GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

"In Pursuit of Technical Excellence"

A Project Report On Landmine Detector Rangeless Robot

In partial fulfillment of the requirements for the degree of
Bachelor of Engineering
In
Electronics and Telecommunication Engineering

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DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
Government College of Engineering, Aurangabad [2022-2023]

CERTIFICATE

This is to certify that the project entitled **Landmine Detector Rangeless Robot** which is being submitted for the final project of Bachelors of Engineering Electronics and Telecommunication and Engineering of **Government College of Engineering, Aurangabad.**

This is the report work of the project presented by **Monika Duthade, Prasad Telalwar, Pawan Misal, Akash Mutkule, Sagar Shelke** under my supervision and guidance during the Academic Year 2022-23. The work embodied in this report is not formed earlier for the basis of the award of degree or compatible certificate or similar title of this for any other diploma examining body of University to the best of my knowledge and belief.

Dr. S. R. HIREKHAN
Guide & Head of Department
Department of Electronics and Telecommunication Engineering

Dr. A. S. BHALCHANDRA
Principal
Government College of Engineering, Aurangabad

DECLARATION

We hereby declare that the project work entitled **"Landmine Detector Rangeless Robot**", submitted to the Government College of Engineering, Aurangabad is a record of an original work done by us under the guidance of **Dr.S.R.Hirekhan.** This project work is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in the Electronics and Telecommunication Engineering Department.

Place: Government College of Engineering, Aurangabad

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ABSTRACT

Detection and removal of landmines is an important worldwide concern. A huge number of landmines have been deployed over the last twenty years and demining will take several more decades, even if no more mines were deployed in the future. An adequate mine clearance rate can only be achieved by using new technologies such as improved sensors, efficient manipulators and mobile robots. The ideas and concepts from the theoretical stages are shaped into the physical hardware components by the fabrication of a prototype and then software programs are integrated into the system so as to test and experiment the concepts that had been developed. The designed robot is capable of detecting a buried mine, marking the exact location of the buried mine, and controlling itself from stepping over it and detonating the mine. The detection of the buried mine is done by using metal detectors since most landmines contain metal components.

Introduction

The project presented here is a land mine detection robot system. In a situation where there are land mines are placed like in such as border areas, there is need for better security system. It is much safer to have a system that monitors and communicates to the device owner without putting human life to risk. This tends to utilize the availability of mobile network , mobile phone, and electronics circuit to achieve an automated system which is programmed to work as a thinking device to accomplish this purpose.

Blasting of land mines is one of the main concerns of many countries in such border areas and also in public places. Many times we have heard about the blasting of the land mines and some have faced such situations. Main intention of this project is to avoid such a situation. This project is designed and developed by taking into consideration the problem mentioned above. Moreover, rangeless robots offer increased operational efficiency by minimizing human exposure to dangerous environments. Their advanced capabilities enable them to operate in complex terrains, such as dense vegetation, rocky landscapes, or sandy deserts, where conventional detection methods often struggle. By reducing the risk to human deminers, these robots enhance safety.

PROBLEM STATEMENT

A land mine is an explosive device concealed under or on the ground and designed to destroy or disable enemy targets, ranging from combatants to vehicles and tanks, as they pass over or near it. To identify this landmines and saves lives we make a robot which identify place buried landmine and send location or mark that place for the soldier during war and Robot chassis is controlled by using just phone call.

NECESSITY

This project solves an important military issue. It's made to determine landmines in warfare. Thereby saving lives of all those navy men who die of landmines. This is a robot that detects landmines. Wireless controlled with live feed on screen. Spotting landmines in a war field to save humans from dying again due to a landmine.

Currently available demining methods which include humanitarian and mechanical demining utilize manual prodders or metal detectors operated by humans and mine clearing machines respectively to detect the location of mines. These conventional methods are labor intensive, expensive, time consuming and possess high risk for the humans and machines involved in the process.

Objectives

The objective of a rangeless robot equipped with a landmine detector is to detect and identify landmines or explosive devices.The rangeless aspect implies that the robot can detect landmines from a safe distance, eliminating the risk to human lives and minimizing potential damage.

- The foremost objective is to ensure the safety of human operators by keeping them at a safe distance from potentially dangerous explosives. By employing a rangeless approach, the robot can detect landmines from a distance using various sensing technologies.
- The robot should be designed to efficiently navigate through different types of terrain, such as rough terrains, vegetation, or urban areas, while effectively scanning for landmines. It should be able to cover large areas in a reasonable amount of time, enhancing the efficiency of mine detection operations.
- The rangeless landmine detector robot should be remotely controllable, allowing operators to supervise and control its movements and detection activities from a safe location. This remote operation capability reduces the risk to human operators and enables effective and efficient mine-clearing operations.

Overall, the objective of a rangeless landmine detector robot is to provide a safer, more accurate, and efficient method for detecting and locating landmines, contributing to humanitarian demining efforts and minimizing the risk of injuries and fatalities caused by landmine accidents.

Challenges

There are several challenges associated with developing a landmine detection robot using an Arduino platform.Landmines can be buried deep in the ground, which requires the robot's sensor to be highly sensitive. The robot must be able to detect the landmine even if it is buried several inches below the surface.The robot must be able to navigate rough terrain and be able to move over obstacles such as rocks, bushes, and trees. It should also be able to maneuver in tight spaces to accurately detect landmines.The robot must be designed to operate for extended periods on battery power. Power consumption must be minimized to ensure that the robot can operate for an adequate amount of time without needing to be recharged or have its battery replaced. Environmental factors such as temperature, humidity, and rain can impact the robot's ability to detect landmines. The robot must be designed to operate reliably in a variety of weather conditions.The use of artificial intelligence algorithms further enhances the performance of rangeless robots. Through continuous learning and pattern recognition, these robots can adapt to dynamic environments and differentiate between harmless objects and potential landmines. This intelligent decision-making process significantly reduces false positives and false negatives, ensuring more accurate detection results.

