FIRE FIGHTER ROBOT USING THE RF TECHNOLGY

Project report submitted in partial fulfilment of the requirement for the degree of Bachelor of Technology

in

Electronics and Communication Engineering

by

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CERTIFICATE

DECLARATION BY THE SCHOLAR

We hereby declare that the work presented in this report entitled **"FIRE FIGHTER ROBOT USING THE RF TECHNOLGY"** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Electronics and Communication Engineering** submitted in the department of Electronics and Communication Engineering**, Jaypee University of Information Technology, Waknaghat India**, is an authentic record of my own work carried out over a period from August 2017 to May 2018 under the supervision of **Ms. Pragya Gupta,** Assistant Professor , Electronics and Communication Engineering Department.

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Alankrit Dubey, 141054 **Akash Luthra, 141058** **Vanshika Juyal, 141060**

This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Ms. Pragya Gupta
Assistant Professor (Grade II)
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We owe our profound gratitude to our project supervisor **Ms. Pragya Gupta**, who took keen interest and guided us all along in the project work titled – "**FIRE FIGHTER ROBOT USING THE RF TECHNOLGY**". We take this opportunity to express profound gratitude and deep regards to our guide for his exemplary guidance, monitoring and constant encouragement throughout the course of this project. The in-time facilities provided by the Electronics and Communication department throughout the project development are also equally acknowledgeable. At the end we would like to express our sincere thanks to all my friends and others who helped me directly or indirectly during this project work. The project development helped us in research and we got to know a lot of new things in the domain.

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LIST OF ABBREVIATIONS

PCB:	Printed circuitry board
RF:	Radio Frequency
UV:	Very High Frequency
UHF:	Ultra High Frequency
Hz:	Hertz
kHz:	Kilo Hertz
rms:	Root Mean Square
dB:	Decibel
IC:	Integrated Chip
DO:	Digital output
IO port:	Input-Output port
GND:	Ground

ABSTRACT

The project is supposed to be developed as a household or the industrial fighting automation robot that makes use of the RF technology in order to perform remote operation. This robotic vehicle is laden with a water tanker on its top and a pump here is the device that is controlled by wireless communication technology to pitch water on the fire. An 8051 series of the microcontroller is employed for performing the specified operations. On the transmitter side, there are the push buttons, from which the command is directed to the receiver antenna so as to drive the robot either in the forward direction or the backward direction. At the receiving device there are 2 dc motors that are interfaced will the motor driver IC L298 which in turn is interfaced with the microcontroller. These 2 dc motors are attached in order to assist the movement of the vehicle in multiple directions.

In this project, the RF transmitting module will act as a part of the RF device that gives us the benefit of covering suitable distance that vary (till two hundred meters) with precise antenna, whereas the receiver device will decode it before it is sent to the microcontroller which drive the DC motors via motor driver IC for performing the movement operations. A storage tank with the brushless water pump is mounted on the automaton body of the robot whose operation is decided from the microcontroller output with an applicable signal from the transmitting controller of the robot. The entire operations of the firefighter robot are controlled by an 8051 series microcontroller. The motor driver L298 IC is also interfaced with this microcontroller which act as the brain of the robot in controlling the motors and the whole device on a whole.

Further, the project is intended to build up a firefighting robot utilizing RF innovation for performing different remote activities. The RF transmitter is the basic component as the RF remote will be controlling in the project, that is advantageous as it will be able to cover large range of distance (ranging from 20-30 meters), while the received signal is translated before sustaining it to the microcontroller to drive DC engines by means of the motor driver IC L298 to perform the primary task of extinguishing the fire.

CHAPTER 1
INTRODUCTION

1.1 Overview to Robotics

A Robot particularly acts as a mechanical tool that is equipped with multiple operations for performing different types of human activities or acting as a human in different situations. Making of a robot requires a personalized ability and also the composite programming technique. The device will also be interfaced with the other framing components like accumulating engines, fire sensors, and jumpers. A fire contender robot is one that has a little fire douser fixed in the forward central part of the robot. By connecting a little fire detector on the robotic vehicle, the robotization with the human controlling from the control rooms puts out the fire. These operational tasks are covered in the outline and development of a robot that can detect and stifle fire.

This robot executes the accompanying ideas that may vary from performing ecological detecting or for relative engine control. This robot collects data of different sensors and components through this microcontroller. In the project, we have made use of the Fire sensor that is the substitute to the thermistors or UV or the Infrared fire sensor to decide any fire mischance. A robot equipped for application is case of any fire at places, where the human brigade reach is slight impossible or is difficult such as in case of industry fire and military applications are the ones. Here, these robots play a key role in extinguishing fire. This fire sensor will be utilized for detecting fire in the surroundings of its region. Once the fire is identified, the robot will start its operation, such that the buzzer will get activated and the alarm will start to ring. The pump gets activated and the robot thus will incite the electronic valve that will be liquidating sprinkles of water on the fire set area.

The undertaken project produces benefits and gives us the additional in applying automation while working onto a functional and realistic solution for protecting lives and relieve the from the danger that is caused due to the property harm. Fire contenders confronts the hazardous circumstances when dousing fires and thus protecting casualties, which is truly an inescapable device of being a fire warrior. Interestingly, this robot can also work independent from anyone

else or be controlled from a larger distance from a control room, which implies that firefighting and safeguard exercises could be executed without putting fire warriors in danger with usage of the technology by utilizing the robot innovation in this modern world.

This robot incorporates the dc motors, a castor wheel loaded at the front end, the microcontroller, fire sensor, water pump, and sprinkler at the head side. The microcontroller here acts as the core of the whole fire extinguishing operation. The microcontroller controls every part on the device by programming it in such a way that the desired operations are successfully completed. In this robot as the fire sensor is able to successfully detect the fire, it sends the signal of this fire to the microcontroller. When the microcontroller gets the flag indicating fire in the surroundings of the robot, a ringer sounds from this robotic device, the bell sound is actually heard to hint the event of flame mischance to the people. After the meeting of the signal, microcontroller impels the driver circuit and the human will be directing the robot towards the smokestack, and as the robot comes closer to the fire, the microcontroller incites the hand-off to the water pump switch which is made ON and water is sprinkled on the fire will the use of the nozzle.

1.2 Why do we need robot?

The real reasons why mechanical technology will be the technology of our future, and a fundamental one? While the democratization of robots is rendering them more present in our day by day lives, a great many people have still blended sentiments about what's to come. Numerous whole-world destroying films have portrayed a future where either the robots are annihilating the people or subjugating them. Maybe a couple (or even none) have done the inverse. In other words, delineating the advantages of a general public brimming with robots, and its certainty.

Robots will be our settlers

Robots are as of now investigating the immeasurability of room for us. Regardless of whether as tests or as on-the-ground wanderers, they enable us to improve comprehension of what's out there. Because of the advance in space travel, joined to those of mechanical autonomy and manmade brainpower, the cutting edge won't be simply logical robots.

No, the people to come or robots will be our pioneers. They will be land framing a planet to make it tenable for a province. Building the basic frameworks for our survival: oxygen, water, and sustenance producing frameworks. Yet in addition, our homes, our streets, our correspondences arrange, essentially making the entire settling conceivable and reasonable and working resolutely to accomplish their undertaking.

We can't consider settling on another planet without these basic frameworks to maintain the principal comers. Not just the assignment would be too extensive to be embraced by a modest bunch of people, yet the hazard and weight would be too substantial to manage. Robots are what make the life past Earth and in this manner our species survival, conceivable.

Likewise, we require robots to enable mankind to hold up under the difficulties of today and tomorrow. As we know that the robots will enable us to adapt to the demography trouble all nations will look after they finish their statistic change. Also, as they get more astute, they will enable us to center not around work and riches generation, but rather on self-change and human associations. To wrap things up, they will help guarantee our species survive and blossom with another planet.

Thus, we can say that the robots are not just “nice to have” as the machines. Instead, they are mandatory, and we need to use them.

1.3 Introduction to RF Technology:

A Radio Frequency (RF) signal refers to the form of the wireless electromagnetic signal used as a form of communicating device. The radio waves that are generated from the EM signals are actually the electromagnetic radiations that have a recognized radio frequency ranging from 3kHz to 300 GHz. Recurrence indicates the rate of RF propagation which will be taking place will the speed that will be similar to that of the light. This RF propagation does not require a medium such as the air so as to make its movement possible. RF waves are generally transmitted from energy transmitted from the rays of the sun, lightning process, or even from the stars in space. All these transmits RF waves in the form of energy give and take phenomenon. The RF device acts as a correspondence to communicating device that is utilized in multiple enterprises that will include TV broadcasting, transmission of radar signals,

Personal Computer or the laptops sharing data with other wireless devices or in the remote control and many more general applications.

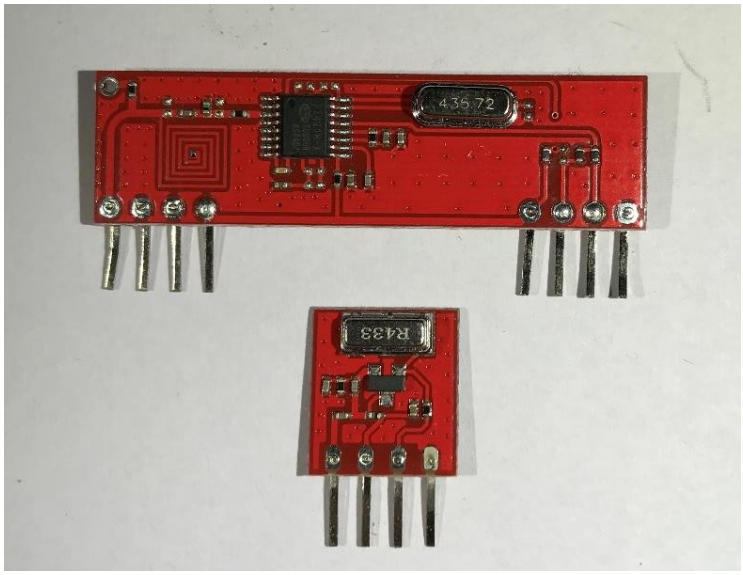


Figure 1: Radio Frequency (RF) modules

1.4 Components Required:

The main building blocks of the project are:

1.4.1 RF Remote

- PCB Board
- RF Transmitter
- HT12E Encoder
- DIP Switch
- Diodes
- Resisters
- Capacitor
- Transistor
- Push Buttons
- Keys for direction
- Wire

- Battery 9V

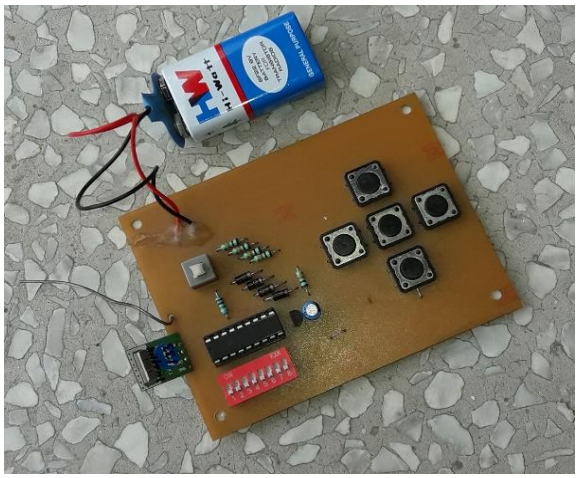


Figure 2: The Transmitting Station

1.4.2 Robot Vehicle

- PCB Board
- Fire Detector (IR Reciever)
- 8051 Microcontroller
- HT12E Encoder
- DIP Switch
- ULN2803 Transistor array IC
- Voltage Regulator LM7805
- Crystal Oscillator
- L298 Motor Bridge IC
- 45 RPM Straight DC motor 2
- Pin Header Connectors
- Network Resistors A103J 2
- Relay
- LED 3
- Transistors

- Resistors
- Capacitors
- Push Buttons 2
- Diodes
- Rechargeable Battery 2

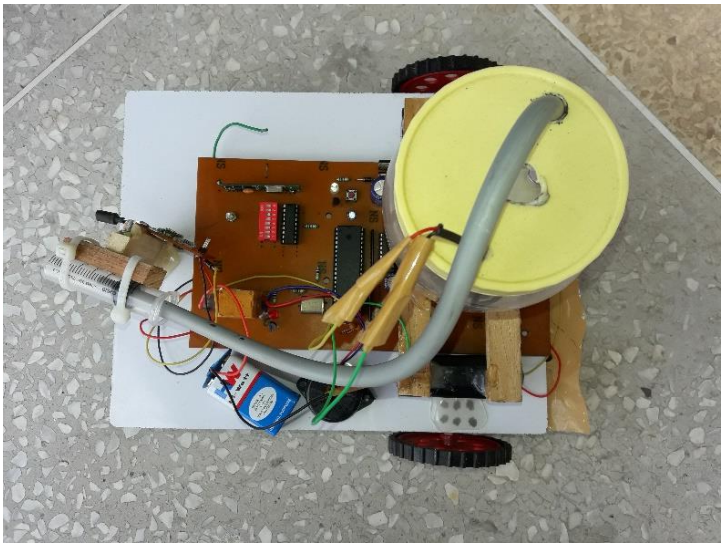


Figure 3: The Receiver Station

1.5 Fire Detector:

In this project, we have utilized thermistor, ultraviolet or the Infrared fire sensor to recognize any of the fire mischances. The robot is skilled of extinguishing fires that are caused at places where human reach is difficult such as in the case of fire inside a tunnel or the industrial fire and in case of military applications are also outlined and assembled. It can recognize the fire or the light with the wavelength at the scope of 760 nm to 1100 nm. The identification edge is around 60 degrees, to a great degree delicate to the firing range. Fire sensors will be utilized for starting the detection of the fire. Once the fire is distinguished or detected, the robot buzzer gives us the caution of fire in the area, and thus the water pump is activated as it starts the scattering nozzle valve which will be discharging sprinkles of water on the fire.

