charge Qg:	47.3 nC
Power Dissipation:	140 W
Factory Pack Quantity :	50

Appendix D

Programming the microcontroller

Micro controller code:

```
int RELAY1 = 9; // define pins for relays
int RELAY2 = 10;
int RELAY3 = 11;
int RELAY4 = 12;
int wait1 = 50; // wait time before a pin is turned on (in ms)
int wait2 = 1000;
int on3 = 4; // input pin
void setup() {
 pinMode(RELAY1, OUTPUT); //sets relay as output
  pinMode(RELAY2, OUTPUT);
  pinMode(RELAY3, OUTPUT);
  pinMode(RELAY4, OUTPUT);
  pinMode(on3, INPUT);
}
void loop () {
  int val3 = digitalRead(on3);
    if(val3 == HIGH) { // if input is turned high, only then turn on relays
    // turn on the relay
    digitalWrite(RELAY1, HIGH);
    delay(wait1);
    digitalWrite(RELAY1, LOW);
    // keep the others turned off
    digitalWrite(RELAY2, LOW);
```

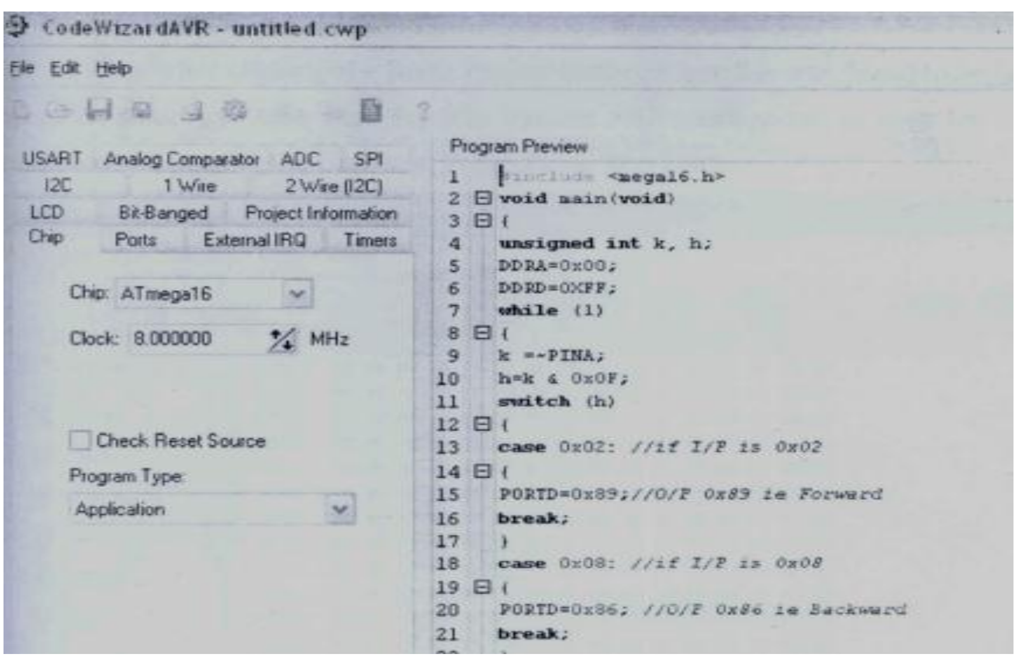
```
digitalWrite(RELAY3, LOW);
digitalWrite(RELAY4, LOW);
delay(wait2); // wait for time defined before turning on the next relay
digitalWrite(RELAY2, HIGH);
delay(wait1);
digitalWrite(RELAY2, LOW);
digitalWrite(RELAY1, LOW);
digitalWrite(RELAY3, LOW);
digitalWrite(RELAY4, LOW);
delay(wait2);
digitalWrite(RELAY3, HIGH);
 delay(wait1);
digitalWrite(RELAY3, LOW);
digitalWrite(RELAY1, LOW);
digitalWrite(RELAY2, LOW);
digitalWrite(RELAY4, LOW);
delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
digitalWrite(RELAY4, LOW);
digitalWrite(RELAY1, LOW);
digitalWrite(RELAY2, LOW);
digitalWrite(RELAY3, LOW);
delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
digitalWrite(RELAY4, LOW);
```

```
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
 digitalWrite(RELAY4, LOW);
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
 digitalWrite(RELAY4, LOW);
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
 digitalWrite(RELAY4, LOW);
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
```

