Chapter 1

Introduction

In this chapter, we have introduced our proposed system. The main theme of this system is to control and protect firing area. Our proposed system is used to
Extinguish fire and it can be also used for surveillance.

1.1 Introduction:

Our task as Electronics and Telecommunication Engineers was to design and build a prototype system that could extinguish a fire. Also aims at minimizing air pollution. It is the Robot that can move through a model structure, our research paper describes the design of a small autonomous Fire Fighting Robot. We have worked on the same project at our college presenting a report showing its basic construction and working. The Fire Fighting Robot is designed to extinguish the fire with the help of the Water Pump, and then return to the front of the house with the help of wireless camera. The wireless communication will take place by using RF trans0mitter and RF receiver at the transmitter and receiver end respectively. The robotic vehicle will consists of water pump which will control over wireless communication to throw water. The controlling of the entire receiver unit will take place by Arduino Microcontroller with the help of operation provided by Transmitter unit.

Small fires from short circuits, gas stoves or other factors in the residence cannot be detected by human's sensitivity while robot design equipped with high sensitivity sensors can detect the presence of heat, smoke and fire. Unlike humans, the robot has a maximum capacity as alert, not tired and is able to perform 24 hours depending on the program of work specified in the robot.

1.2 Objectives:

These are the objectives of proposed system

a) To Control all the robot directions wirelessly.
b) Display all the activity of the fire area through camera.
c) To extinguish fire.

1.3 Problem statement:

Fire Fighting Robot is specifically designed for help humans, especially for firemen in the face of extinguishing fire situation. This robot uses can be applied at home or residential depending on how its operation. No matter it is used by firemen or individuals, the goal is only one which is to save lives when against the fire.

Place and the rest suffer from cancer as a result of direct contact with chemicals and poisonous. Firemen are more vulnerable to death in the course of their daily routine firefighting. The use of robots is one of the alternative medium for reducing firemen casualties and enhancing fireman capabilities.

Small fires from short circuits, gas stoves or other factors in the residence cannot be detected by human's sensitivity while robot design equipped with high sensitivity sensors can detect the presence of heat, smoke and fire. Unlike humans, the robot has a maximum capacity as alert, not tired and is able to perform 24 hours depending on the program of work specified in the robot.

1.4 Organization:

Chapter 1 is a general introduction to our proposed system and it is essential for the remaining chapters. In chapter 2, Literature survey in which comparison between previous system with our proposed system is given and also given detailed literature survey.

The chapter, **Chapter 2: Literature Survey** includes literature survey of proposed system.

Chapter 2

Literature Survey

In this chapter, we have discussing the conventional method of controlling fire area and overcome its disadvantages using our proposed system. Mainly we have comparing conventional and our proposed system.

The Fire Extinguisher Robot concept proposed by Japan in the 1967. Later that they added the wireless feature in it, in 1969.After that many countries follows the idea of fire fighting robot like USA, China etc. The content of extinguishing agent varies from 1 to 250 kilograms

A fire extinguisher is a device which contains a pressurized fire fighting agent; the agent will come out through a hose by opening a valve at the fire extinguisher. The hose then needs to be pointed directly to the flame. A normal fire extinguisher will have a device that avoids an accidental start off; it has to be disabled before using the fire extinguisher. Fire extinguishers have a lot of different sizes and types, from small ones which are carried in cars, to larger ones which are called cart-mounted or also known as wheeled extinguishers. The content of extinguishing agent varies from 1 to 250 kilograms. The problem with these devices (except the largest ones) is that the agent runs out quickly. The time of continuous download is from 18 to 20 seconds. They are also distinguished by the fires that they are able to put out. Different classes of fire are shown in next table.

2.1 Literature review on fire extinguisher:

Review on types of manual fire extinguisher and robot fire extinguisher had showed many differences, where the robot fire extinguisher act faster compared to manual when it senses the fire. Then, we choose to design robot fire extinguisher but different design with better specification to get fastest action.

The next chapter, **chapter 3: Project Methodology and Description,** in this we will explain the each component in detail.

Chapter 3

Project Methodology and Description

In this chapter, we will explain block diagram, selection criteria and circuit diagram in details and describe how to control motor via RF transmitter and receiver.

3.1 Introduction:

This system will provide remote controller having 5 operations which are send and received by RF transmitter and receiver respectively. In this system we can switch on and off water pump using wireless remote. For this proposed system we will use RF transmitter and receiver, microcontroller, 200rpm DC motor, male to female single stand cables, relays etc.