Sensitivity will always be adjustable in the fire sensor. (The adjustor, appears in blue computerized potentiometer form) The comparator yields the clean flag, great waveform, the

solid driving capacity of more than 15mA. With a flexible accuracy potentiometer to modify the affectability. Working voltage:3.3V-5V. The yield frame: DO advanced exchanging yields (0 and 1).

Specifications:

The fire sensor is most touchy to fire, and it will likewise react to customary light for the most part utilized as a part of flame caution and different purposes. A little board yield interface can be specifically associated with the microcontroller IO port. The sensor ought to be kept a specific separation from the fire, so as not to harm the sensor due to high temperature the test remove for the lighter fire ought to be 80cm, the bigger the fire, the bigger the test remove.

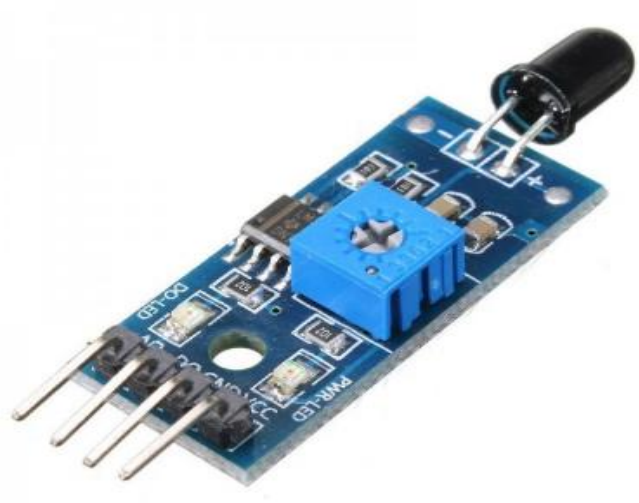


Figure 4: The Fire Detector

CHAPTER 2
SYSTEM DESIGN

This project named “Firefighting robot using the RF Technology” is going to allow a user to control this robot which is equipped with the water tank and nozzle on the front. The three-wheel vehicle is controlled remotely from the transmitting remote wirelessly for using it in the application of extinguishing fires. Overall, the system makes use of this RF remote for remote operation that is used for operating the robotic vehicle and water storage device that pumps out water at the time of fire break-outs. The rf based remote basically encode the user commands through the rf signals which are remotely received by the receiver circuit. The receiver circuit will now be decoding the whole data commands sent by the transmitter and forward the signal on the microcontroller. Now the microcontroller will decode these instructions as transmitted and will further instruct the 2 vehicle motors allowing us to run the vehicle in desired instructed direction. The robot also operates the pump which will start its operation and spray water either automatically or on the command of the user, allows him to operate the robot and puts off the fire from a safe distance away from the fire. This robot operates within a range of 20-30 meter from the remote.

2.1 Block Diagram:

The fire fighter robot has the specific block diagram that incorporates all the control devices used in making the fire fighter robot.

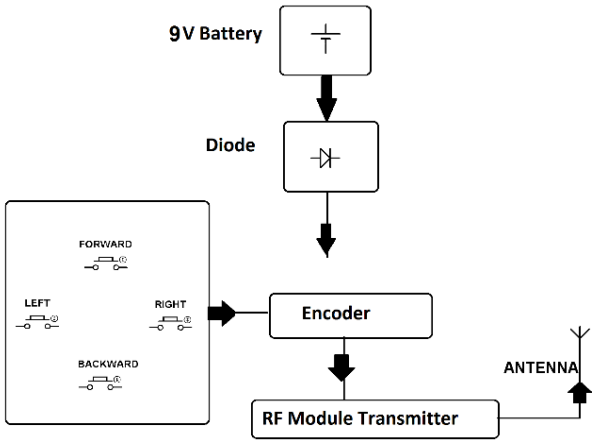


Figure 5: Block Diagram of Transmitter

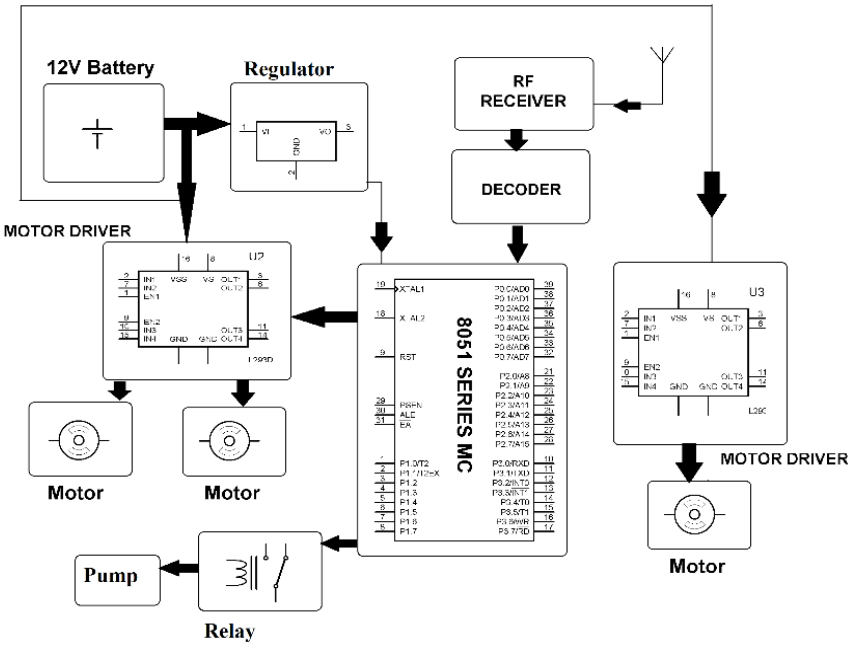


Figure 6: Block Diagram of Receiver

2.2 RF Technology

We know that the Radio Frequency (RF) signal refers to the form of the wireless electromagnetic signal used as a form of communicating device. The radio waves that are generated from the EM signals are actually the electromagnetic radiations that have a recognized radio frequency ranging from 3kHz to 300 GHz.

In this project we have made use of the RF module (R433), that comes in the group of two, the transmitter module and the receiving module. These two component forms the complete RF Modules that are used in communication of the 2 parts of the robot:

1. The Transmitting Remote
2. The Receiving device (the Robot)

Below is the flow chart of how the RF communication takes from in the controlling components of this

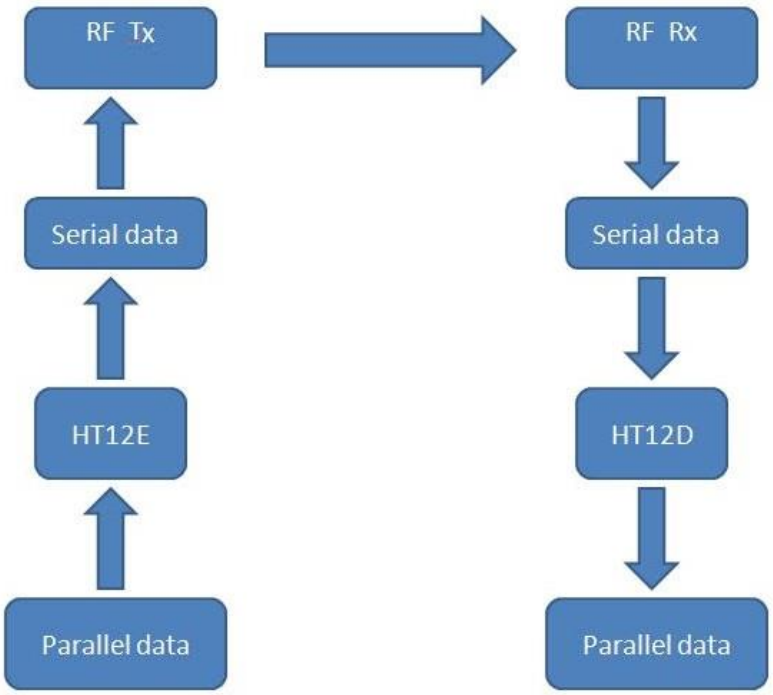


Figure 7: Flow Chart of RF Technology

2.3 Encoding and decoding of Signals

Now, we know that the data that has to be transmitting is in some form that is different from the one that is required by us. So, we make use of certain coding technique so that data that we want to transmit, is easily understood by both the machine as well as we humans. This happens by performing of two simultaneous operations that are

(A) Encoding of Signals
(B) Decoding of Signals

Now the question arises, what do we mean by the encoding and decoding of signals?

In modest language, encoding can be termed as wrapping up of the data. This data can be anything like either it can be our simple binary data (that is in the form of 1's and 0's) or it can either be a text patterned signal or else it can be in the form of the audio signal. Coming to the working of our robot, we are here considering only the type of encoding that is used only for

the conversion of binary signals. The wrapped data is termed to be known as a **Packet**. These packets are sent through the medium that can be wireless medium in the form of rf signal or it can be the wired signal either. Onto the decoder part this data gets unwrapped or what we call that, it is decoded. This decoding means that our data is converted back to its normal form that was before the start of encoding process. This is what is also explained in the block diagram of RF communication technique.

This is exactly comparable to the example of posting of an envelope. Whenever to place our letter into an envelope, it is termed as Encoding. When a postmaster comes to take this envelope, he acts as the medium for transmission, and lastly, decoding is the process whenever the recipient opens the envelope and reads it.

2.4 Fire Sensor

We have used an **IR Sensor** that works as the fire sensor used to detect the fire. Now, one would be estimating how can this be possible? Guess what! Whenever the fire burn takes place, the fire will lead to release of some quantity of Infra-red ray/light. The light will be acknowledged by the IR receiver connected with the sensor module of our robot. Then we use an Operational Amplifier circuit, in order to check for any change in voltage across our IR Receiver. This IR Sensor will be detecting the fire on the output pin (OUT) that will give 0V(LOW), is case of no fire detection and will be giving 5V(HIGH) on the output pin, whenever the sensor detects fire.

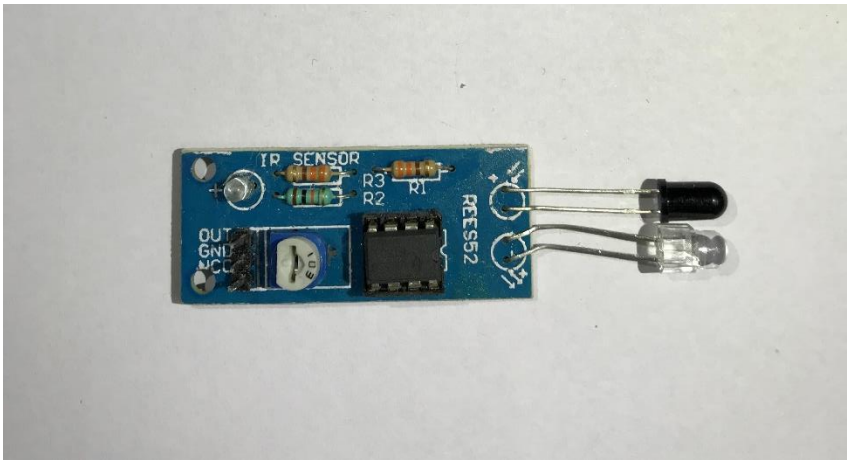


Figure 8: IR Sensor

2.5 Motor Driver IC

The motor driver IC (L298) attached on the robotic vehicle PCB Board is interfaced with the microcontroller 8051 which instructs the IC to drives the motors for the movement of our robot. L298 IC is a dual structured, H-bridge motor driver IC. We first, will have to detect the region of the fire at which the fire breaks out by continuous movement of the robot or by fixing certain no. of fire sensor around the robot. We make use of the dc motors to move the vehicle by making the wheels to rotate. When we reach near the fire by driving our robot through the use of this **L293D module**. Then pump is prompted to start its operation to put this fire out by sprinkling water. Using the container to carry water, a 5V brushless water pump is also fixed inside the container.