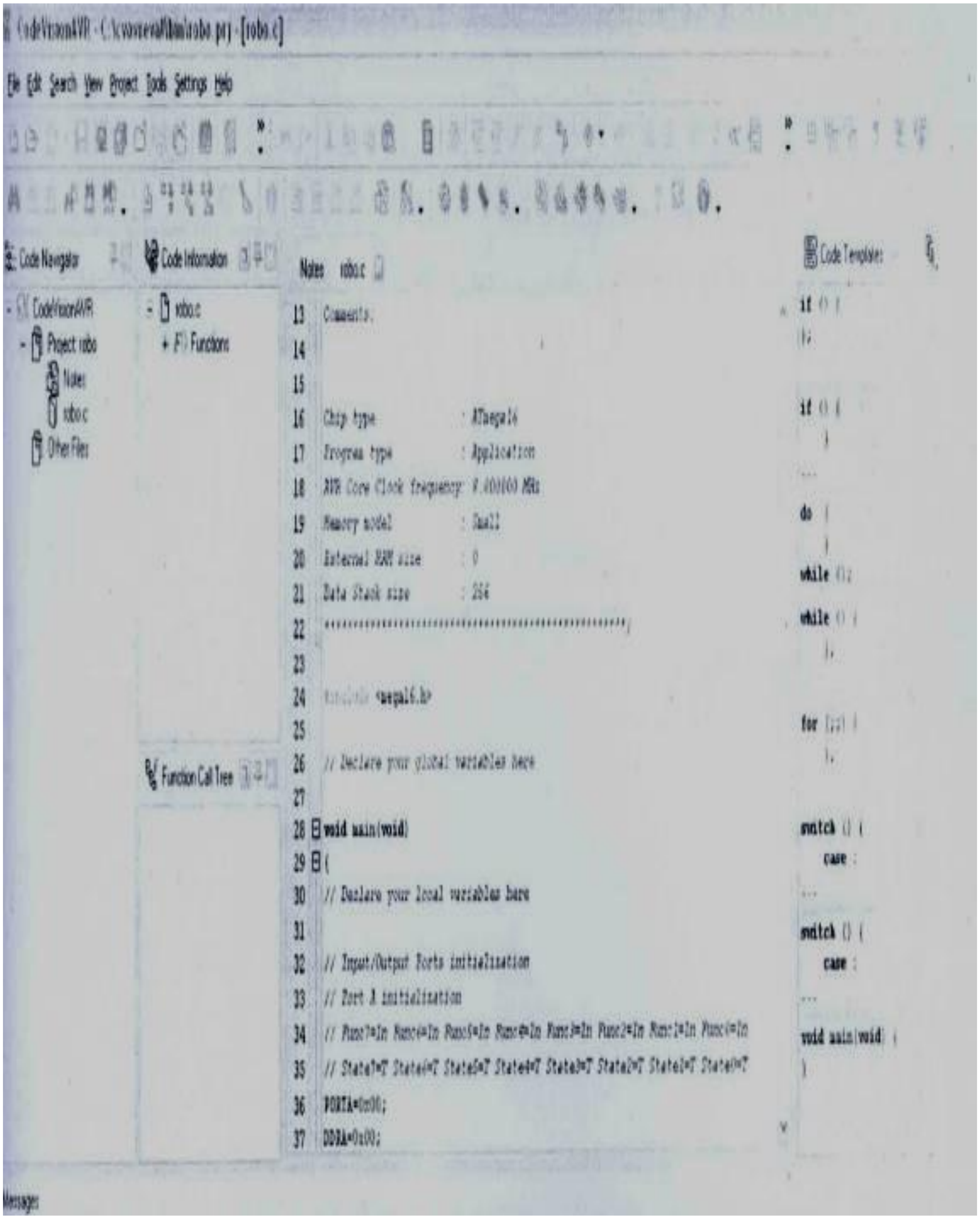
```
 digitalWrite(RELAY4, LOW);
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
 digitalWrite(RELAY4, LOW);
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
 digitalWrite(RELAY4, LOW);
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay(wait2);
digitalWrite(RELAY4, HIGH);
delay(wait1);
 digitalWrite(RELAY4, LOW);
 digitalWrite(RELAY1, LOW);
 digitalWrite(RELAY2, LOW);
 digitalWrite(RELAY3, LOW);
 delay (wait2);
digitalWrite(RELAY1, HIGH);
```

```
    delay (wait1);
    digitalWrite(RELAY1, LOW);
    digitalWrite(RELAY2, LOW);
    digitalWrite(RELAY3, LOW);
    digitalWrite(RELAY4, LOW);
    delay (wait2);
  } else { // if input is low, then keep all relays turned off
    digitalWrite(RELAY1, LOW);
    digitalWrite(RELAY2, LOW);
    digitalWrite(RELAY3, LOW);
    digitalWrite(RELAY4, LOW);
  }
}
```