3.2 Block diagram of proposed system:

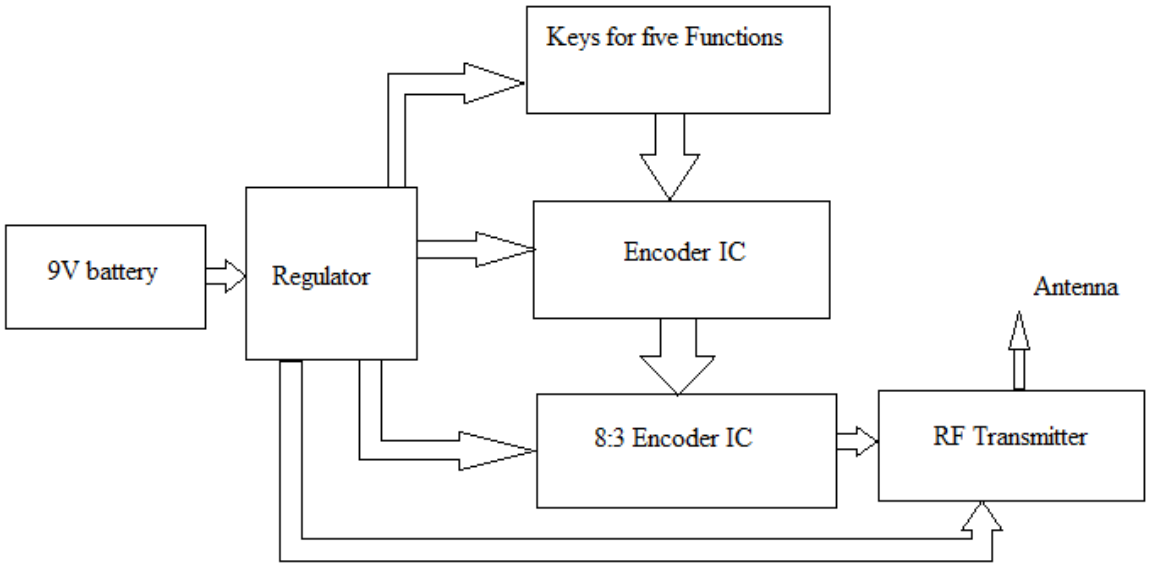

Fig.3.1: Transmitter of proposed system

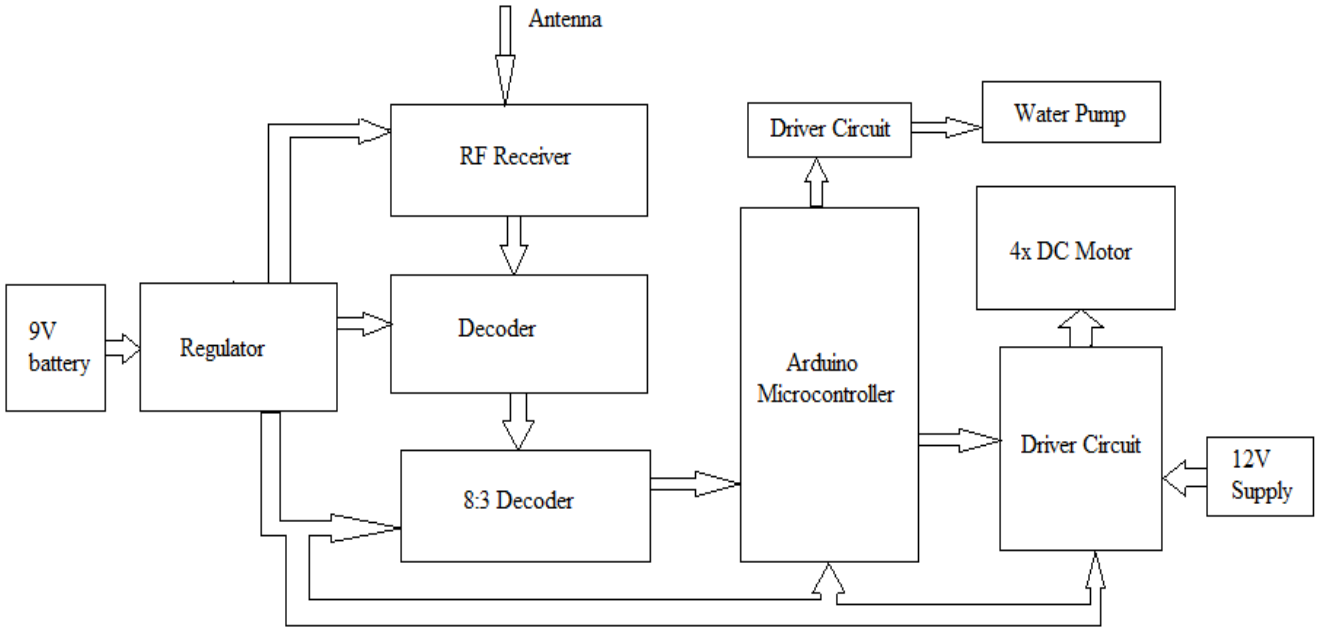

Fig.3.2: Receiver of Proposed System

3.3 Description of system:

The details description of our whole proposed of our whole proposed system is explained in this chapter. Also discussed the each component in detail.

This advanced project Fire Fighter Robotic Vehicle with Camera allows a user to control a fire fighter robot equipped with water tank. For this purposes the system uses an RF remote for remote operation along with RF receive based microcontroller circuit for operating the robotic vehicle and water pump. The receiver circuit receives RF signals through RF based remote transfer user's commands. The receiver circuit now decodes the data commands sent. It then forwards it to the microcontroller.

Now the microcontroller processes these instructions and then instructions the vehicle motors to run the vehicle in desired directions. It also operates the water pump motor and pump direction motor to spray water based on user's commands. This allows the user to operate the robot and put off the fire by standing at a safe distance.

This robot body also has a wireless camera mounted over it. This camera helps to direct the robot body in whichever direction as needed. This is because whatever area that will be captured by this wireless camera can be viewed on PC or any other device for reference.