We made use of two 5V rechargeable lead acid batteries that are used for giving the power to the 2 motors and 2 numbers of 9V batteries are used for driving the transmitter and the receiver.

The motor RPM is 45.

2.6 Circuit Diagram

Circuit diagrams of the following transmitter and receiver circuits are as follows:

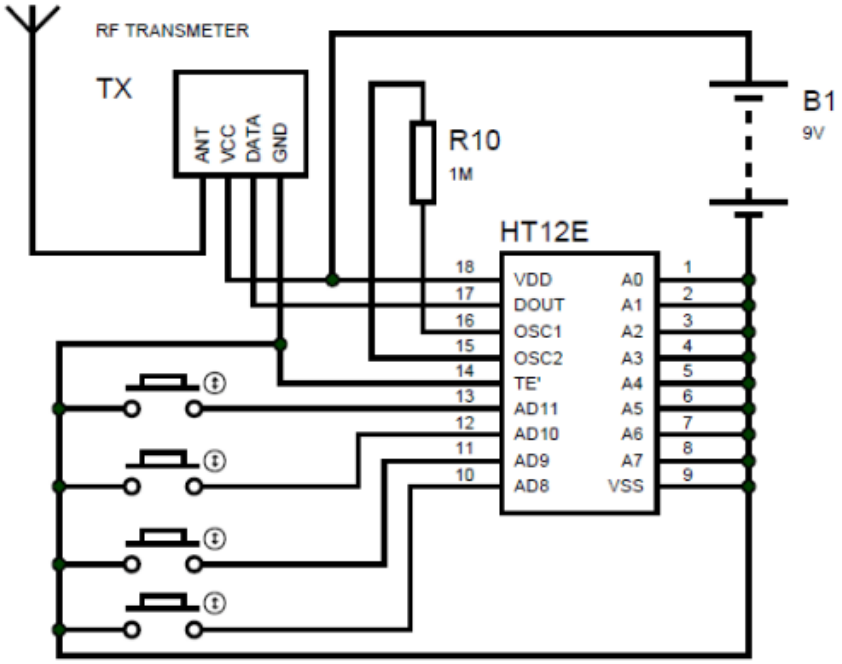


Figure 9: Transmitter Circuit

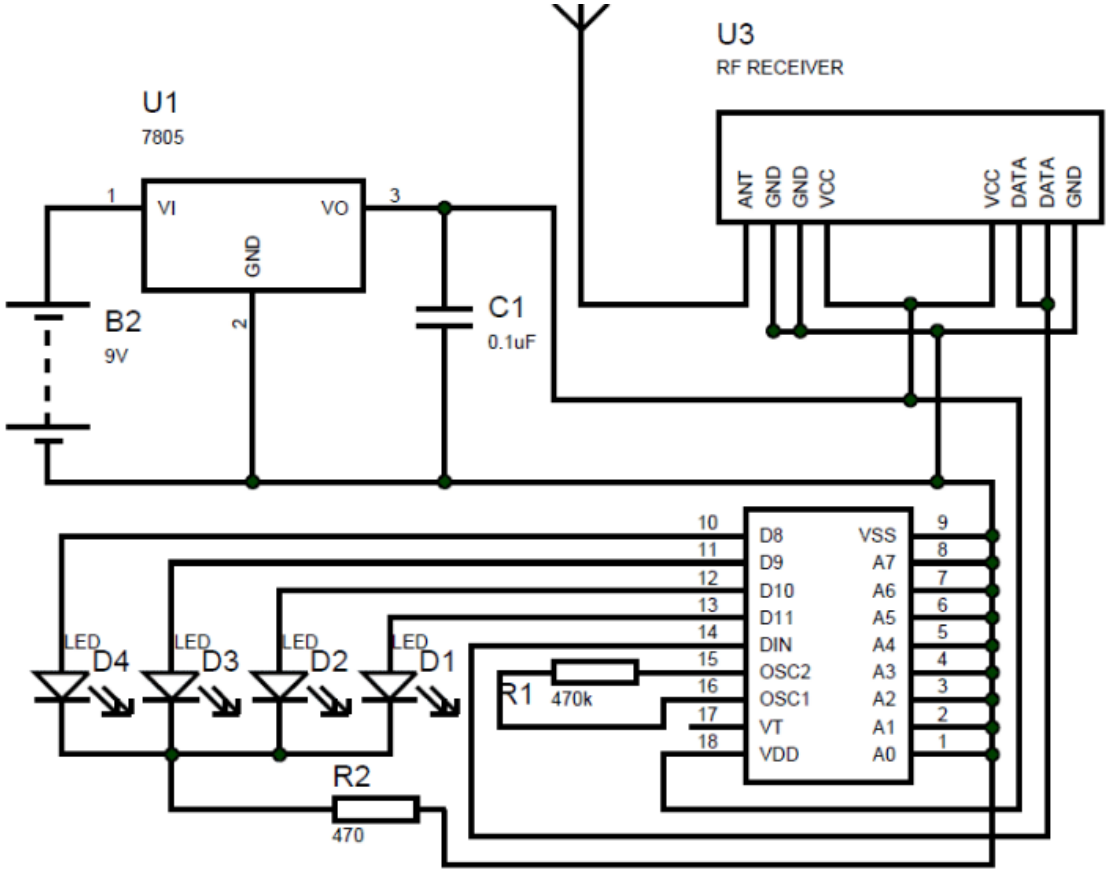


Figure 10: Receiver Circuit

Now after we have developed the block diagram, the circuit diagram for our project and also discussed briefly about various number of important component that were required in the designing of our project. In the further chapter we will explain in details the components that allowed us smooth formation of this project.

CHAPTER 3

The Transmitting Station

(Control unit)

The transmitting station is essentially the control unit in this project that is the transition point of all the important decisions that needs to be taken and that so, whenever the human being directs for the movement of the robot. It does so by wirelessly transmitting the information to the receiver station.

3.1 Flowchart

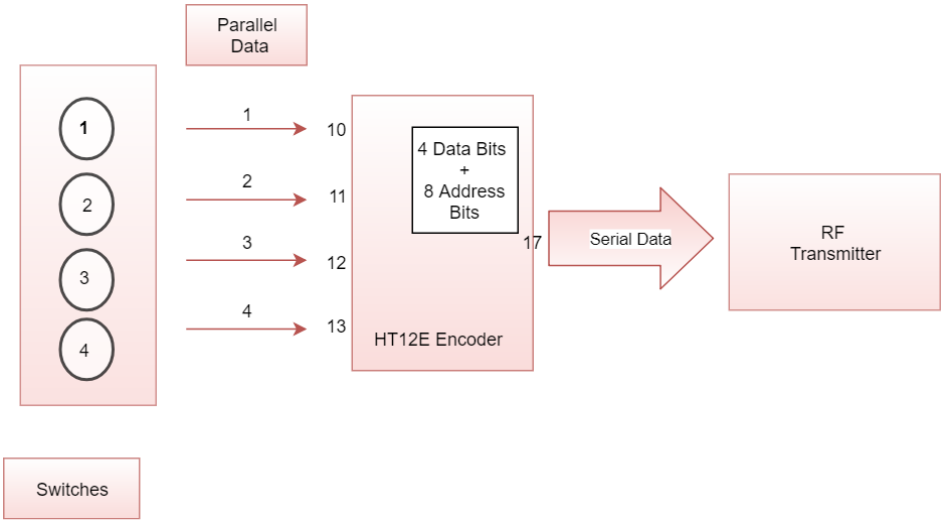


Figure 10: Flowchart of the Transmitting Station

3.2 Theory of operations:

RF remote acts as the brain to the robot, where the transmitting control circuit works on the principle which states that whenever we press any button on the remote, the transmitter section generates the matching RF signal that will encoded in the desired form and this signal will then be received by the receiver section, decoded back to the original required form and hence performing the further stated operation as stated in the requirement for the robot.

In performing the desired operation, the 4-channel encoder decoder module pair HT12E and HT12D are used for this system design. The input signal from the transmitter section is

received from any of the five switches and the output signals received by the receiving antenna is sensed from the further movement of the robot, plus execution of extinguishing operation caused by detection of fire by our robot device.

Conversion to an appropriate form at this receiver, means that the encoder IC HT12E is used to convert the parallel data into serial form. This data will be transmitted serially to receiver point through radio Frequency module (RF). The robotic vehicle receives this data serially which is then given to the HT12D decoder IC which plays the role of converting this data into parallel.

The RF transmitting module will act as a part of the RF device that gives us the benefit of covering suitable distance that vary (till two hundred meters) with precise antenna, whereas the receiver device will decode it before it is sent to the microcontroller which drive the DC motors via motor driver IC for performing the movement operations.

3.3 RF Transmitter

First and foremost, we need to know is that the RF technology can be called the brain of this project. This is because, the communication between the two stations is one of the primary tasks in the working of the robot.

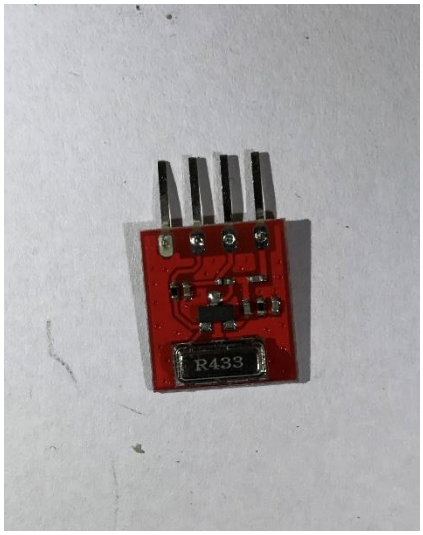


Figure 11: RF transmitting module

Where, the actual transmitting station looks like the one in the below figure.

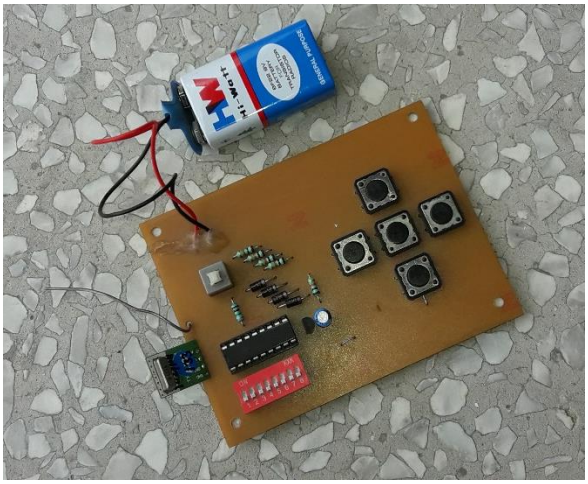


Figure 12: RF transmitting Station

RF Tx Module: RF Transmitter (R433) is used in the remote to transmit signal wirelessly to robot via the remote control. It transmits the signal received from the keys by encoding the signal in suitable form and thus send it to the receiver device.