1.5 TOOLS USE

1.5.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is an open-source software tool used for developing and uploading code to Arduino microcontroller boards. The IDE provides a simplified programming environment that allows users to write, compile, and upload code to their Arduino boards without needing to have an in-depth understanding of low-level programming languages or microcontroller architecture.

Some key features of the Arduino IDE include:

- ➢ Code editor: The IDE has a simple code editor with syntax highlighting, auto-complete, and other features that make it easy to write and edit code.
- ➢ Board and serial port selection: The IDE provides an easy-to-use interface for selecting the Arduino board and serial port to which code will be uploaded.
- ➢ Library manager: The IDE has a built-in library manager that allows users to easily search for, install, and update libraries that provide additional functionality to their projects.
- ➢ Serial monitor: The IDE has a built-in serial monitor that allows users to send and receive data from their Arduino board over the serial port.

Examples and tutorials: The IDE comes with a range of example sketches and tutorials that can help users get started with Arduino programming and learn more advanced techniques.Overall, the Arduino IDE is a powerful and user-friendly tool that has helped to make microcontroller programming more accessible and easy for people of all skill levels.

2. Literature Survey

2.1 Land Mine Detection Robot Using Microcontroller.

There are many works on land mine detection robot monitoring using ZigBee, robots which are available in the literature. In this chapter, surveys of related works on the above fields are discussed. The authors research on land mine detection robots.

Bharath J, Automatic Land Mine Detection Robot Using Microcontroller.

This paper describes the problems faced by the Land mines that are faced in 70 countries. The purpose of this paper is to eliminate the problems of land mine. The purpose of this paper is to design a robot prototype which is capable of detecting buried land mines and changing their locations, while enabling the operator to control the robot wirelessly from a distance. This technology interfaces the metal detector circuit in a robot to search the land mines. The metal detector circuit is interfaced with the robot and it is left on the required search area in order to detect the metallic components used in the landmines. The main advantage in this project is that we can make this robot at low cost and more efficient.

Michael YU. Rachkov, Lino Marques, Anibal T. De Almeida.

The paper describes an advanced multi-sensor demining robot. The robot transport system is based on simple structure using pneumatic drive elements. The robot has robust design and can carry demining equipment up to 100 kg over rough terrains. Due to the adaptive possibilities of pedipulators to obstacles, the robot can adjust the working position of the demining sensors while searching for mines.

The detection block consists of a metal detector, an infrared detector, and a chemical explosive sensor. The robot is controlled by means of an on-board processor and by an operator remote station in an interactive mode. Experimental results of the transport, control, and detection systems of the robot are presented. The main disadvantage of the robot is weight factor due to the overloading of sensor.

Seong Pal Kang, Junho Choi, Seung-Beum Suh, Sungchul Kang, Design of mine detection robot for Korean minefield.

This paper presents the critical design constraints of mine detection robots for Korean minefields. As a part of a demining robot development project, the environment of the Korean minefield was investigated, and the requirements for suitable robot design were determined. Most of the landmines in the Korean minefield were buried close to the demilitarized zone (DMZ) more than half a century ago.

The areas have not been urbanized at all since the Korean War, and the potential locations of the explosives by military tactics have been covered by vegetation. Therefore, at the initial stage of the demining robot system development, the target areas were investigated and the suitable design for Korean minefield terrain was determined. The design includes a track type main platform with a simple moving arm and a mine detection sensor (consists of a metal detector and a GPR at this stage). In addition, in order to maintain the effective distance between the landmine sensors and ground surface, a distance sensing technique for terrain adaptability was developed and briefly introduced in this paper. The overall design of this robot was determined by considering the speed.

3.METHODOLOGY

3.1. HARDWARE REQUIREMENTS

3.1.1. ARDUINO UNO 328

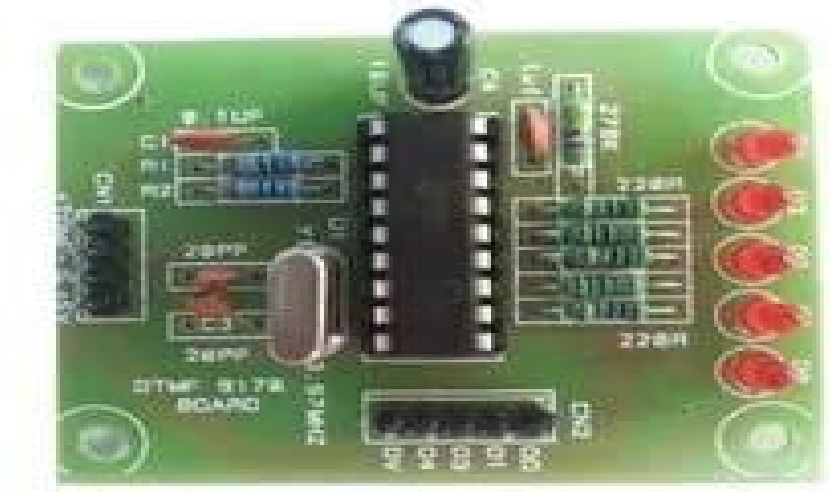
The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller . It consists of 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

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 become very fast and give to the instruction to the user