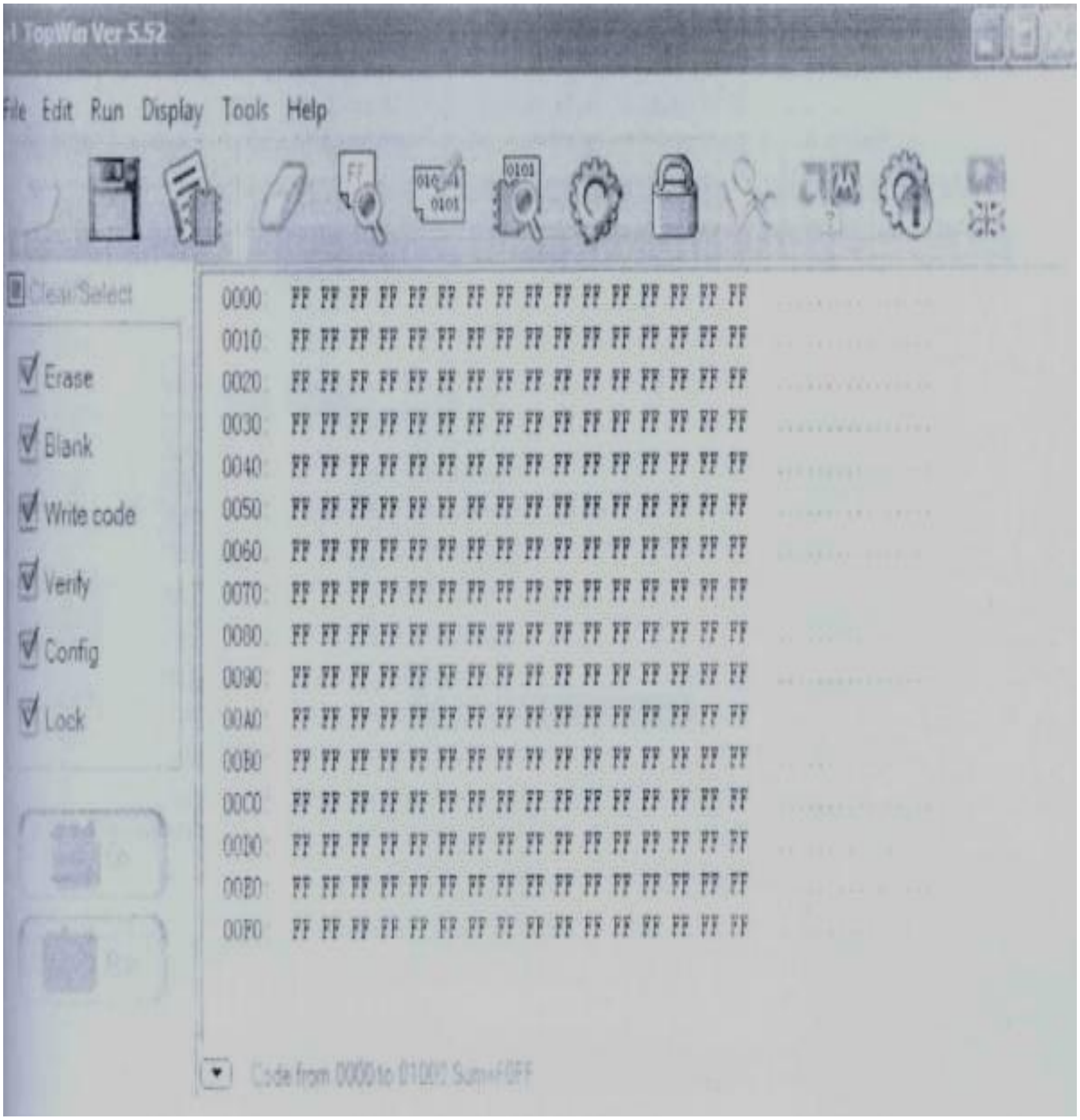
CodeVision AVR version 2.34 was installed on the computer at first. A new project was opened in the CodeVision AVR program and from there the ATmega 16 IC that were used in the project was selected. The clock rate was selected to be 8MHz. The source code was typed on to the Program Preview window.