Thus this system helps to extinguish fire from a safe distance with the help of the water tank.

3.3.1 Arduino Microcontroller:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without warring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start

over again."Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0.

Fig.3.3.1: Arduino Board

The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Following table gives the specification of Arduino Microcontroller:

Table no. 3.3.1: Arduino Specification

Parameter	Specification
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (Recommended)	7V-15V
Input Voltage (limit)	6V-20V
Digital I/O pins	14(of which 6 pins provide PWM output)
Analog input pins	6
Dc current per I/O pins	20mA
Flash memory	32KB (of which 0.5KB used by Boot loader)
SRAM	2KB

3.3.2 HT12E encoder IC: These IC used for encode the key functions.

The 212 encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12N data bits. Each address/data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger on the HT12E or a DATA trigger on the HT12A further enhances the application flexibility of the 212 series of encoders. The HT12A additionally provides a 38 KHz carrier for infrared systems.

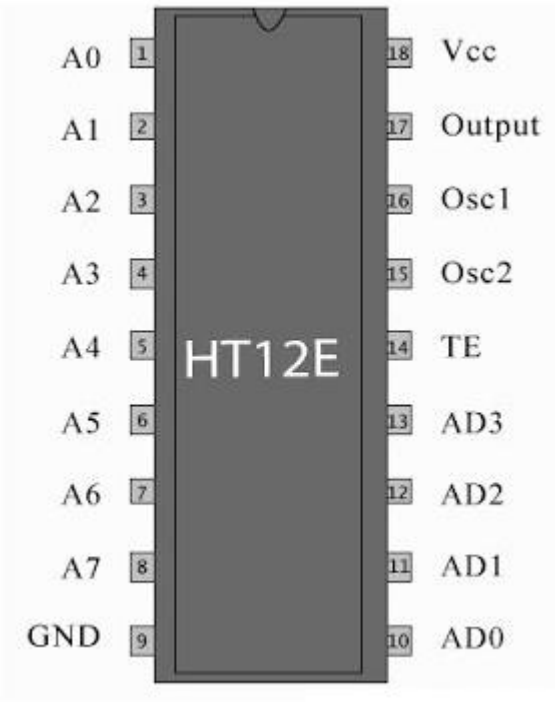

Fig.3.3.2 HT12E Encoder IC

3.3.3 HT12D decoder IC: These IC used for decoding the key functions received at the receiver.

The 212 decoders are a series of CMOS LSIs for remote control system applications. They are paired with HOLTEK's 212 series of encoders (refer to the encoder/decoder cross reference table). For proper operation a pair of encoder or decoder with the same number of addresses and data format should be chosen.

The decoders receive serial addresses and data from a programmed 212 series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses. If no error or unmatched codes have been found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission. The 212 series of decoders is capable of decoding information that consists of N bits of address and 12–N bits of data. Of this series, the HT12D is arranged to provide 8 address bits and 4 data bits, and the HT12F is used to decode 12 bits of address infor0mation.

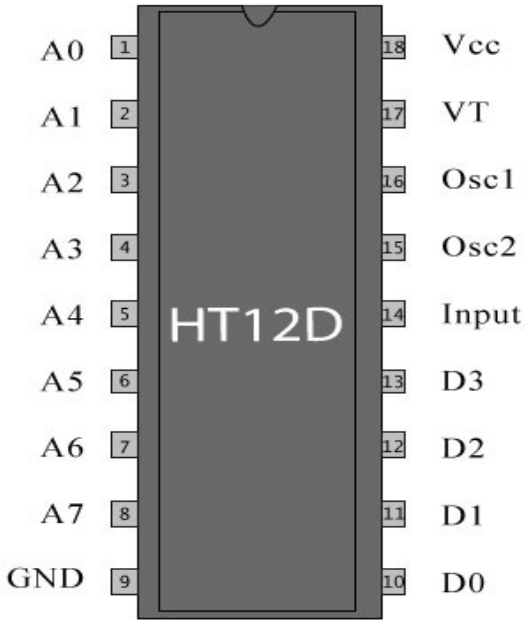

Fig.3.3.3 HT12D Decoder IC

3.3.4 RF Transmitter and Receiver:

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).Transmission through RF is better than IR (infrared) because of many reasons.

Fig.3.3.4: RF Module

Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz an RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

3.3.4 9V Battery:

A battery is a type of linear power supply that offers benefits that traditional line operated power supplies lack: , portability and reliability. A battery consists of multiple electro chemical cells connected provide the voltage desired. Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Here in our application we need a 5v DC power supply for all electronics involved in the project. This requires step down transformer, rectifier, voltage regulator, and filter circuit for generation of 5v DC power.

Fig.3.3.4 Battery

3.3.5 DC Water Pump:

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

Fig.3.3.5: Water Pump

Among these we are using Direct Lift Pump whose specifications are as follows:

Table no.3.3.5: Specification of Water Pump

Operating Voltage	**12V**	**6V**
Power Consumption	14.5W	4.8W
Max Flow	2 liters/minute	1 liter/minute
Self Priming Height	2'	10"
Inlet/Outlet Width	6mm	
Compatible Tubing	3/16" Airline Tubing for Aquariums	
Operating Temperature	-10°C - 100°C (Does not account for frozen liquids)	
Weight	.5 lbs.	