Features of Tx-Rx 433 RF Modules:

- Range without any physical distraction: 100 Meters
- Frequency of the Receiver: 433 MHz
- Sensitivity: 105 dBm
- Current Supply: 3.5 mA
- Operating Voltage: 5V
- Output Power: 4 ~ 12 dBm
- Low Power Consuming
- Easy for Application

3.3.1 Pin Structure

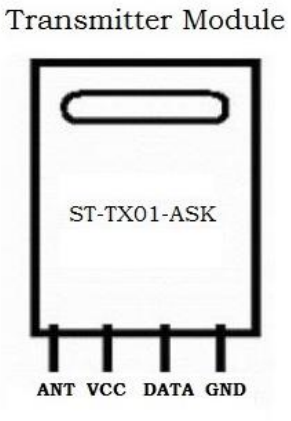


Figure 13: Pin Diagram of RF Transmitter Module

PIN Description

Pin No.	Name of the pin	Function Performed
1	Ground Pin (GND)	Ground (0V)
2	Data Pin (DATA)	Serial data input pin
3	(VCC)	Supplied voltage: 5V
4	Antenna Pin (ANT)	Antenna output pin

Table1: Pin Description of RF transmitter module

3.4 HT12E Encoder IC

HT12E is a 24-pin (12*2) encoder IC that is extensively used in construction of the required remote controller. This is further used in many number of applications of Radio Frequency. This IC is also responsible for converting our Parallel input data of 12-bit into the output of serial form.

These Parallel input data pins of 12 bits are classified such that there are:

(A) 8 address bits: A0-A7, and

(B) 4 data bits: AD0-AD3.

With the assistance of the four address pins (AD0-AD3), we are able to offer 8-bit security code for our protected data transmission amid the encoder, the decoder. But an important thing we need to keep in mind is that the encoder and the decoder IC should use make use of the same address and also the same data format while carrying out these basic operations. HT12E Encoder IC is skilled such that it can cover a wide voltage range ranging from 2.4V to 12V.

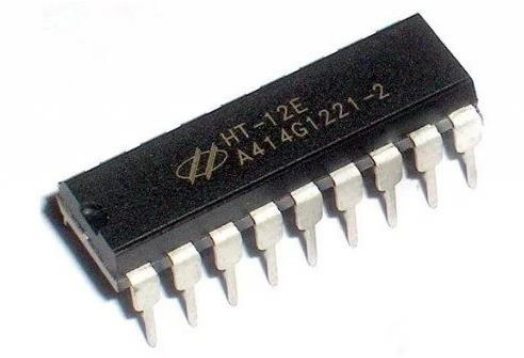


Figure 14: HT12E Encoder Pin

Pin Description:

The pin Description of the IC HT12E is as follows:

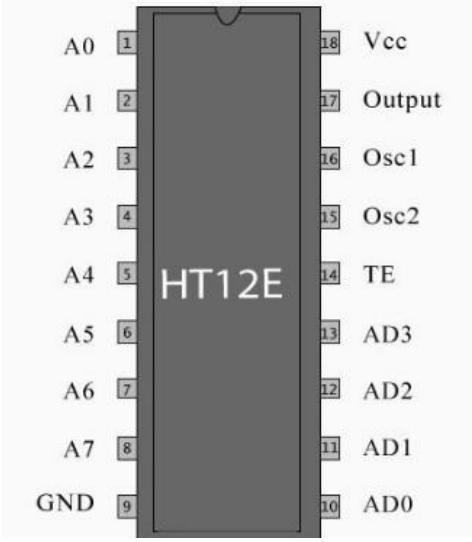


Figure 15: Pin description of HT12E Encoder

The Characteristics of all 18 pins are as follows:

Pin No	Function	Name
1	8-bit Address pins for input	A0
2		A1
3		A2
4		A3
5		A4
6		A5
7		A6
8		A7
9	Ground (0V)	Ground
10	4 bit Data/Address pins for input	AD0
11		AD1
12		AD2
13		AD3
14	Transmission enable; active low	TE
15	Oscillator input	Osc2
16	Oscillator output	Osc1
17	Serial data output	Output
18	Supply voltage; 5V (2.4V-12V)	Vcc

Table 2: Pin Description of HT12E

(1) **VDD:** Positive power supply pin.

(2) **VSS**: Negative power supply pin.

(3) **TE**: Pin that is used for enabling the transmission.

(4) **A0 – A7**: Input address pins, for the secured transmission of udata.

(5) **OSC1** and **OSC2**: Input and output pins for the internal oscillator.

(6) **AD0 – AD3**: Address pins required to feed data into the IC.

(7) **DOUT**: Output pin.

Operation of HT12E:

HT12E begins working with a low flag on the TE pin. After it gets a low flag, the HT12E begins the transmission of 4 information bits. Furthermore, the output cycle will be reworked in view of the status of the TE pin in the Encoder IC. In the event that the TE pin holds the low

flag the cycle is reused as long as the low flag in the TE pin exists. The encoder IC will be on standby mode if the TE pin is crippled and subsequently the status of this pin is actually fundamental for the whole encoding process. The address of these bits can be set on the A0 – A7 and a similar plan ought to be utilized as a part of decoders to recover the flag bits.

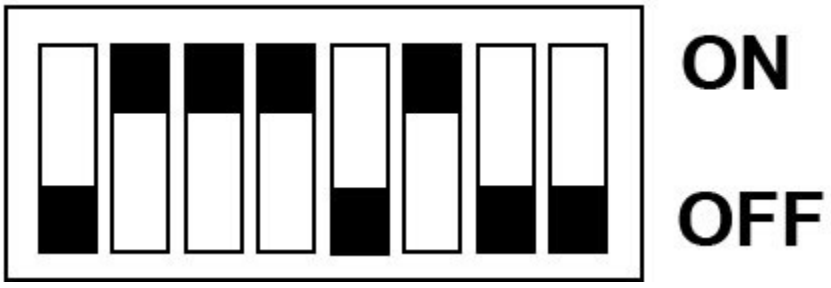
3.5 DIP Switch

A DIP switch, is defined as the dual inline package switch that consists of a set of manual electrical switches that are designed to hold configurations. It is also used to select the interrupt request (IRQ) from the encoder or the Decoder ICs.

Figure 16: DIP Switch

DIP switch is usually mounted on the surface on PCB board or on the breadboard with 8-bit data pins and these DIP switches are used in those bids where multiple numbers of switches are involved in generation of the output. For instance, in case of the remote control, the DIP switch is used to set the data of the binary bits according to the output device that is to be operated.

A computation DIP Switch is as someone like the below figure:



CHAPTER 4

THE RECEIVING STATION

(FOUR WHEELED ROBOT)

The receiver station is essentially the main unit of this project that performs all the important operations that it is assigned. The human being will only direct the operation to the receiver station, which when received by the robot and onto the inputs pins of the microcontroller. This microcontroller will direct the movement of the model and other desired operations that is detecting fire, functioning of the water pump, fire alarm, water gun and all others.

4.1 Flowchart

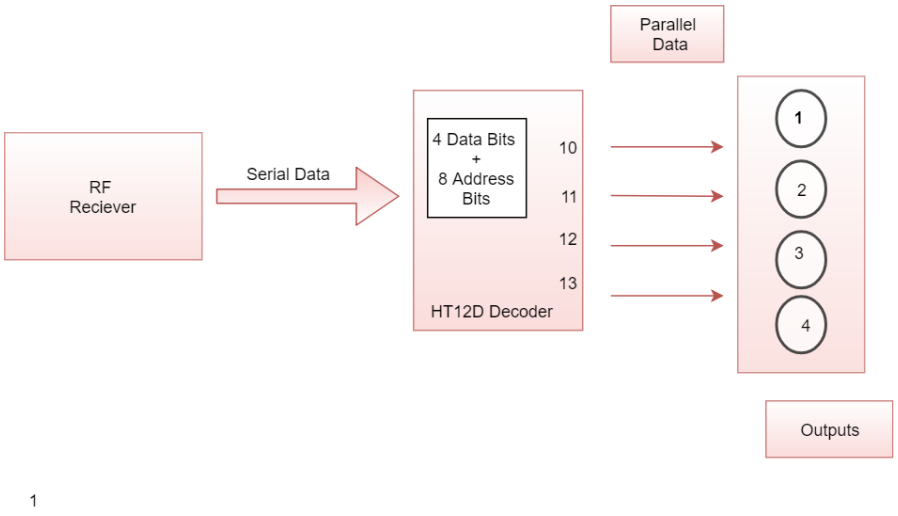


Figure 17: Flowchart of the Robot device

4.2 Theory of Operations:

On the receiving station i.e. the robot device, we see how the movement of the robot is controlled by the two independent dc motors build on cardboard chassis casing this PCB electronic circuit over it.

The RF transmitting module will act as a part of the RF device that gives us the benefit of covering suitable distance that vary (till two hundred meters) with precise antenna, whereas the receiver device will decode it before it is sent to the microcontroller which drive the DC

motors via motor driver IC for performing the movement operations. A storage tank with the brushless water pump is mounted on the automaton body of the robot whose operation is decided from the microcontroller output with an applicable signal from the transmitting controller of the robot. The entire operations of the firefighter robot are controlled by an 8051 series microcontroller. The motor driver L298 IC is also interfaced with this microcontroller which act as the brain of the robot in controlling the motors and the whole device on a whole.

4.3 RF Receiver

After having discussed about the RF transmitter we need to know that the RF receiver module complete the pair of Tx-Rx parts of the RF circuit. Both these components are supposed to communicate at same operational frequency, so that the communication can conveniently take place. We should also know that the RF technology can be termed the brain of this project. This is because, the communication between the two stations is one of the primary tasks in the working of the robot.

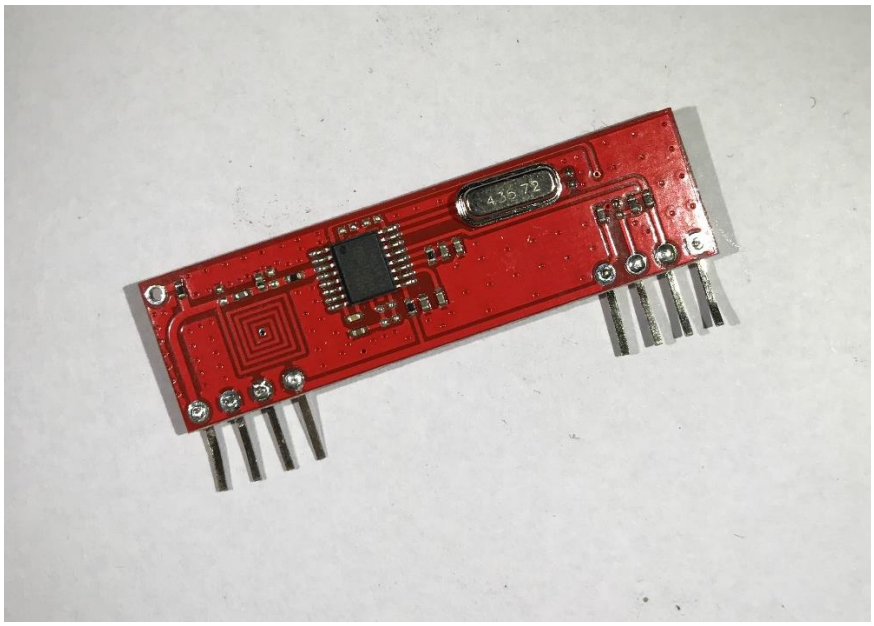


Figure 18: RF receiving module

Where our actual receiver station looks like the one in the below figure.

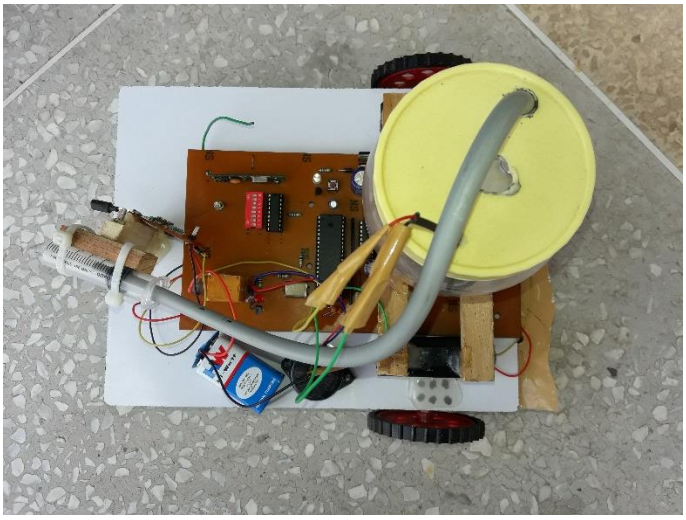


Figure 19: RF Receiving Station

RF RECIEVER MODULE: RF Receiver module (R433) is used in the 3 wheeled robot device that will be controlled such that it receives the operation request from the transmitter station, the signal is wirelessly sent to its receiving counterpart, the robot via the remote control. It recieves the signal from the antenna and makes in understandable for the microcontroller by decoding the signal in suitable form and thus sending data on the input pins of the microcontroller.