Fig.2. Arduino uno 328

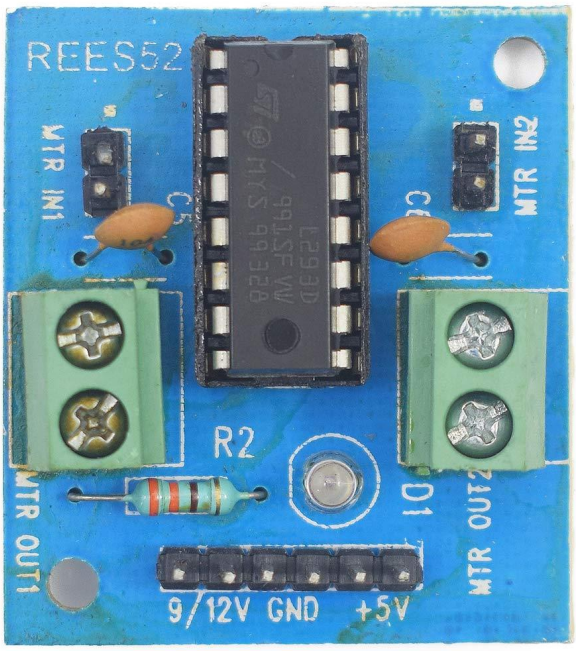
3.1.2. DTMF DECODER MODULE.

DTMF is a Dual Tone Multiple Frequency decoder module which has a MT8870 DTMF decoder IC which decodes DTMF tone signal to digital signal that are acceptable for arduino digitally. This module works as a tone decoder that uses its 3.5 mm audio connector socket to get the input audio signal.DTMF is commonly found in tone based dial pad devices such as mobile phones or telephones dial pad. When the dial pad is pressed, it produces a **combination of two separate sine waves** which is a unique frequency signal that can be decoded and produced as a binary output. The MT8870 based DTMF module does exactly the same thing. The pressed button can easily be identified by checking the binary output. It can produce binary output by getting tone input from 0-9 number, A - D letters, * and # symbols.



3.1.3. MOTOR DRIVER L293D

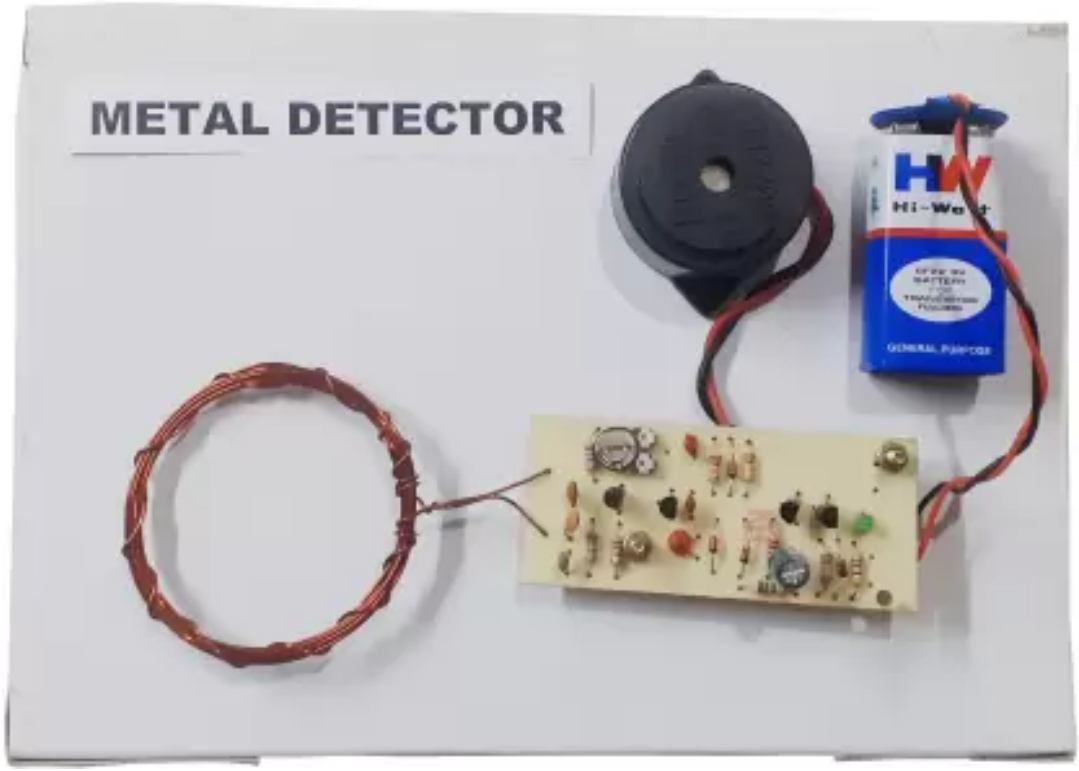
The L293D is a dual-channel H-Bridge motor driver capable of driving a pair of DC motors or a single stepper motor. This means it can drive up to two motors individually which makes it ideal for building a two-wheeled robotic platform.The L293D is most often used to drive motors, but can also be used to drive any inductive load such as a relay solenoid or large switching power transistor.It is capable of driving four solenoids, four uni-directional DC motors, two bi-directional DC motors or one stepper motor.The L293D IC has a supply range of 4.5V to 36V and is capable of 1.2A peak output current per channel, so it works very well with most of our motors.



3.1.4. Metal detector

Metal detector is a very common device that is used for checking persons, luggage or bags in shopping malls, hotels, cinema halls, etc. to ensure that a person is not carrying any metals or illegal things like guns, bombs etc. Metal Detectors detect the presence of metals.There are different types of metal detectors like hand held metal detectors, walk through metal detectors and ground search metal detectors. Metal detectors can be created easily and the circuit for a basic metal detector is not that complex.

In this project, we have designed a simple DIY type Metal Detector Circuit using very simple components that can be used in our homes and gardens.



3.1.5. DC MOTORS

- DC motors are generally more powerful than servos in terms of speed and torque. Microcontrollers could not accurately control DC motors without a motor controller.

- So, motor Controllers are a must needed. An encoder is used to get feedback from the DC motor. In real life, though, DC motors will always have more than two poles.