3.3.6 DC Motor:

Modern DC motors are often controlled by power electronics systems which adjust the voltage by "chopping" the DC current into on and off cycles which have an effective lower voltage.

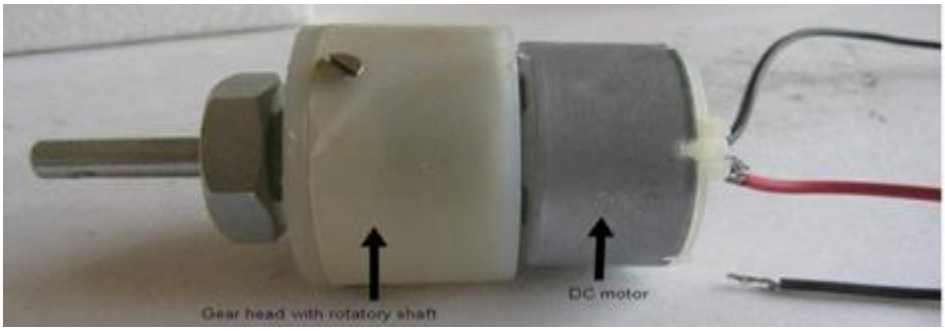

Fig.3.3.6: DC Motor

Following are the specifications of the Motor we used:

a) 200RPM 12V DC motors with Gearbox
b) 3000RPM base motor
c) 6mm shaft diameter with internal hole
d) Same size motor available in various rpm.
e) 0.5kgcm torque

3.3.7 74LS148 Multiplexer IC:

The SN54/74LS147 and the SN54/74LS148 are Priority Encoders. They provide priority decoding of the inputs to ensure that only the highest order data line is encoded. Both devices have data inputs and outputs which are active at the low logic level. The LS147 encodes nine data lines to four-line (8-4-2-1) BCD. The implied decimal zero condition does not require an input condition because zero is encoded when all nine data lines are at a high logic level. The LS148 encodes eight data lines to three-line (4-2-1) binary (octal). By providing cascading circuitry (Enable Input EI and Enable Output EO) octal expansion is allowed without needing external circuitry.

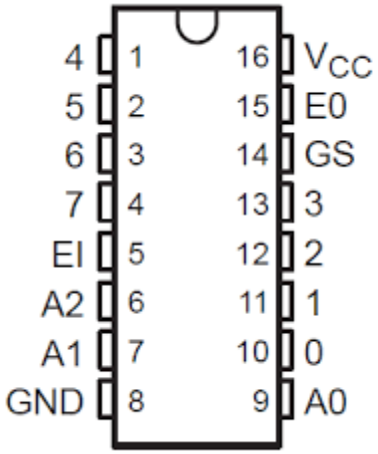

Fig.4.3.7: 74LS148

The SN54/74LS748 is a proprietary Motorola part incorporating a built-in deglitched network which minimizes glitches on the GS output. The glitch occurs on the negative going transition of the EI input when data inputs 0–7 are at logical ones. The only dc parameter differences between the LS148 and the LS748 are that (1) Pin 10 (input 0) has a fan-in of 2 on the LS748 versus a fan-in of 1 on the LS148; (2) Pins 1, 2, 3, 4, 11, 12 and 13 (inputs 1, 2, 3, 4, 5, 6, 7) have a fan-in of 3 on the LS748 versus a fan-in of 2 on the LS148. The only ac difference is that t PHL from EI to EO is changed from 40 to 45 ns.

3.3.8 74LS138 Demultiplexer IC:

The LSTTL/MSI SN54/74LS138 is a high speed 1-of-8 Decoder/ Demultiplexer. This device is ideally suited for high speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three LS138 devices or to a 1-of-32 decoder using four LS138s and one inverter. The LS138 is fabricated with the Schottky barrier diode process for high speed and is completely compatible with all Motorola TTL families.

- Demultiplexing Capability
- Multiple Input Enable for Easy Expansion
- Typical Power Dissipation of 32 mW
- Active Low Mutually Exclusive Outputs
- Input Clamp Diodes Limit High Speed Termination Effects

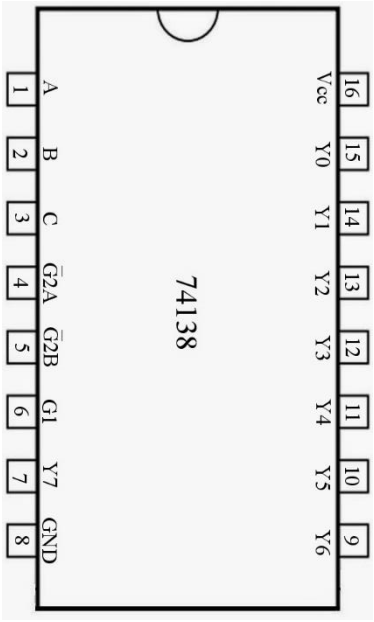

Fig.4.3.8: 74LS138 IC

3.4 Selection Criteria:

We will discuss the component used in block diagram of proposed system and its and its description is explained in this chapter.

3.4.1 Microcontroller

We require accuracy of microcontroller so we have used the Arduino controller. And also designing of the project is totally based on the robust so that person can handle that device easily Without knowledge of the internal circuit. Following table shows the comparison between general microcontroller and Arduino Controller.