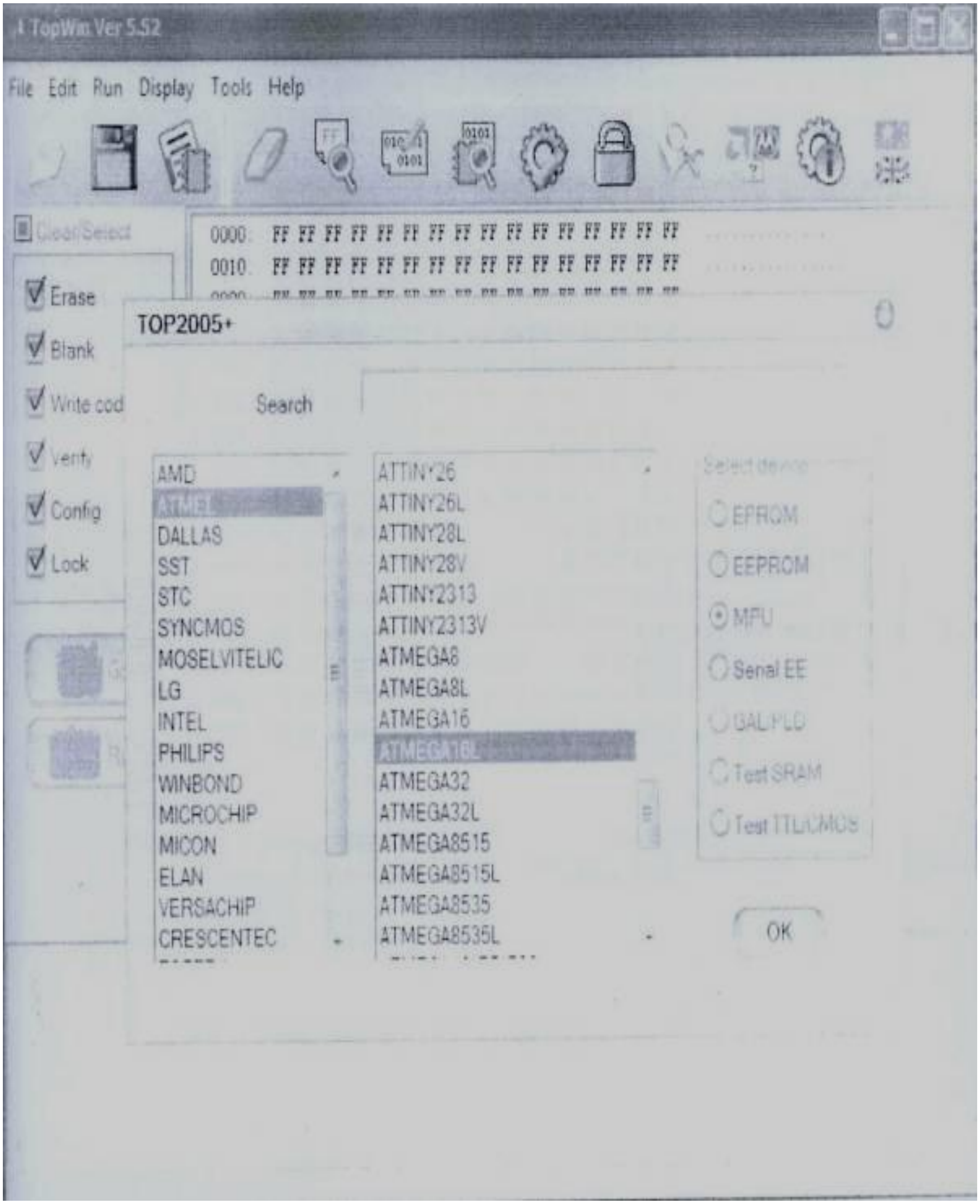
Then the Generate, Save and Exit button was pressed, and all the files were saved with the same name. After that it was found that the Code Wizard generated the file that was initialized.