- We can imagine how with our example two pole motor, if the rotor alignment is exactly at the middle of its rotation it will get stuck there.

- **Specifications:**

o Input Voltage:4.8/35V

o Maximum output current:15A/13.8V per channel

Fig4.1.9.Dc motor

3.1.6. ROBOT CHASSIS WITH WHEELS

This is a DIY 4-wheel double-layer Robot car chassis kit. It includes the four pairs of Geared Motors and Wheels. The chassis used in this kit is transparent so as to create dynamic handling of the components mounted on your robotic vehicle.

Features :

- Easy to assemble/disassembling.
- Transparent Car Chassis with Attractive design.
- Operating Voltage: 3-6V DC
- Bottom Plastic thickness of about 3 mm
- Length: about 10 inch
- Width: about 6 inch
- Simple mechanical structure, easy for installation.
- Adopts 4 DC motors for better power, speed, and load capacity
- Large and stable Chassis, easy for expansion.
- Speed test encoding disk.
- When powered at 6V, this robot can reach speeds up to 0.6m/sec
- The height between two chassis can be changed by varying the length of the copper pillar
- 20 slot Speed Encoder, more accurate than other 6 or 10 slot encoders
- This kit is great for DIY Learning, Academic Research, Hobby Projects, and Robot Competitions

Aux wire

This 3.5 mm Aux cable is convenient for connecting portable audio devices. 3.5mm Stereo Audio Cable is ideal for extending the audio connection on iPods, iPhones, Media Players or any other via the aux input (3.5mm jack).
It’s designed in such a way that it provides a secure connection even with a smartphone in a case. Specifically designed to take advantage of the convenient 3.5mm input jack (AUX input) on your car's audio system.

3.5mm Plug provides the best quality connection for all your music, unlike FM adaptors. Slender Design to provide a seamless experience while driving or at home.

CABLE TYPE - Aux Cable

MODEL NUMBER - AC6B

LENGTH - 1.8 Meters, 6 Feet

COMPATIBILITY - Aux Devices

PRODUCT WEIGHT - 35 grams

CONNECTING WIRES

This is a set of 10 rainbow color male to female jumper wires. They can be used for interconnecting electronic components on breadboard or berg strips. The wires are 20 cm long. One side has a male header and the other end is a female header.
These male to female jumper wires are of good quality, reusable and have an approximate length of 20cm.

Specifications of Male to Female:

- 1 x 20cm male to female breadboard connecting wires
- Easy to plug in
- Durable, Flexible
- Multiple Colors
- Jumper wire size : 26 AWG
- Current Rating : up to 1 A
- Insulation Type: PVC

BATTERY CONNECTORS

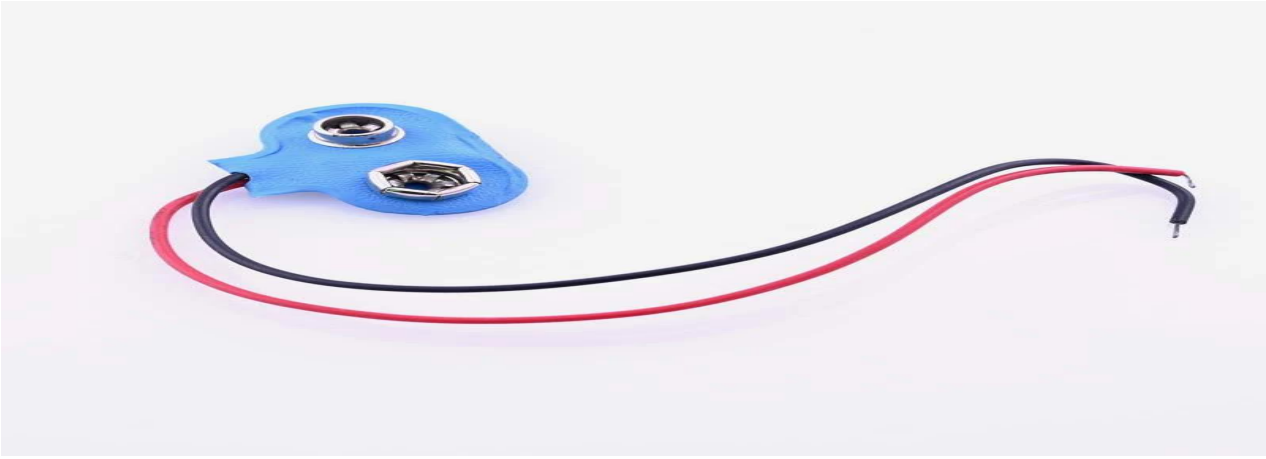
A battery connector is a gadget that combines electric circuits. Most battery packs require more than one connector. The primary battery connector is both the mechanical and electrical part that interfaces the battery to the PDA or other electronic gadget.

An Electric battery Connector, as the name recommends, interfaces.

All the more explicitly, it is utilized to interface or separate electrical circuits. Connectors are along these lines, otherwise called electrical connectors.

A battery connector can come in different shapes, sizes, and tones. This article covers the most widely recognized forms and the conventional terms used to portray them.

These are usually utilized on electric forklift trucks just as different kinds of electric vehicles like material dealing with gear, ground-support vehicles, and golf trucks.