Table no. 3.4.1: Microcontroller

General Microcontroller	Arduino Controller
IDE available	Own IDE available
Operating frequency: 12MHz	Operating frequency: 16MHz
Flash memory:16kb/32kb/64kb	Flash memory:32kb
Operating voltage:5v/5.5v	Operating voltage:5v
Low accuracy	High accuracy

3.4.2 Communication Module

Table no.3.4.2: Communication Module

IR Module	RF Module
Operate in Infrared region	Operate in Radio Frequency region
Operating Voltage:5v	Operating Voltage:3.3to5v
Operating range less	Operating range wide
Low accuracy	High accuracy

Chapter 4

Circuit Diagram

4.1 Circuit Diagram of Transmitter:

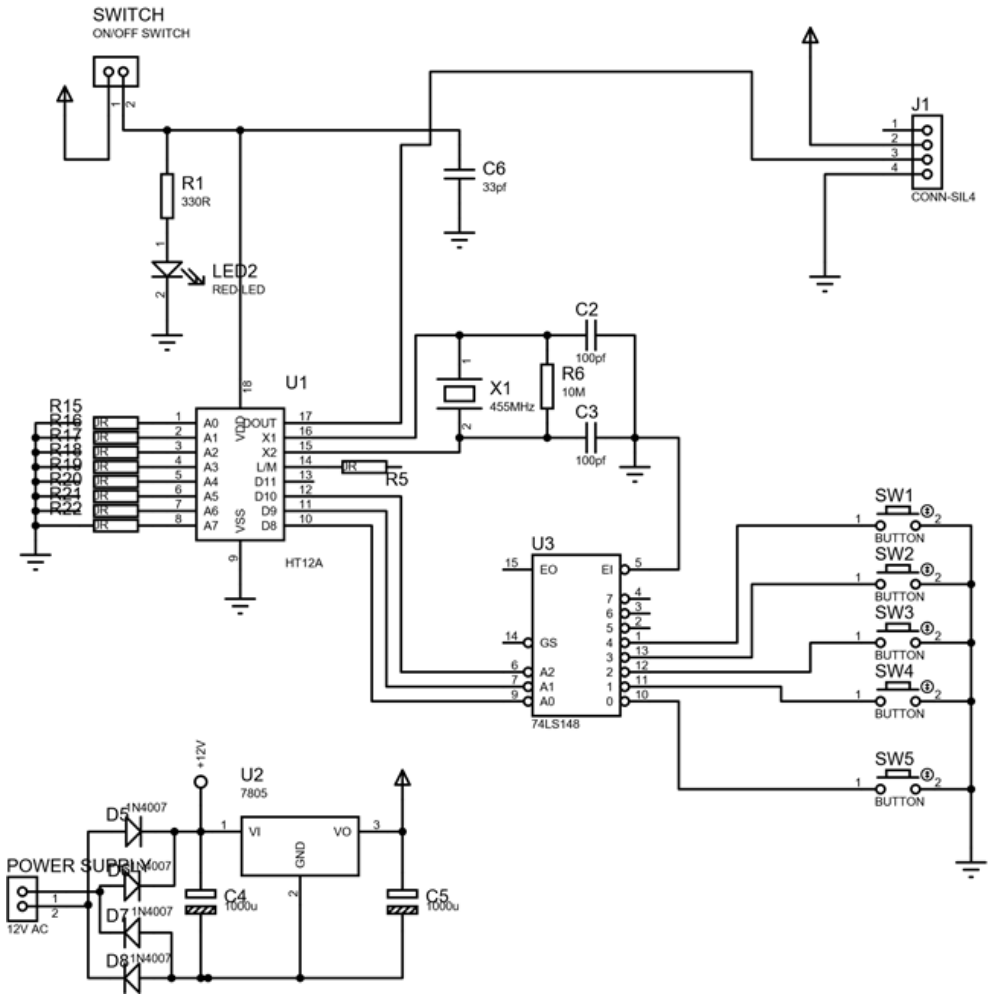

Fig. no.4.1: Transmitter

4.2 Circuit Diagram of Receiver:

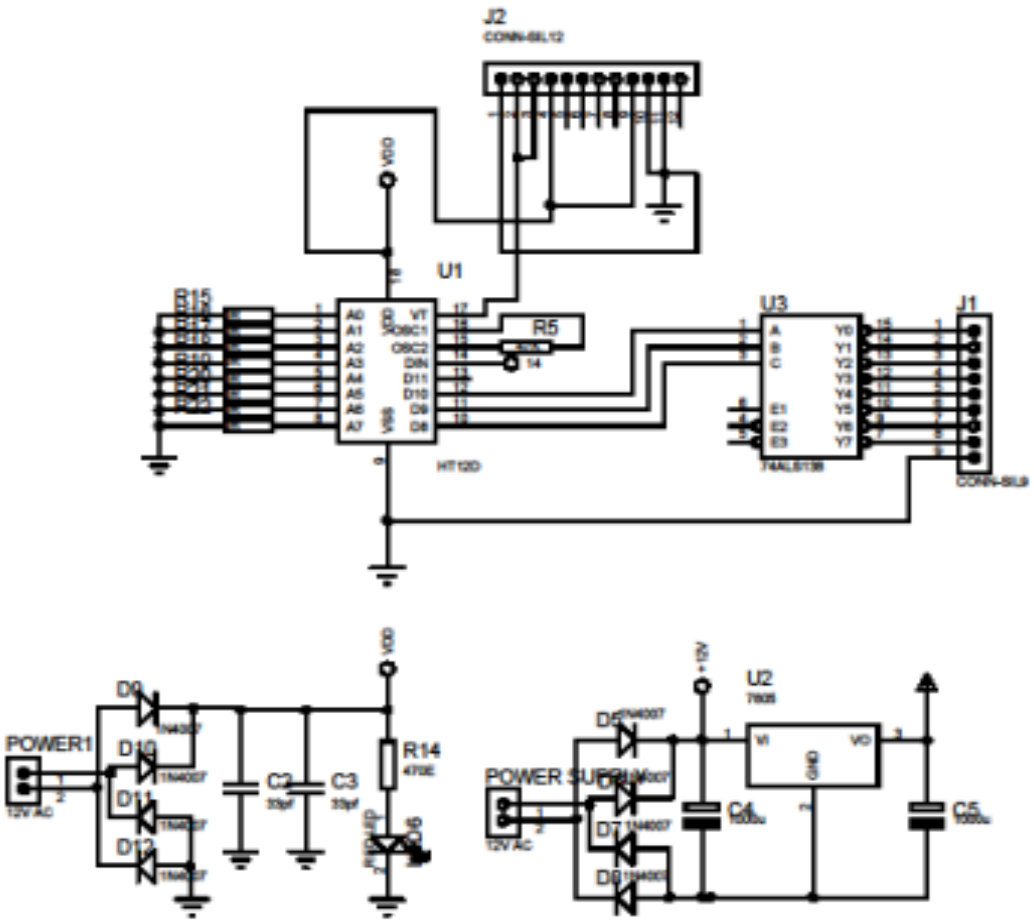

Fig.no.4.2: Receiver

4.3 Circuit diagram of relay driver:

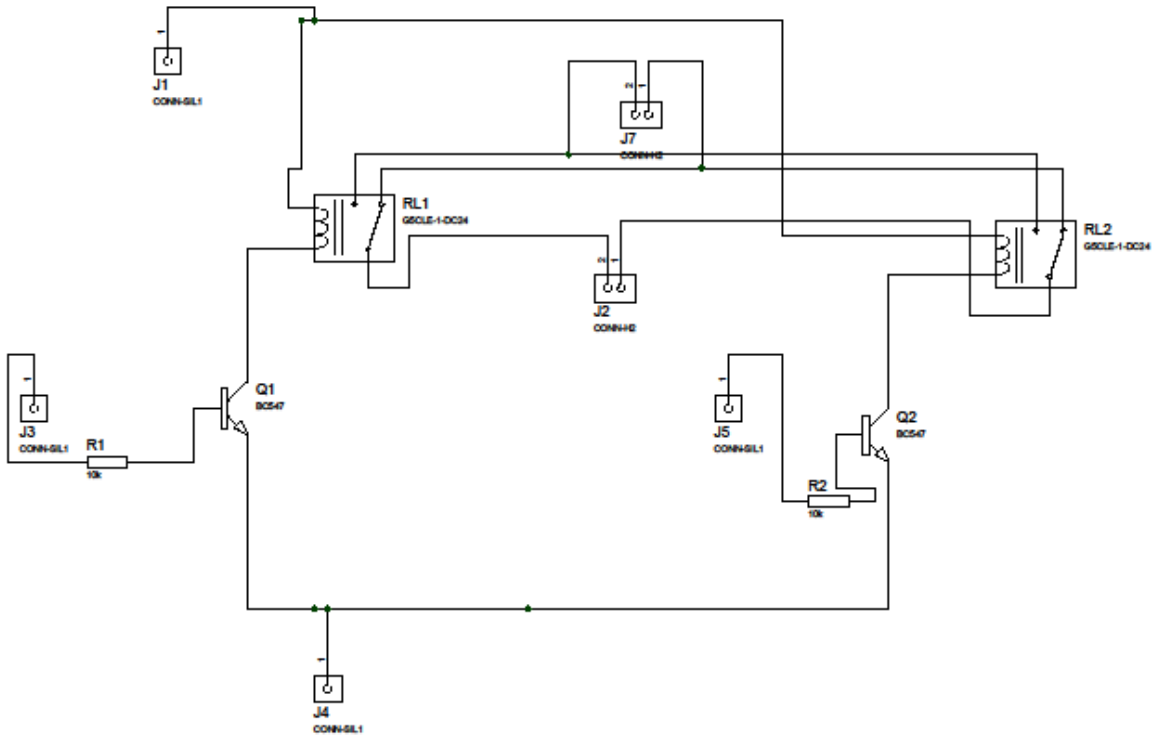

Fig.no.4.3: Relay driver

CHAPTER 5

PCB DESIGNING

5.1 General Description

The PCB layout for the circuit is attached. Board consists of insulating material coated with conducting material. Mostly copper- coated boards are used instead fo copper, silver and gold can also be used, but as copper is cheaper mostly it is preferred. The metal conducting pattern serves as connecting medium for electronic components that are assembled on the board components are mounted by leads passing through the holes that are drilled or punch on the based material and the foil. These leads are soldered to the conducting pattern to form complete PCB. The base or insulating material used for PCB is glass, glass epoxy paper, polyester, paper phenolic etc. The copper foil on the base meterial is developed by process of electrode position in etching process.