Features of Tx-Rx 433 RF Modules:

- Range without any physical distraction: 100 Meters
- Frequency of the Receiver: 433 MHz
- Sensitivity: 105 dBm
- Current Supply: 3.5 mA
- Operating Voltage: 5V
- Output Power: 4 ~ 12 dBm
- Low Power Consuming
- Easy for Application

4.3.1 Pin Structure

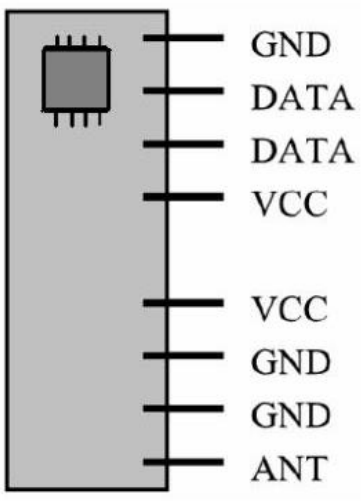


Figure 20: Pin Structure of RF Receiver Module

4.3.2 PIN Description

Pin No.	Name of the pin	Function Performed
1	Ground Pin (GND)	Ground (0V)
2	Data Pin (DATA)	Serial data output pin
3	Data Pin (DATA	Linear output pin; not connected
4	VCC	Supply voltage; 5V
5	VCC	Supply voltage; 5V
6	Ground Pin (GND)	Ground (0V)
7	Ground Pin (GND)	Ground (0V)
8	ANTENNNA (ANT)	Antenna input pin

Table 3: Pin Description of RF Receiver Module

4.4 MICROCONTROLLER

A microcontroller serves as the heart of the whole robotic vehicle. All the necessary decisions, desired operations, are one and only performed by this microcontroller chip on the receiver circuit of the robot. It is essentially a single chip that contains the CPU: Serving as the processor of the unit), ROM or flash: Serving as the non-volatile memory for the program, RAM: Serving as the volatile memory for input and output, an oscillator, the clock and an I/O data pins, plus the address pin, making the whole control unit. Microcontroller is also called a "computer on a chip" Let us take the case of a single vehicle, that can use 70 or more microcontrollers performing all the multiple type of operations.

In our project, we have made use of the: **AT89S52** Microcontroller.

The following picture defines a general block diagram of microcontroller.

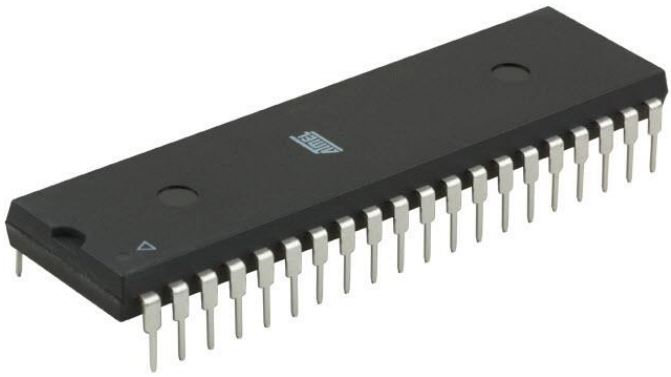


Figure 21: A 8051 microcontroller

4.4.1 AT89S52:

The microcontroller of Atmel AT89 series, is the Intel 8051 compatible family of the bit microcontrollers (µCs) that are manufactured by the Atmel Corporation.

The AT89S52 comes with the embedded 8 Kbyte of Flash memory and 256 bytes of RAM memory. It is a low-power, high-performance CMOS 8-bit microcontroller with in-system programmable Flash memory. This µC is manufactured using the Atmel's high density nonvolatile memory technology. Its special functionality is that it is very much compatible with the basic industry standard 80C51 instruction set and pin out. Further that 8 Kbyte on-

chip Flash memory allows the program memory to be reprogrammed, either by in conventional burning process or by a conventional nonvolatile memory programmer.

The Atmel AT89S52 is capable of combining the in system programmable flash memory with the versatile 8-bit CPU on a monolithic chip. Th combination of the two gives the access to multiple abilities and thus makes the microcontroller a powerful tool which provides a highly flexible and cost-effective solution to lot of control applications in the making of the embedded circuit.

The pin diagram of our microcontroller shows all of the 40 input/output pins.

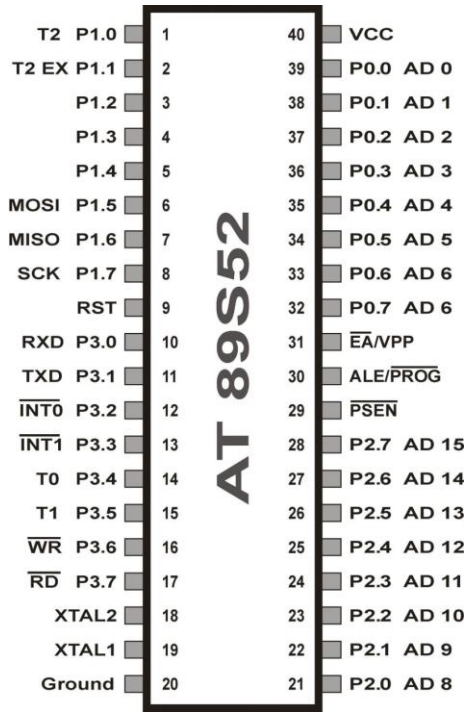


Figure 22: Pin Structure of 8051 Microcontroller

Some of the standard features of AT89S52 are as follows:

(A) 256 bytes of RAM
(B) 8 Kbytes of Flash
(C) 32 I/O lines
(D) Timer
(E) Two data pointers

(F) Three 16-bit timer/counters

(G) The clock circuitry

(H) An interrupt

(I) On-chip oscillator

In addition, the AT89S52 is designed with the idle mode that stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt. The hardware is driven by a set of program instructions, or software.

The **key features** of microcontrollers:

(A) 4 KB on chip program memory.

(B) 128 bytes on chip data memory(RAM).

(C) 128 user defined software flags.

(D) 8-bit data bus

(E) 16-bit address bus

(F) 32 general purpose registers each of 8 bits

(G) 16bit timers (usually 2, but may have more, or less).

(H) 3 internal and 2 external interrupts.

(I) Bit as well as byte addressable RAM area of 16 bytes.

(J) Four 8-bit ports, (short models have two 8-bit ports).

(K) 16-bit program counter and data pointer.

(L) 1 Microsecond instruction cycle with 12 MHz Crystal

.

4.5 FIRE SENSOR

We have used the IR fire sensor to recognize any of the fire mischances in the region. The robot is skilled of extinguishing fires that are caused at places where human reach is difficult such as in the case of fire inside a tunnel or the industrial fire and in case of military applications are also outlined and assembled. It can recognize the fire or the light with the wavelength at the scope of 760 nm to 1100 nm. The identification edge is around 60 degrees, to a great degree delicate to the firing range. Fire sensors will be utilized for starting the detection of the fire. Once the fire is distinguished or detected, the robot buzzer gives us the caution of fire in the area, and thus the water pump is activated as it starts the scattering nozzle valve which will be discharging sprinkles of water on the fire.

Some of the key features of this IR sensor are as follows:

(A) Sensitivity will always be adjustable in the fire sensor. (The adjustor, appears in the form of variable resistor)

(B) With a flexible accuracy potentiometer to modify the affectability the working voltage:3.3V-5V.

Pin Description:

Figure 23: 3 Pin Fire Sensor

4.6 HT12D Decoder IC

HT12D is a 24-pin (12*2) encoder IC that is extensively used in construction of the required robotic vehicle. This is further used in many number of applications of Radio Frequency. This IC is also responsible for converting our Serial input data of 12 bits into parallel form of output.

These 12 bits are classified such that there are:

(C) 8 (A0-A7) address bits, and

(D) 4(D0-D3) data bits.

HT12D is able to decode the serial addresses and data received by the RF receiver, into parallel form of data and sends the messages to the output data pins. Here, in this project, these output pins are further sent to the input pins of our microcontroller. The input serial data is compared with the local addresses multiple times. The input data code is then decoded, and when no error or unmatched codes are found into it, the data transmission becomes stationary.
A valid transmission in indicated by the VT pin, that will be in high state.

HT12D decoder IC is skilled such that it can cover a wide voltage range ranging from 2.4V to 12V.

Figure 24: HT12D Decoder

Pin Description:

The pin description and the characteristics of the IC HT12D is as follows:

Pin No	Function performed	Name
1	8-bit Address pins for input	A0
2		A1
3		A2
4		A3
5		A4
6		A5
7		A6
8		A7
9	Ground (0V) / VSS	Ground
10	4-bit Data/Address pins for output	D0
11		D1
12		D2
13		D3
14	Serial data input	Input
15	Oscillator output	Osc2
16	Oscillator input	Osc1
17	Valid transmission; active high	VT
18	Supply voltage; 5V (2.4V-12V)	Vcc

Table 4: Pin Description of HT12D

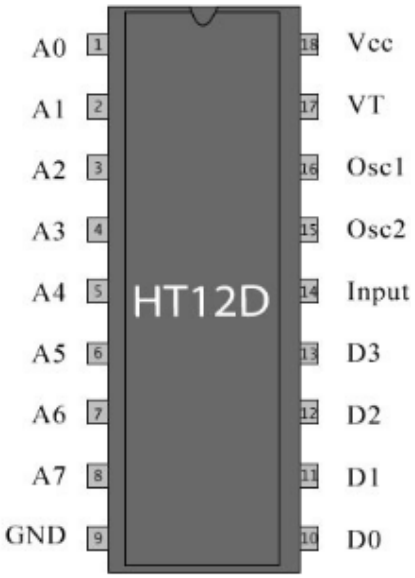


Figure 25: Pin Structure of HT12D Decoder

(1) Vcc: Positive power supply pin.

(2) VT: Validates the transmitted power.

(3) OSC1 and **OSC2**: Input and output pins for the internal oscillator.

(4) GND or Vss: Connection to the ground.

(5) Input: The input pin.

(6) TE: Pin that is used for enabling the transmission.

(7) A0 – A7: Input address pins used for secured transmission of data.

(8) D0 – D3: Address pins required to feed data into the IC.

Operation of HT12D:

The primary function of HT12E encoder IC is to decode the serial 12 bit that is received by the input pin. The decoder IC comes with an in-built Oscillator, which makes it very flexible to make this IC work. The IC is should be powered by VCC voltage 5V (pin 18) and the ground pin GND (pin 9) that is grounded. For decoding the data, the IC will require an oscillator, which is in built into this IC. We just have to connect the OSC1 and OSC2 (pin 15 & 16) through a 470K resistor to invoke it. The 4-bit data that is received can be obtained on pins D0 to D1 and an address of 8-bit has to be set using the pins A0 to A7. The necessary condition on same of both encoder and the decoder have to be preserved.

4.7 DIP Switch

A DIP switch, is defined as the dual inline package switch that consists of a set of manual electrical switches that are designed to hold configurations. It is also used to select the interrupt request (IRQ) from the encoder or the Decoder ICs.

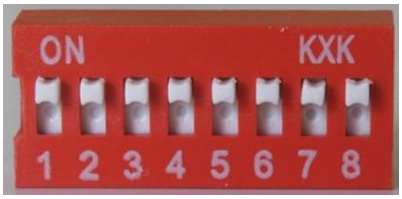


Figure 26: Structure of DIP Switch

DIP switch is usually mounted on the surface on PCB board or on the breadboard with 8-bit data pins and these DIP switches are used in those bids where multiple numbers of switches

are involved in generation of the output. For instance, in case of the remote control, the DIP switch is used to set the data of the binary bits according to the output device that is to be operated.

4.8 Rectifier Circuit

The main component used in the formation of rectifier circuit are the diodes. The rectifier is used for the conversion of the power supply from the alternating current (AC) to direct current (DC), the process that is known as rectification. They are also used in the type of circuits, where a large current must pass through the diode.