3.2 Software requirements

3.2.1. ARDUINO IDE

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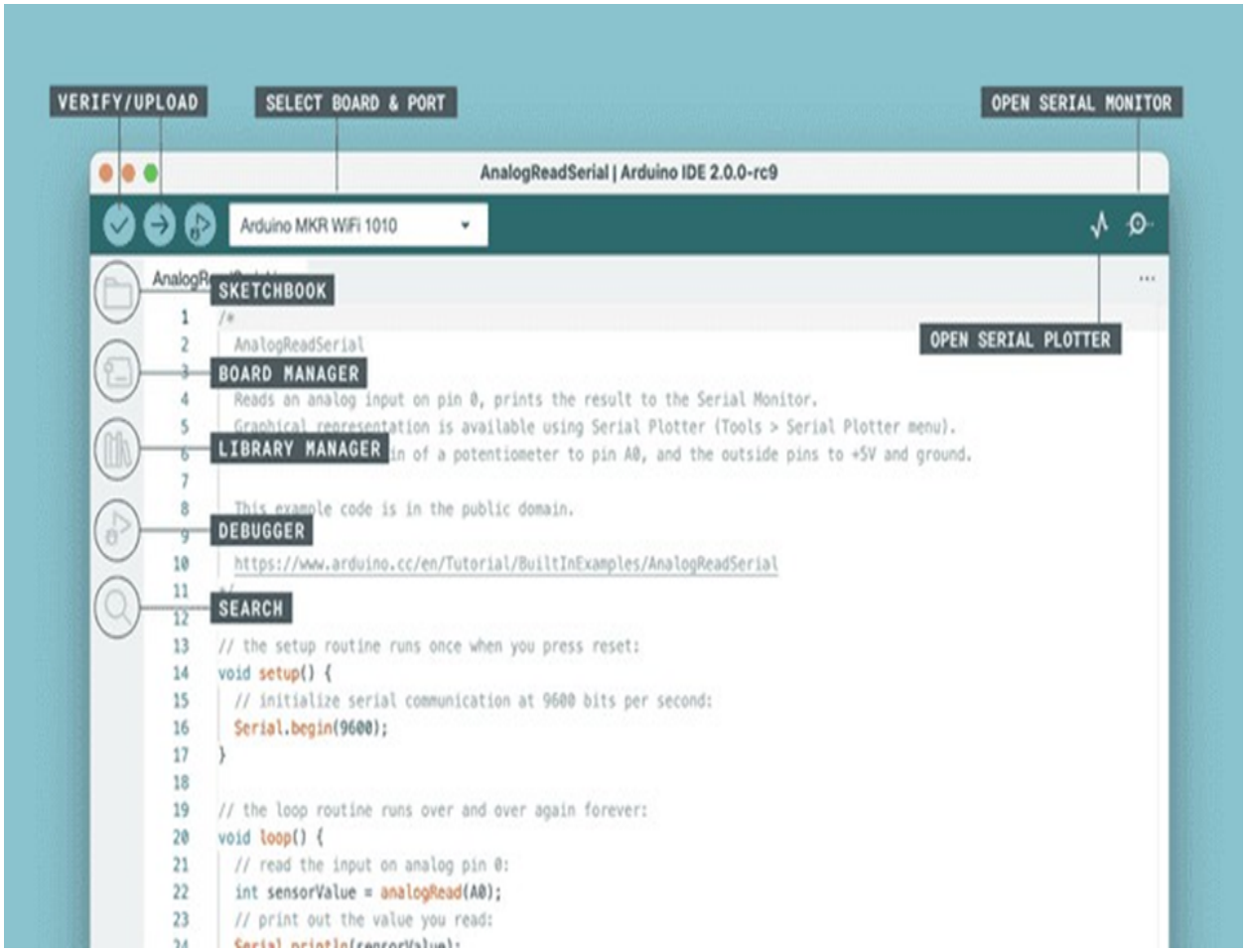
Some key features of the Arduino IDE include:

- ➢ Code editor: The IDE has a simple code editor with syntax highlighting, auto-complete, and other features that make it easy to write and edit code.
- ➢ Board and serial port selection: The IDE provides an easy-to-use interface for selecting the Arduino board and serial port to which code will be uploaded.
- ➢ Library manager: The IDE has a built-in library manager that allows users to easily search for, install, and update libraries that provide additional functionality to their projects.
- ➢ Serial monitor: The IDE has a built-in serial monitor that allows users to send and receive data from their Arduino board over the serial port.
- ➢ Uploader: Arduino IDE includes an uploader that allows you to upload your code to the Arduino board via a USB cable or other connection.

Overall, Arduino IDE is a powerful and easy-to-use platform that makes it easy for anyone to create and upload code to an Arduino board. Whether you are a beginner or an experienced programmer, Arduino IDE provides the tools and features you need to get started with Arduino programming.