Some of the etchant are used as follows

1. FeCl3
2. Cucl2
3. Chromic Acid, etc
4. But FeCl3 is most commonly used in etching process.
5. PCB acts as a heat sink.

5.2 Artwork of PCB

Perfect artwork is most important process in production of PCB. The circuit is initially tested and location of component is fixed. Artwork is the drawing showing conduction pattern on PCB . After testing the circuit a rough layout is prepared on paper then that layout is transferred on PCB by using PCB aids. The artwork can also be prepared on transparent paper with sticking tapes and pads self- adhesive (stickers) in various ranges.

5.3 Filming of PCB

To prepare a PCB at home following procedure is adopted

Measure the dimensions of all components for e.g. Resistors Capacitor , Inductors, etc and prepare a layout by using components mounting rules

1. Using trace paper or carbon paper draws the mirror image of the figure.
2. Draw this mirror image on Cu coating of PCB by using PCB pen, pencil or tapes and pads then drill the hole by using drilling machine
3. After drying the paint put the PCB in FeCl3 solution for etching . If you want fast etching add some drops of HCL during etching unwated Cu is dissolved in FeCl3.
4. After etching wash it with water and if you to remove paint then use acetone.
5. Then mount the component on opposite sides of a track.
6. Cut the leads of proper length and solder all the terminals of the components.
7. In this way PCB is fabricated manually.

For PCB designing you should have following things

1. Detail circuit diagram
2. Physically each component with you
3. Determination of the size of PCB
4. Layout & Filming
5. PCB manufacturing
6. Bear board testing

5.4 Actual PCB designing

Cutting the larger copper clad plastes in required size Pieces accroding to the measurement of the actual layout of the circuit a small copper clad was also used for the power supply. Proper case should be taken while cutting the Copper clad should be symmetric.

5.5 Cleaning copper clad

For cleaning the copper clade ,first of all the fecl3 solution was completely me a dilute selution (by adding water fecl3).

Draw the PCB layout of the circuit on paper considering actual component size. Consider the actual size of the components and the conduction line the layout of the circuit was drawn on the paper. First of all we should consider the actual size of the integrated circuit, displays & many more. While constructing the layout it should be notice that

1. Fewer jumpers are more preferable because to make the circuits more compact, more neat in look.
2. For conducting line we should go for more caned line instead of 90-degrecue due to this also the circuit become more compact.

5.6 Tracing of layout from paper clad

First of all the actual circutit layout is taken on the tracing paper with exact dimension of the components. Now placing this tracing paper on the copper clad under a carbon paper traced the layout on the copper clad. It should be noticed that the tracing on the clad should be accurate.

5.7 Applying non-etching materials on the layout

Applying the non-etching materials on the layout is done manually . The non-etching materials are drafting ads, oil paints, etc . on the PCB drafting aids are used, because more linearity conducting are obtained. The drafting aids are different shapes & z-size for every components are should be no crack on the drafting aids, because due at this after etching there will be no conduction between two lines.

5.8 Etching procedure

After applying the non-etching on the copper clad then this copper clad is kept in the fecl3 solution for etching procedure. The etching procedure longs for the about 5 to 6 hours. During the etching procedure the copper under the drafting aids does not get etched, while all other copper on the clad gets etched & only the layout remain.

5.9 Cleaning the PCB & remaining non-etch materials

After the etching the cleaning of PCB is done. It is done with the help of the soap solution & brush to remove the transferred pattern with the cotton swab-dipped in pattern remover solution. Against wash with coup & water & dry it.

5.10 Drilling

After the PCB is ready, drilling is necessary. Drilling is done with the help of the hand drill or drilling machine. For mounting of components proper drilling (holes) are necessary. The holes are of the dimension so that the terminals of each component and pins of the JC can easily pass through it to make a contact with the conducting line on the PCB.