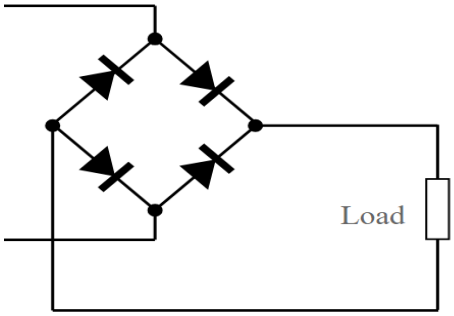


Figure 27: Bridge Rectifier circuit

BRIDGE RECTIFIERS: Generally, a bridge rectifier makes use of four diodes in the form of a bridge to achieve full-wave rectification of voltage. This is a widely used configuration, both with individual diodes wired and with single module bridges where the diode bridge is wired within its inner side. For obvious reasons, this design is called a bridge Rectifier

4.9 The Capacitor Filter

Capacitors acts just lie a battery. It is capable of storing electric charge. These are used with resistors in timing circuit because it will usually take time for a capacitor to fill with charge. They are used:

(A) In filter circuits because capacitors easily pass AC signals by block DC signals.

(B) In smooth varying DC supplies by acting as a reservoir of charge.

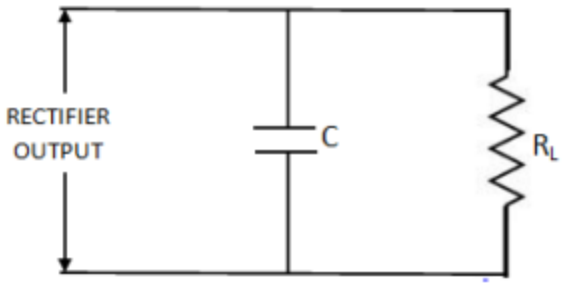


Figure 28: Capacitor Filter circuit

Capacitor is usually a passive electronic element that comprises of a pair of conductors that are separated by a dielectric. Whenever a voltage potential difference is present between the conductors, an electric field will present in the dielectric. This field stores the energy and produces a mechanical force between the plates. An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. The capacitance is a measure of a capacitor's ability to store charge. Thereafter, a large capacitance means that more charge can be stored.

4.10 Regulator IC

Regulator IC is also known as a voltage regulator three pin IC that is used to convert unregulated DC current into regulated DC current. Normally we get fixed output by connecting the voltage regulator at the output of the filtered DC. It can also be used in circuits to get a low DC voltage from a high DC voltage. For example, In our we used 7805 Voltage regulator IC to get 5V from 12V.

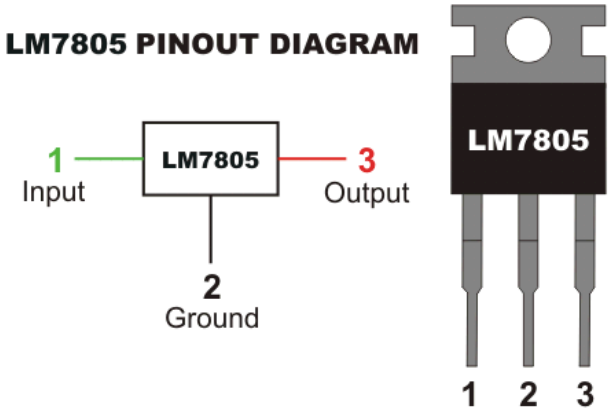


Figure 29: Voltage regulator 7805 IC

CHAPTER 5

SOFTWARE IMPLEMENTATION

Microcontroller can be defined as the heart of the whole robotic vehicle. This is because it controls all the necessary controls of the robot regarding how and when to perform particular operations. It usually controls all the adaptable chips on board and it greater significance extends in control applications in the use in home appliance, industrial usage or in the military arm making industry too. These are widespread varied range of fields like building of vehicles, automatic gadgets, manufacturing controlling devices, medical equipments, and even in engineering projects. The basic 8051 microcontroller is preferred and it serves to the leading choice by the learners in colleges who alike us, want to start their practical implementation of embedded projects because of its simple programming and high reliability in nature.

5.1 Programming the Microcontroller

Software used: Keil µVision IDE

Microcontroller Programming Language: Embedded C

Microcontroller used: AT89S52

Keil development tools for the microcontroller 8051 family is a very simple software that support almost every level of developer comprising of all type of programmers, from the scholar to a skilled applications engineer. Simply learning regarding the embedded software development helps in the implementation of the programming in the operation of our programmable microcontroller.

This software further allows our code to be written either in assembly or C programming languages, for which it providing us with the software so that the process can to be simulated on a computer before being loaded onto the microcontroller.

For this keil software**, µVision3** is an Integrated Development Environment (IDE) that helps us to write, compile, and debug our embedded programs in programming of our robot.

Figure 30: Keil Software opening window

The **Keil** Software development tools are the programs that we use to compile our C code, link and locate object modules and libraries, assemble our assembly source files, create HEX files, and debug your target program. Keil also provides us with a code limited evaluation version for 8051 architecture (C51) which is sufficient for learning purposes. The code limit with be of 2K bytes.

5.1.1 Stages for programming the microcontroller

The µVision IDE makes use of the constituents that are easy to design any type of applications on our 8051 based microcontroller.

Below are the steps that are involved in order to create a new project:

- Starting the µVision and selecting the toolset.
- Creating the project file and selecting a CPU from the device database.
- Creating a new source file and adding this source file to our project.
- Setting the tool options for target hardware device.
- Adding and configuring the startup code for the ARM.
- Building the project and creating a HEX file for PROM programming.

Further, for burning the microcontroller, means for transferring the program code into the memory in done using a compiler software onto the burner hardware. Once this code is stored in our microcontroller, its function will remain in accordance with the program. That means, it will perform our extinguishing operation such that on detection of fire, the alarm rings and the pump simultaneously get activated and thus sprinkle water of the burning area.

5.1.2 Programming Code

****

```
                ORG 00H
                MOV P0,#00H
                MOV P1,#0FFH
                MOV P2,#00H
                MOV P3,#00H

START:          MOV A,P1

                CJNE A,#00001000B,PROJECT1
            MOV P2,#11011011B       ;FF
                JMP START

PROJECT1:       CJNE A,#00000010B,PROJECT2
                MOV P2,#11000010B           ;R
                CALL DELAY
                MOV P2,#11010010B           ;STOP
                JMP START

PROJECT2:       CJNE A,#00000001B,PROJECT3
                MOV P2,#00010011B           ;L
                CALL DELAY
                MOV P2,#11010010B           ;STOP
```

```
                JMP START

PROJECT3:       CJNE A,#00000100B,PROJECT4
                MOV P2,#00010110B       ;B
                JMP START

PROJECT4:       CJNE A,#00010000B,PROJECT5
                MOV P2,#11010010B       ;STOP
                JMP START

PROJECT5:       CJNE A,#00000011B,PROJECT6
                CPL P3.5
                MOV R3,#255

XX1:            DJNZ R3,XX
                JMP START

XX:
                JMP XX1

PROJECT6:       JMP START


delay:
End
```

5.1.3 Organization of the code

The code deal with the received signal from the transmitting remote that is usually controlled by the human beings. We control the moment such that when the microcontroller gets the data on its input bits via the HT12D decoder IC.

The Basic operation that we usually code onto our microcontroller are:

(A) Forward Movement
(B) Reverse movement
(C) Right ways movement
(D) Left ways Movement
(E) Stop of movement

The microcontroller takes into consideration the first pressed key and also changes its present movement whenever new control keys are pressed onto the transmitting remote of the robot device.

5.2 Designing the PCB

We know that the breadboards are great for prototyping our basic designed circuits, but we should understand that they aren't so good for actually using the thing what we are building. Breadboards can only be used to create a temporary circuit designing.

So, at some point, one will probably want to make a project that is more permanent. The best way to do that is to put it on a PCB. PCB refers to the printed circuited boards, i.e. the circuitry that will mechanically support all the used component on our circuit in a more easy, reliable and a more convenient way.

Now, this etching of the circuitry can either be done by oneself with the use of lot of chemicals or it can also be made by a professional manufacture. The latter option anyway, is always more convenient since it saves time and gives us a far more accurate circuit for our operations.

5.2.1 Starting with schematic

Before starting the design of our PCB, it is more convenient to draw the schematic of the circuit. This will be serving as the blueprint in laying out the circuitry for our components, connections and the power supply onto our circuit.

Further, we can easily import this schematic in the step forward to carry it onto the PCB file, making the whole process of PCB designing easy and more time saving

5.2.2 Schematic Software

Software used n used to create the circuit for the transmitter and the receiver circuit of the control remote and the robotic vehicle is the EasyEDA.

It's a web-based online tool that enables the hardware engineers like the electronics people to design and to simulate the schematics, simulations of the circuit designed for getting it fabrication onto the PCB board.

Below are the schematic diagrams for the 2 components of our robot that have been constructed using the hep of the EasyEDA software.

5.2.3 Designing the PCB Layout

The easyEDA software used by us a very convenient software since it helps us create both the schematic structure of our circuit and also in the later stages, help in designing the PCB board from the same schematic figures.

Simply by going on to the menu to convert the 'project to PCB', we are able solve half our requirements.

The PCB editor will now comprise of the footprints that were previously associated with each of the used schematic symbol in the schematic diagrams. Everything will now to transferred onto the PCB editor interface.

Lastly we also perform the **design rule check**, in order to check if any of the component overlap with one another or if some connection is left open in the designing stage, if any.

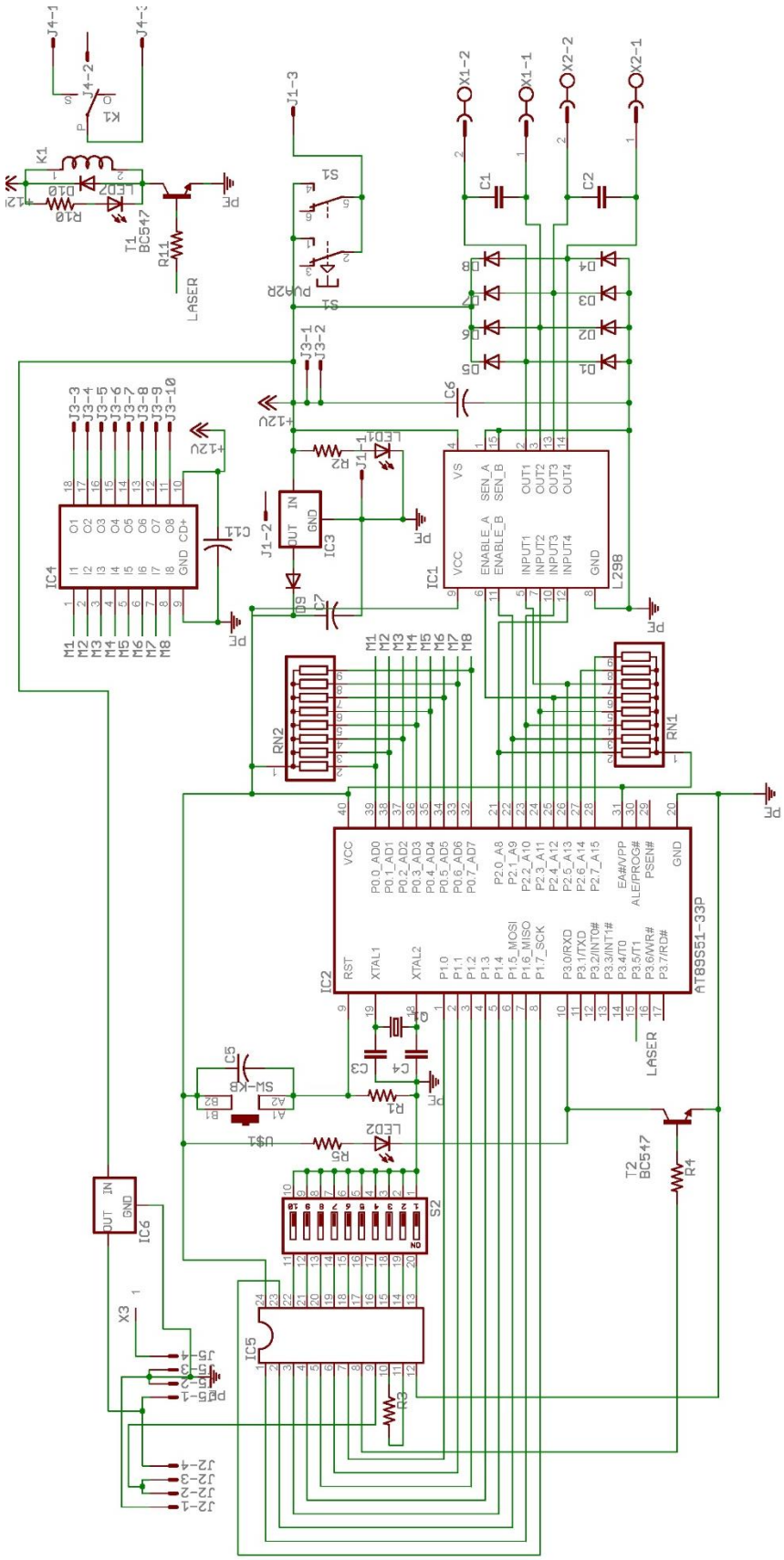


Figure 32: Schematic diagram of Receiving Robot

5.2.4 Ordering the PCB

After the PCB structure is completely designed we perform the last step by ordering our PCB from the hardware manufacturer. In the PCB editor we select the “Fabrication Output” button, which lets us download the several files which are handed over to the manufacturer. And hence, we get our desired PCB board for carrying out with our circuit implementation.