3.3. INTEGRATION

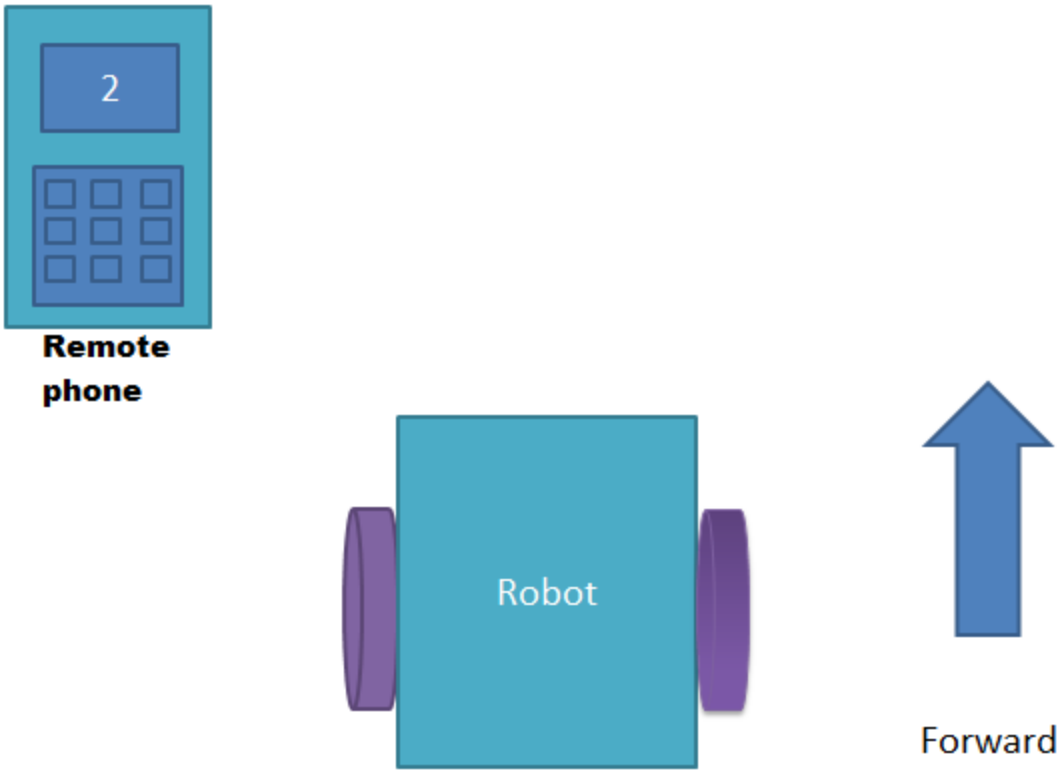
3.3.1. Working of DTMF Controlled Robot

DTMF controlled robot run by some commands that are sent via mobile phone. We are here using the DTMF function of mobile phones. Here we have used the mobile phone to show the working of a project. One is a user mobile phone that we will call a ‘remote phone’ and the second one is connected with Robot’s circuit using aux wire. This mobile phone we will call ‘Receiver Phone’.

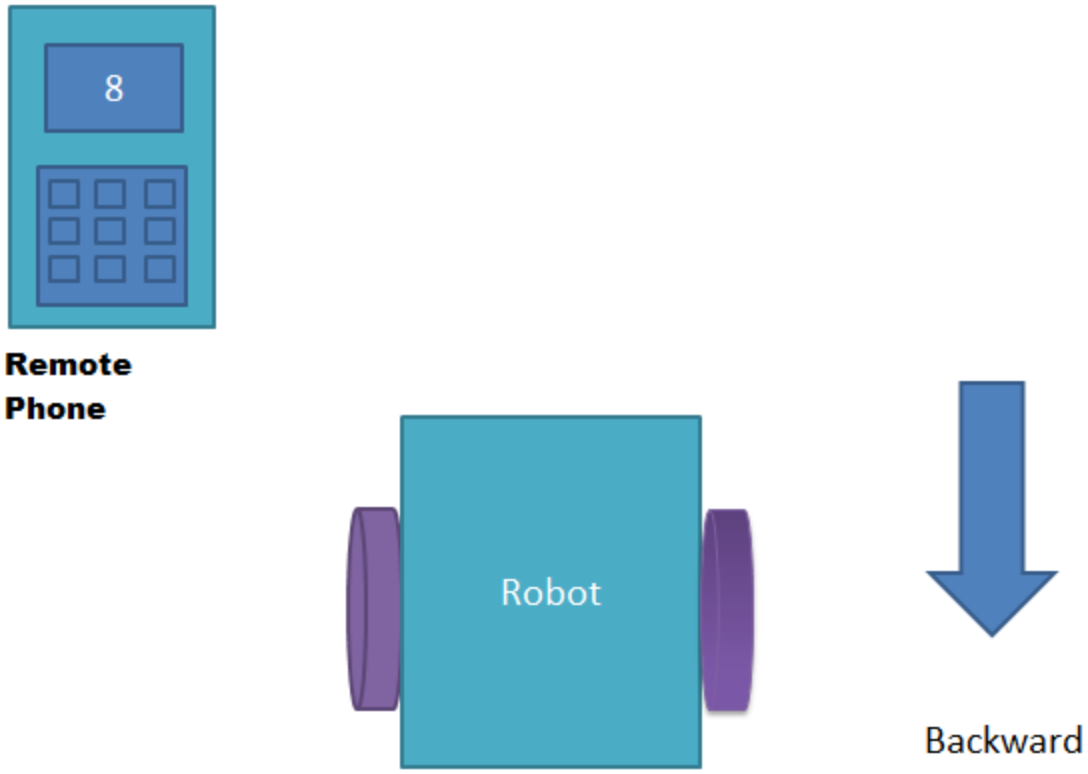
First we make a call by using a remote phone to the receiver phone and then attend the call by manually or automatic answer mode. Now here is how this DTMF controlled robot is controlled by cell phone:

When we press ‘2’ by remote phone, the robot starts moving forward and moving continues forward until the next command comes.