5.11 PCB Layout of Transmitter

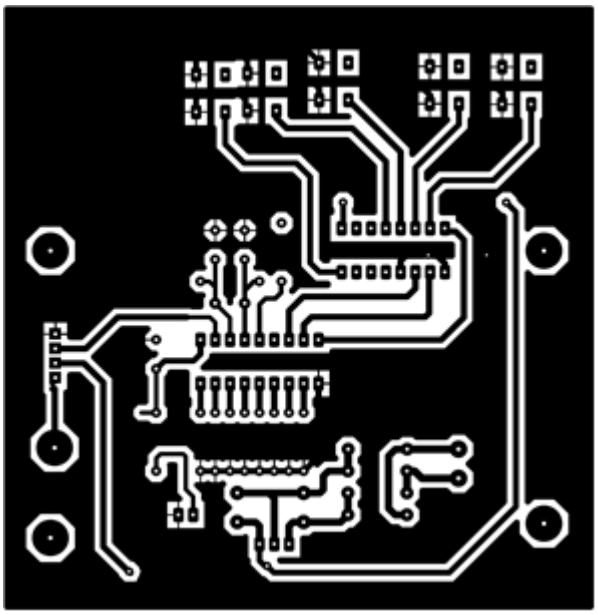

Fig.no.5.11: Transmitter

5.12 PCB Layout of Receiver:

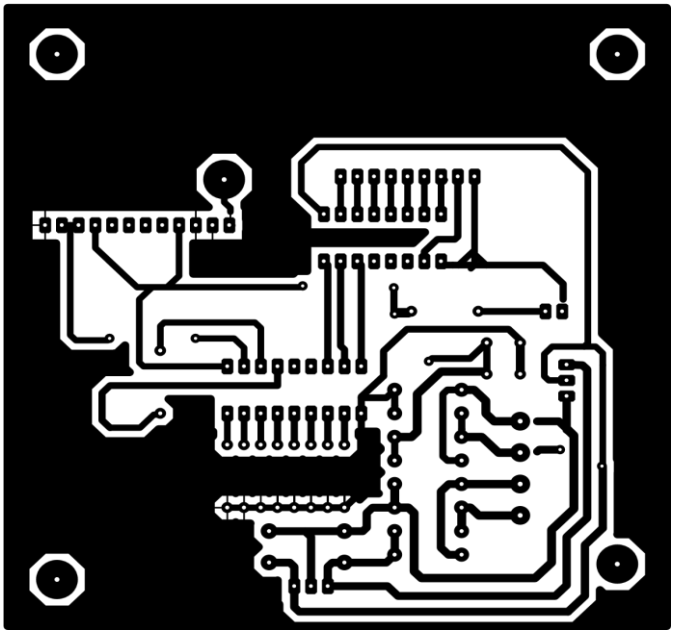

Fig.no.5.12: Receiver

5.13 PCB Layout relay driver:

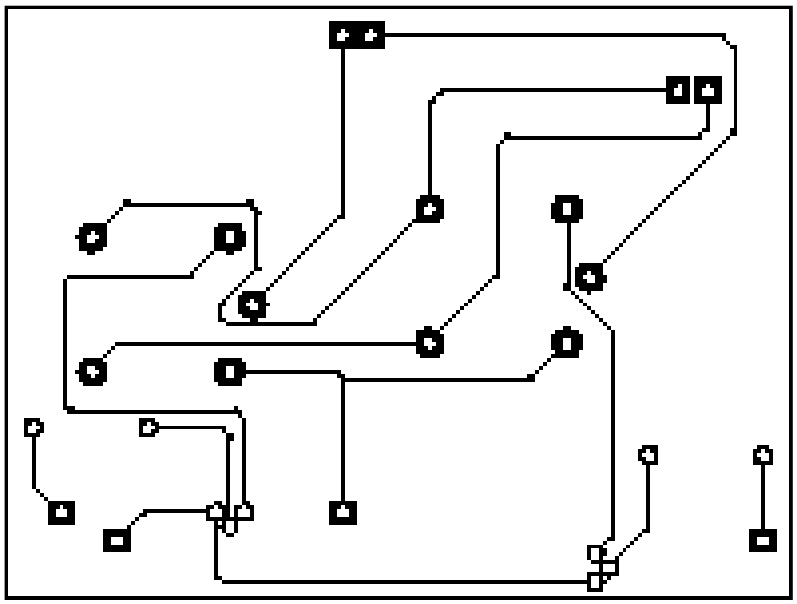

Fig no.5.13: Relay driver

CHAPTER 6

SOFTWARE DESCRIPTION

This project is implemented using following software‘s

Proteus 8 (Embedded C) – for designing circuit.

6.1 PROTEUS 8

Proteus 8 is a single application with many service modules offering different functionality (schematic capture, PCB layout, etc.). The wrapper that enables all of the various tools to communicate with each other consists of three main parts.

6.1.1 Application Framework

Proteus 8 consists of a single application (PDS.EXE). This is the framework or container which hosts all of the functionality of Proteus. ISIS, ARES, 3DV all open as tabbed windows within this framework and therefore all have access to the common database.

6.1.2 Common Database

The common database contains information about parts used in the project. A part can contain both a schematic component and a PCB footprint as well both user and system properties. Shared access to this database by all application modules makes possible a huge number of new features, many of which will evolve over the course of the Version 8 lifecycle.

6.1.3 Live Netlist

Together with the common database the maintenance of a live netlist allows all open modules to automatically reflect changes. The most obvious example of this is wiring in ISIS producing rats nest connections in ARES but it goes much further than that. The new Bill of Materials module contains a live viewer and the 3D Viewer and Design Explorer are also linked into the live netlist.

CHAPTER 7

Summary

7.1 Application

1. The robot can be used as a guider to guide the visitors from the entrance to main office.
2. The main purpose is to rescue the people by extinguishing fire in building.
3. The save the lives of fire man.
4. It warns the person against the intruder.
5. Useful in controlling fire at extreme place where human being cannot reach.

7.2 Feature scope

1. A CO2 booster can be attached to make it powerful extinguisher.
2. By using GPS communication range increases.
3. Speech assisted technologies also include.

7.3 Conclusion

Through this we can conclude that a robot can be used in place of humans reducing the risk of life of the firefighters. We can use them in our homes, labs, offices etc. They provide us greater efficiency to detect the flame and it can be extinguish before it become uncontrollable and threat to life. Hence, this robot can play a crucial role.

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