5.3 Final layout

Now, after we have our PCB Board and other mechanical components along with us, we perform the final task on assembling them component on our PCB board. The spaces of all our components in already embarked onto the PCB board. We only need to fix these components in their respective holes.

After these components are assemble them permanently by soldering them into these respective positions.

CHAPTER 6

WORKING OF THE PROECT

The project that supposed to be developed as a household or the industrial fighting automation robot by making use of the RF technology in order to perform remote operation. This robotic vehicle is laden with a water tanker on its top and a pump here is the device that is controlled by wireless communication technology to pitch water on the fire. An 8051 series of the microcontroller is employed for performing the specified operations. On the transmitter side, there are the push buttons, from which the command is directed to the receiver antenna so as to drive the robot either in the forward direction or the backward direction. At the receiving device there are 2 dc motors that are interfaced will the motor driver IC L298 which in turn is interfaced with the microcontroller. These 2 dc motors are attached in order to assist the movement of the vehicle in multiple directions.

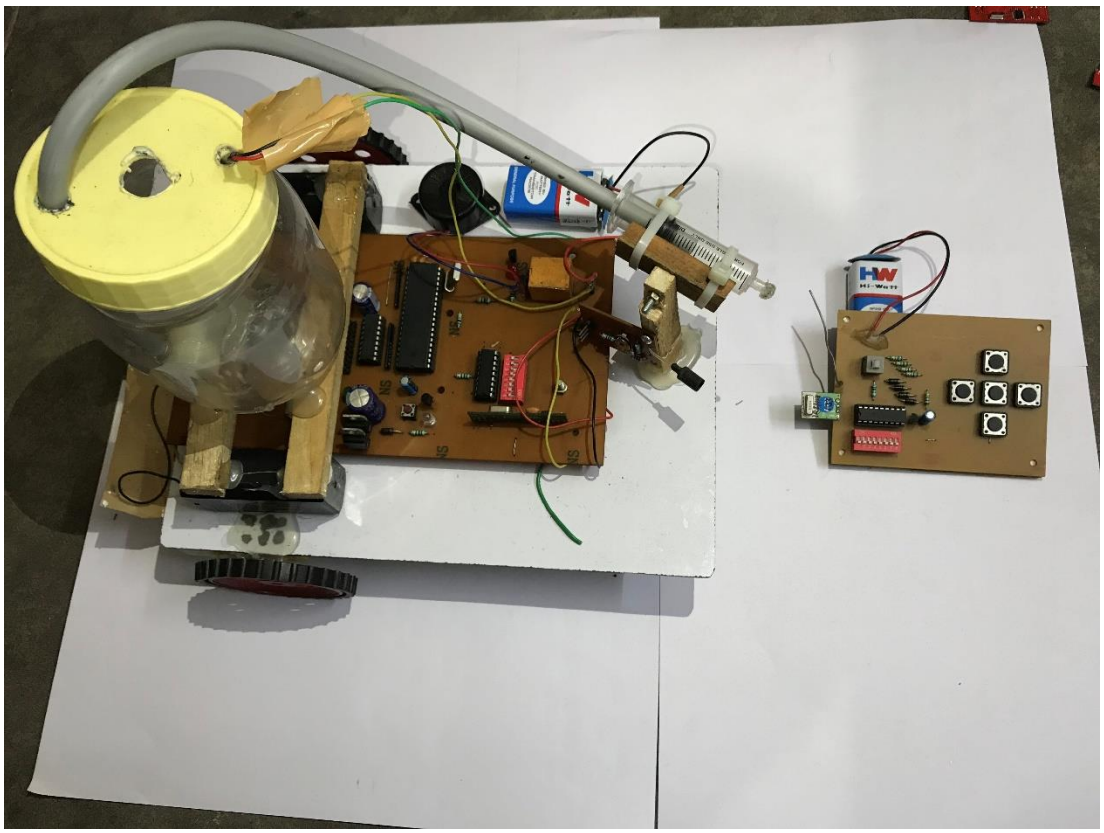


Figure 33: Fire Fighter Robot

In this project, the RF transmitting module acts as a part of the RF device that gives us the benefit of covering suitable distance that vary (till two hundred meters) with precise antenna, whereas the receiver device will decode it before it is sent to the microcontroller which drive the DC motors via motor driver IC for performing the movement operations. A storage tank with the brushless water pump is mounted on the automaton body of the robot whose operation is decided from the microcontroller output with an applicable signal from the transmitting controller of the robot. The entire operations of the firefighter robot are controlled by an 8051 series microcontroller. The motor driver L298 IC is also interfaced with this microcontroller which act as the brain of the robot in controlling the motors and the whole device on a whole.

The three-wheel vehicle is controlled remotely from the transmitting remote wirelessly for using it in the application of extinguishing fires. Overall, the system makes use of this RF remote for remote operation that is used for operating the robotic vehicle and water storage device that pumps out water at the time of fire break-outs. The rf based remote basically encode the user commands through the rf signals which are remotely received by the receiver circuit. The receiver circuit will now be decoding the whole data commands sent by the transmitter and forward the signal on the microcontroller. Now the microcontroller will decode these instructions as transmitted and will further instruct the 2 vehicle motors allowing us to run the vehicle in desired instructed direction. The robot also operates the pump which will start its operation and spray water either automatically or on the command of the user, allows him to operate the robot and puts off the fire from a safe distance away from the fire. This robot operates within a range of 20-30 meter from the remote.

Further, the project is intended to build up a firefighting robot utilizing RF innovation for performing different remote activities. The RF transmitter is the basic component as the RF remote will be controlling in the project, that is advantageous as it will be able to cover large range of distance (ranging from 20-30 meters), while the received signal is translates before sustaining it to the microcontroller to drive DC engines by means of the motor driver IC L298 to perform the primary task of extinguishing the fire.

CHAPTER 6

CONCLUSION

We have successfully developed and then implemented this project that satisfies the aim and objective of our fourth-year project. The Fire Fighter robot system is the 8051-microcontroller based hardware system which can easily be reprogrammed to get costume different hardware-based system. The system is then implemented and burn by a program in Embedded C programming language.

We have intended to build up a firefighting robot utilizing RF innovation for performing different remote activities. The RF transmitter is the basic component as the RF remote will be controlling in the project, that is advantageous as it will be able to cover large range of distance (ranging from 20-30 meters), while the received signal is translated before sustaining it to the microcontroller to drive DC engines by means of the motor driver IC L298 to perform the primary task of extinguishing the fire.

The Fire fighter robot has been designed using the RF Technology in such a way that it can cater to the needs of everyone, whether it may be the military, the police and armed forces. This fire fighter robot can be made into use at places where human reach is difficult or in not possible and in the situations where the chances of loss of human life exists. The implementation of our is done successfully and is experimented with care.

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APPENDICES

[A]: COMPONENTS DETAIL AND COST

Table V: Components used Details and Cost

SNo.	Component	Price
1.	**PCB**	**800**
2.	**Wooden Chassis**	**200**
3.	**Breadboards-4**	**300**
4.	**9V Battery-5**	**150**
5.	**Buzzer**	**50**
6.	**Fire Sensor**	**150**
7.	**HT12E and HT12D**	**100**
8.	**RF Tx and Rx Modules**	**500**
9.	**Water Pump**	**100**
10.	**Voltage Regulator 7805, 7905**	**100**
11.	**Resistors, Capacitors, Diodes, Transistors, LEDs, Switches**	**300**
12.	**DC motors + Wheels**	**200**
13	**5V Lead Acid Rechargeable Batteries**	**150**
14	**Relay**	**50**
15	**Others**	**1000**