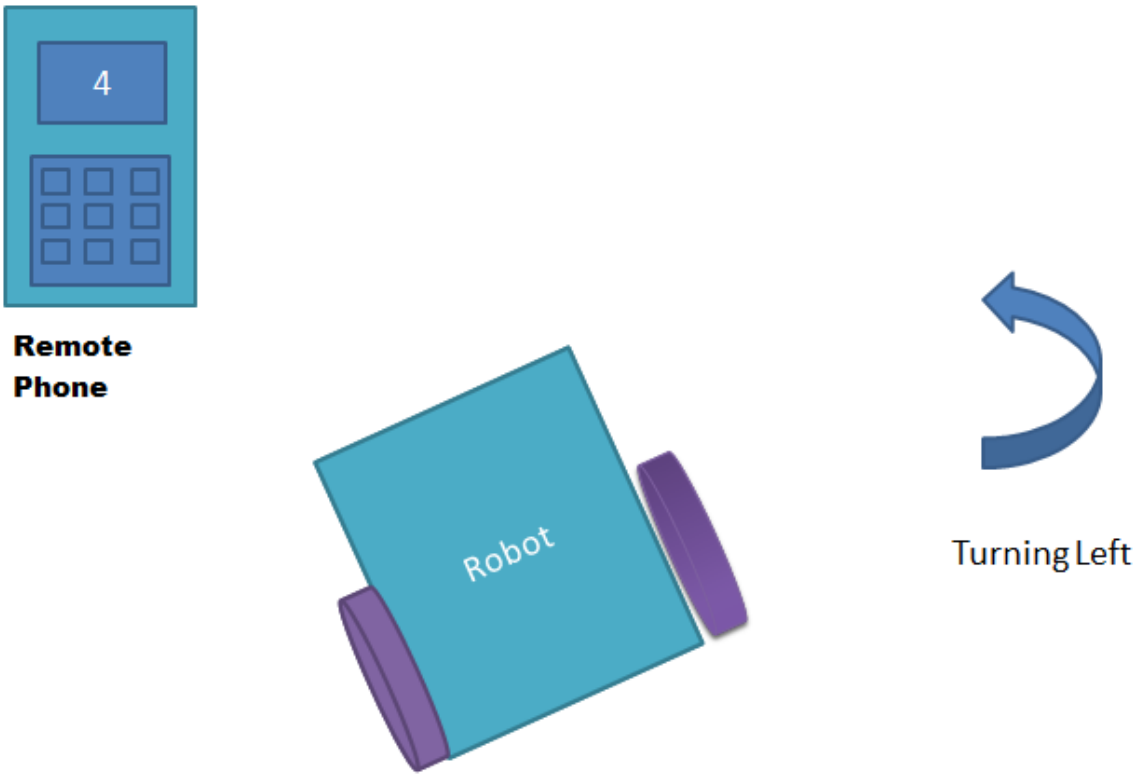
DTMF technology works by **having the handset generate tones at specific frequencies and playing them over the phone line when a button is pressed on the keypad**. Equipment at the other end of the phone line listens to the specific sounds and decodes them into commands.



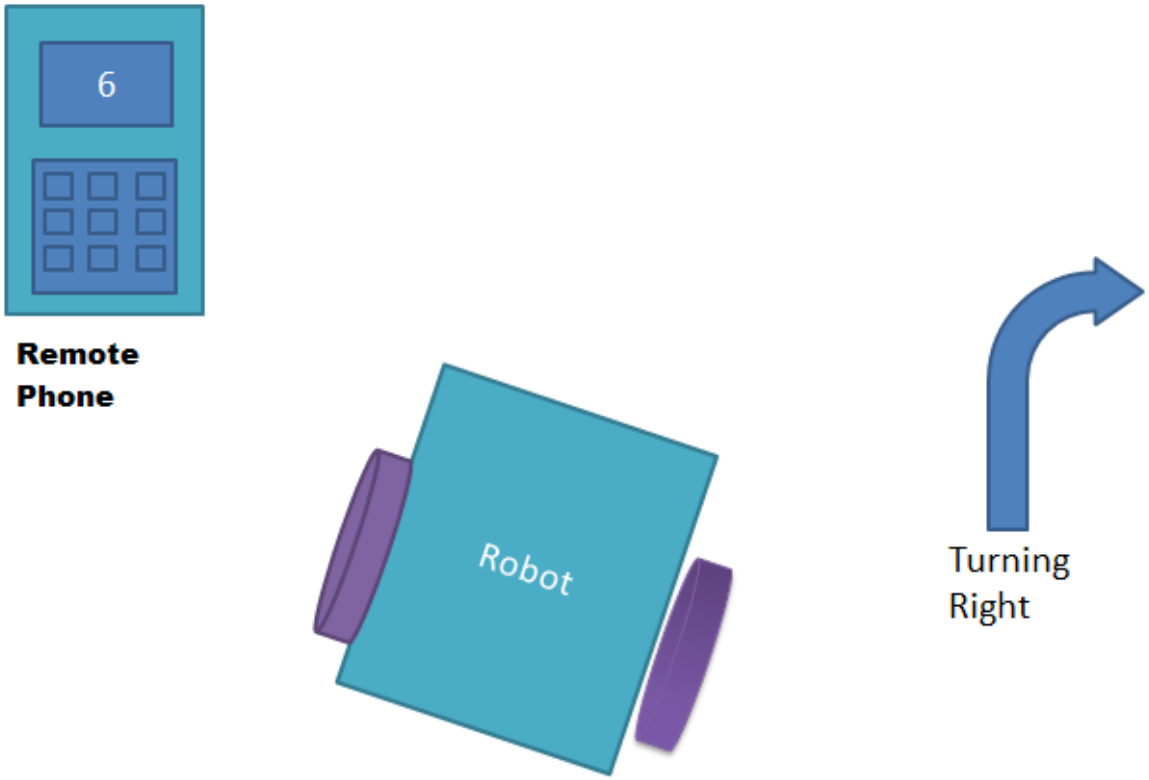
When we press ‘8’ by remote phone, the robot changes its state and starts moving in the backward direction until another command comes.