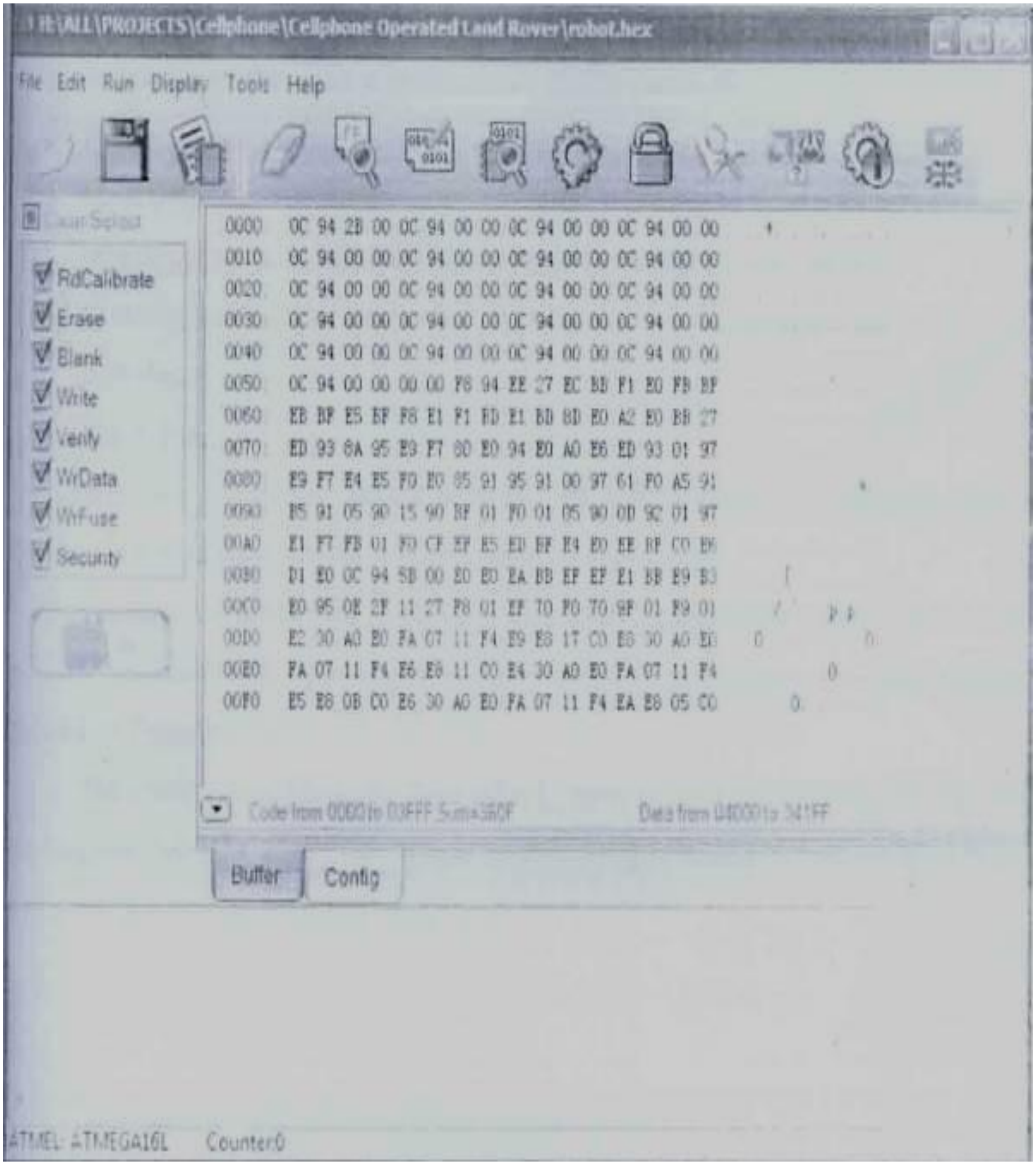
Then after clicking the Build Project button, a hex file was found to be generated in the specified directory. After that TopWin Version 5.52 was opened, to burn the hex code in the microcontroller using the Universal Programmer Top 2005+.



The IC ATmega16 was selected from the list.



Then the hex code was located to the buffer, to be burnt on the microcontroller.



Then the write button was clicked to complete burning the code into the microcontroller

END