TOTAL **Rs. 4500**

[B] Circuit Implementation

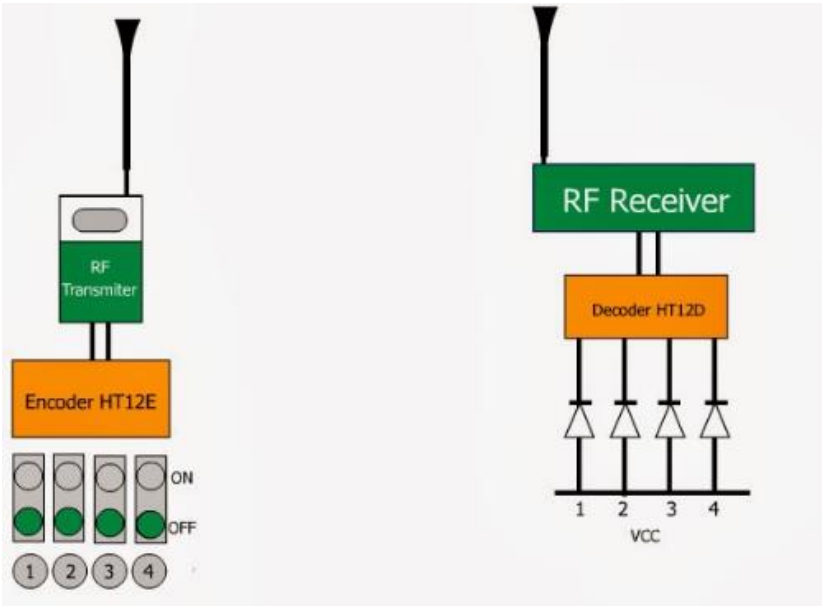

Figure A: RF Circuitry Structure

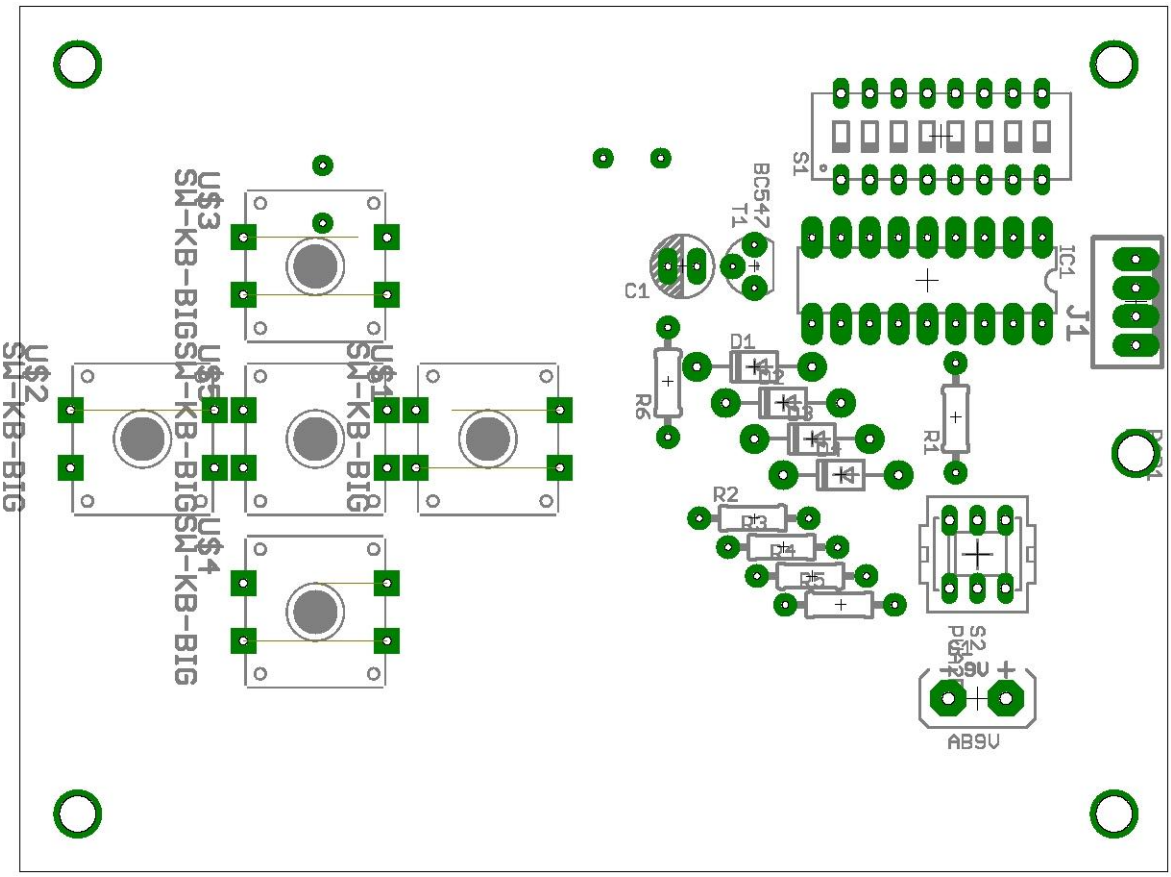

Figure B: PCB Layout for transmitting Remote

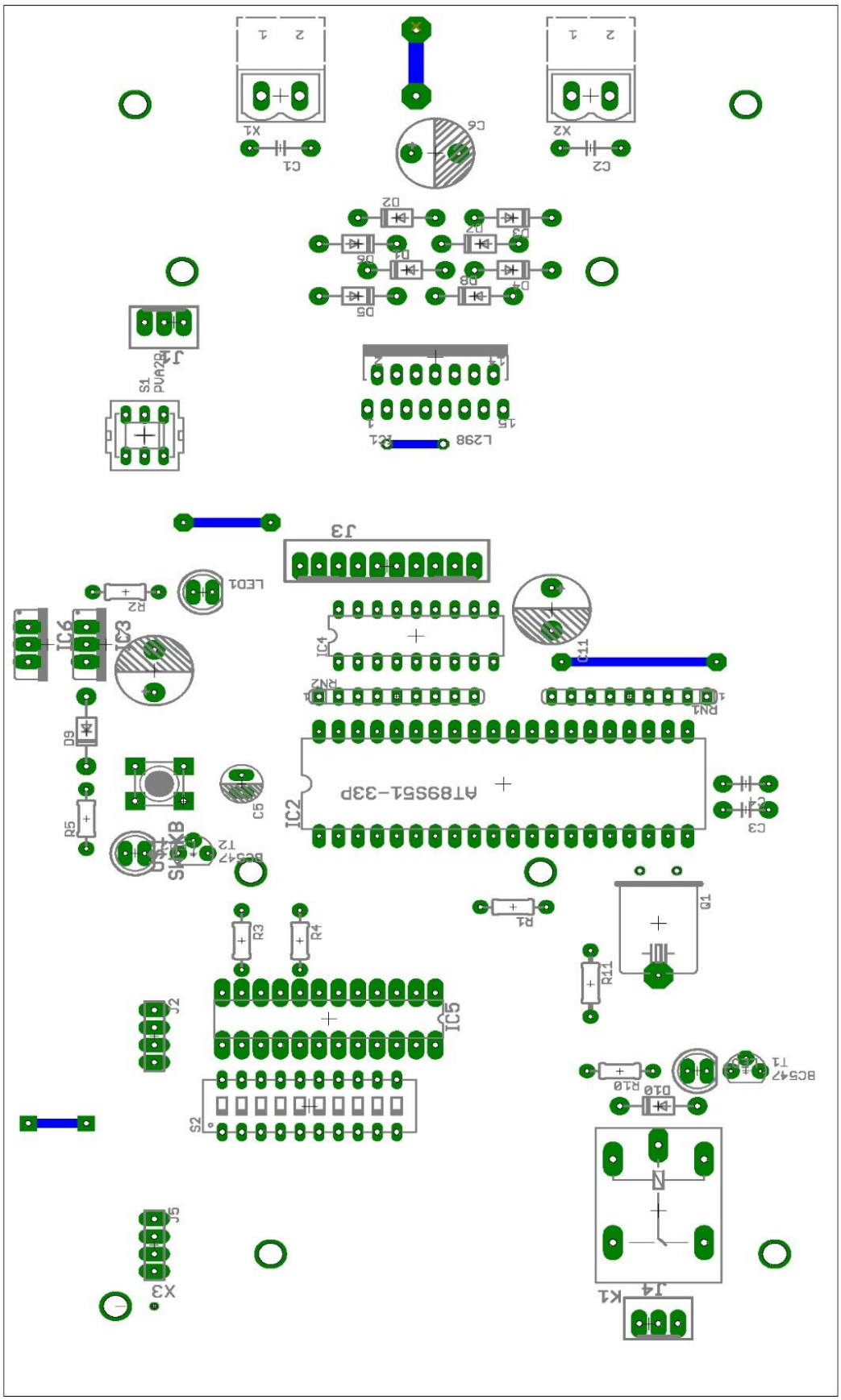

Figure C: PCB Layout for receiving station (ROBOT)

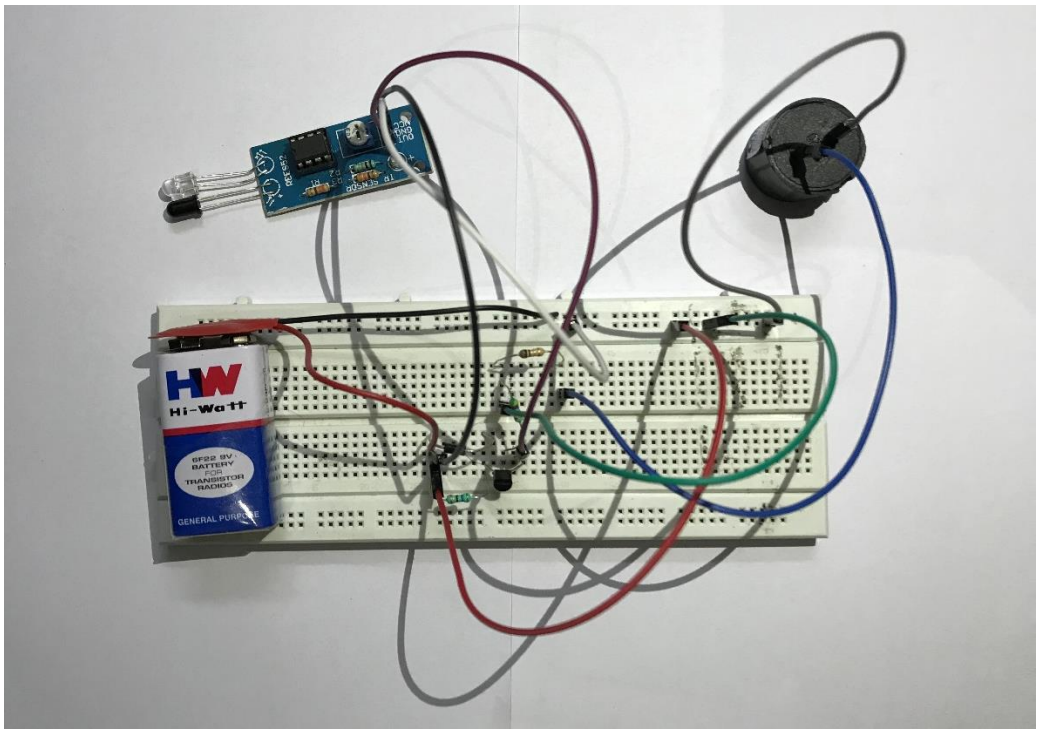

Figure D: RF remote on Bread Board

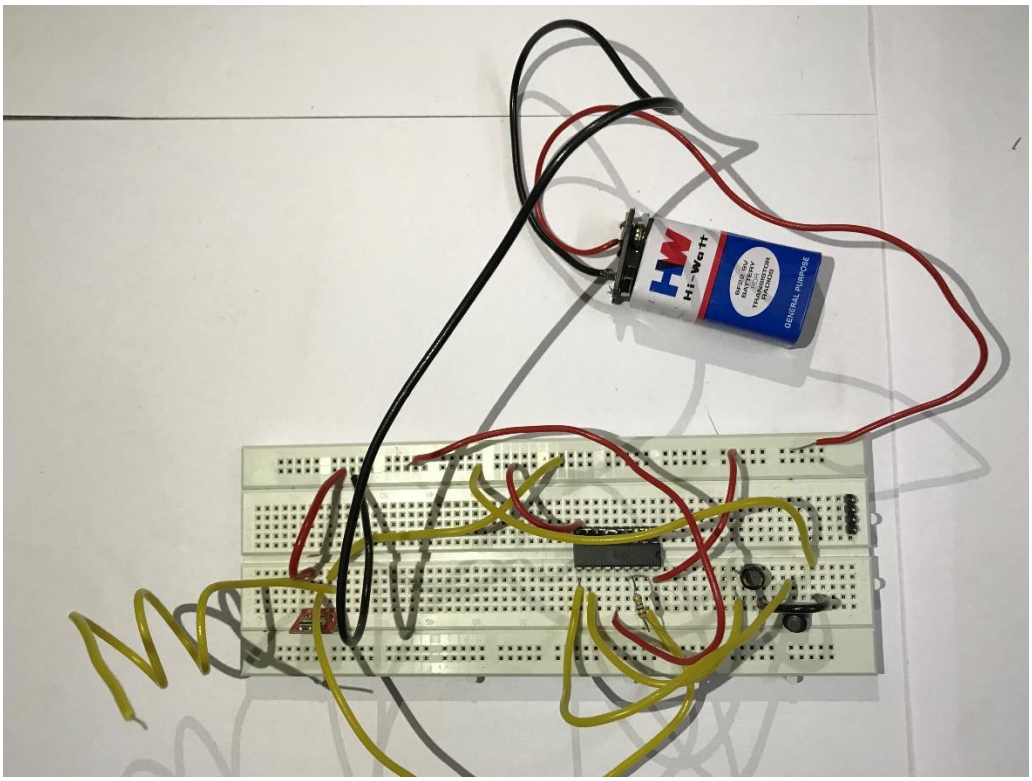

Figure E: RF Transmitting Station on Breadboard

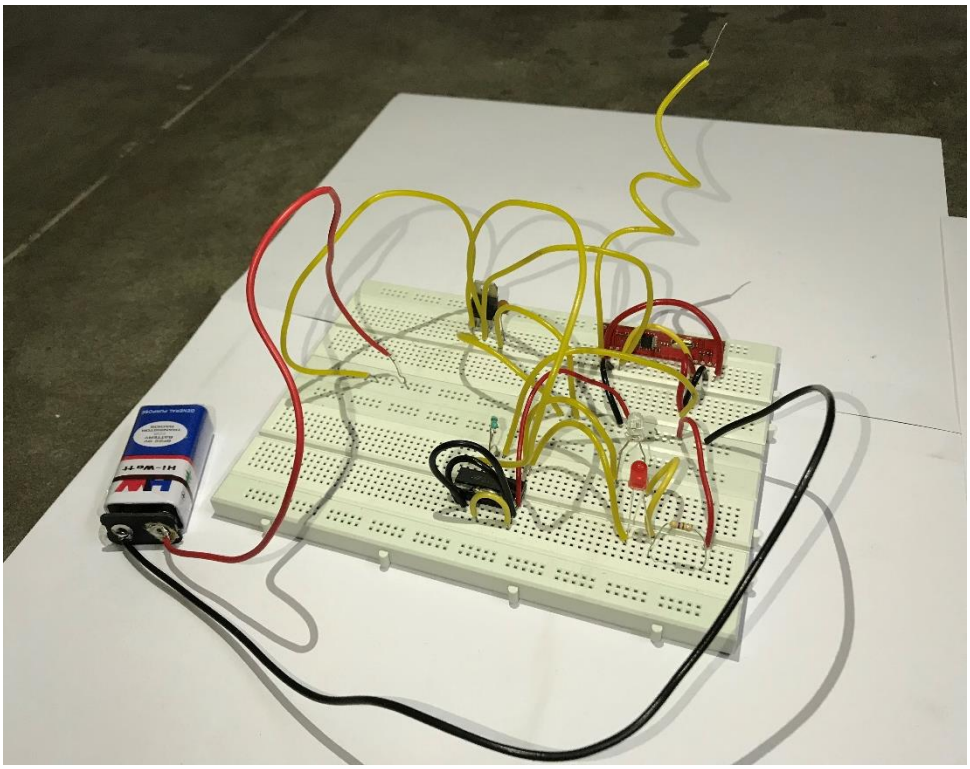

Figure F: RF Receiving Station on Breadboard