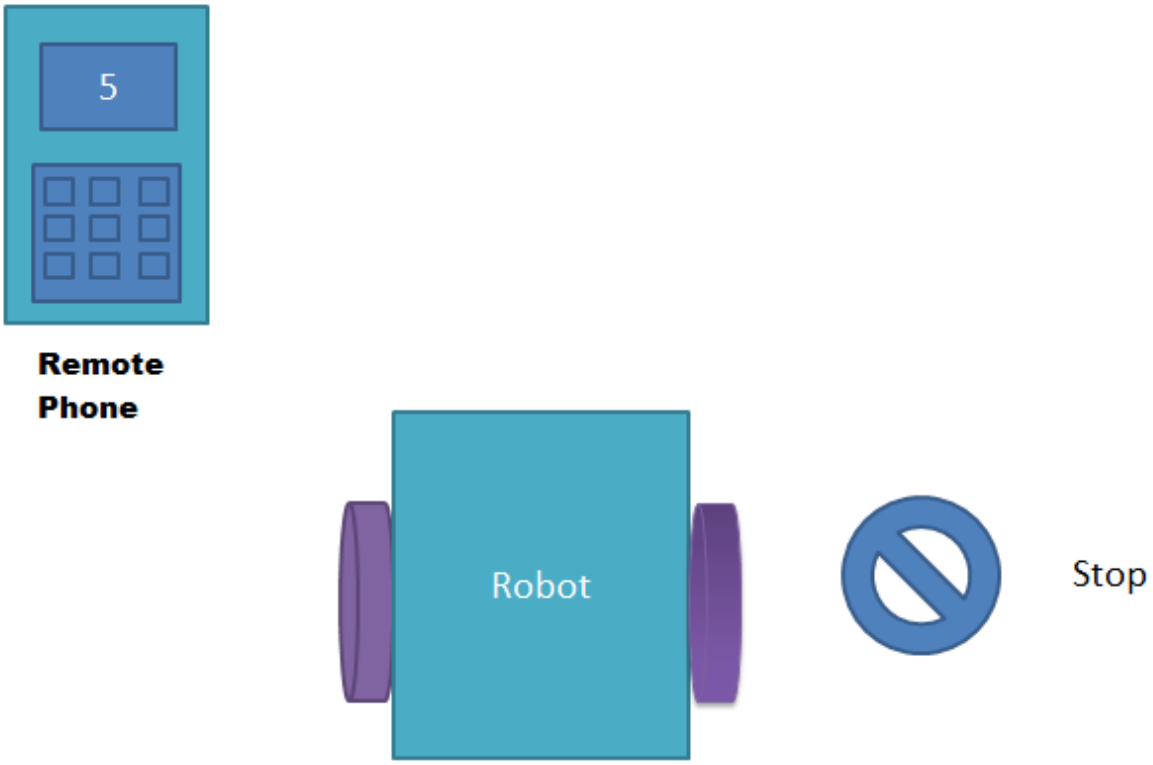
When we press ‘4’, Robot get turn left until the next command is executed.



When we pressed ‘6’, the robot turned to the right.



And for stopping a robot we pass 5’.



3.3.2. Working of Metal Detector

Metal detectors work by transmitting an electromagnetic field from the search coil into the ground. Any metal objects (targets) within the electromagnetic field will become energized and retransmit an electromagnetic field of their own.

The detector's search coil receives the retransmitted field and alerts the user by producing a target response. Minelab metal detectors are capable of discriminating between different target types and can be set to ignore unwanted targets.

1. Control Box

The control box contains the detector's electronics. This is where the transmit signal is generated and the receive signal is processed and converted into a target response.

2. Search Coil

The detector's search coil transmits the electromagnetic field into the ground and receives the return electromagnetic field from a target.

3. Transmit Electromagnetic Field *(visual representation only - blue)*

The transmit electromagnetic field energizes targets to enable them to be detected.

4. Target

A target is any metal object that can be detected by a metal detector. In this example, the detected target is treasure, which is a good (accepted) target.

5. Unwanted Target

Unwanted targets are generally ferrous (attracted to a magnet), such as nails, but can also be non-ferrous, such as bottle tops. If the metal detector is set to reject unwanted targets then a target response will not be produced for those targets.

6. Receive Electromagnetic Field *(visual representation only - yellow)*

The receive electromagnetic field is generated from energized targets and is received by the search coil.

7. Target Response *(visual representation only - green)*

When a good (accepted) target is detected the metal detector will produce an audible response, such as a beep or change in tone. Many Minelab detectors also provide a visual display of target information such as an ID number or 2 dimensional display.

Target Size

Large targets can be detected deeper than small targets.

Target Shape

Circular shapes like coins and rings can be detected deeper than long thin shapes like nails.

Target Orientation

A horizontal coin (e.g. lying flat) can be detected deeper than a vertical coin (e.g. on edge).

Target Material

High conductive metals (e.g. silver) can be detected deeper than low conductive metals (e.g. lead or gold).

3.4. Code

Programming Explanation

In the program , first of all we have defined output pins for motors and Input pins for DTMF decoder output as in INPUT for Arduino.

```
#define m11 3
#define m12 4
#define m21 5
#define m22 6

#define D0 19
#define D1 18
#define D2 17
#define D3 16
```

And then in the setup set the motor pin as OUTPUT and DTMF decoder output pins as INPUT.

```
void setup()
{
  pinMode(D0, INPUT);
  pinMode(D1, INPUT);
  pinMode(D2, INPUT);
  pinMode(D3, INPUT);

  pinMode(m11, OUTPUT);
  pinMode(m12, OUTPUT);
  pinMode(m21, OUTPUT);
  pinMode(m22, OUTPUT);
}
```

After that we read DTMF decoder output and then compare with defined values by using the “if” statement and perform a relative operation.

```
int temp1=digitalRead(D0);
int temp2=digitalRead(D1);
int temp3=digitalRead(D2);
int temp4=digitalRead(D3);

if(temp1==0 && temp2==1 && temp3==0 && temp4==0)
forward();
```

There are five conditions in this **DTMF controlled Robot** that are giving below:

Input					Output				
Mobile Key	DTMF Decoder				Motor				Robot Movement
	D3	D2	D1	D0	M11	M12	M21	M22	
5	0	1	0	1	0	0	0	0	Stop
4	0	1	0	0	1	0	0	0	Left
6	0	1	1	0	0	0	1	0	Right
2	0	0	1	0	1	0	1	0	Forward
8	1	0	0	0	0	1	0	1	Backward

Code

```
const int MetalS =8;

int Metal =1;


#define m11 3

#define m12 4

#define m21 5

#define m22 6


#define D0 19
```

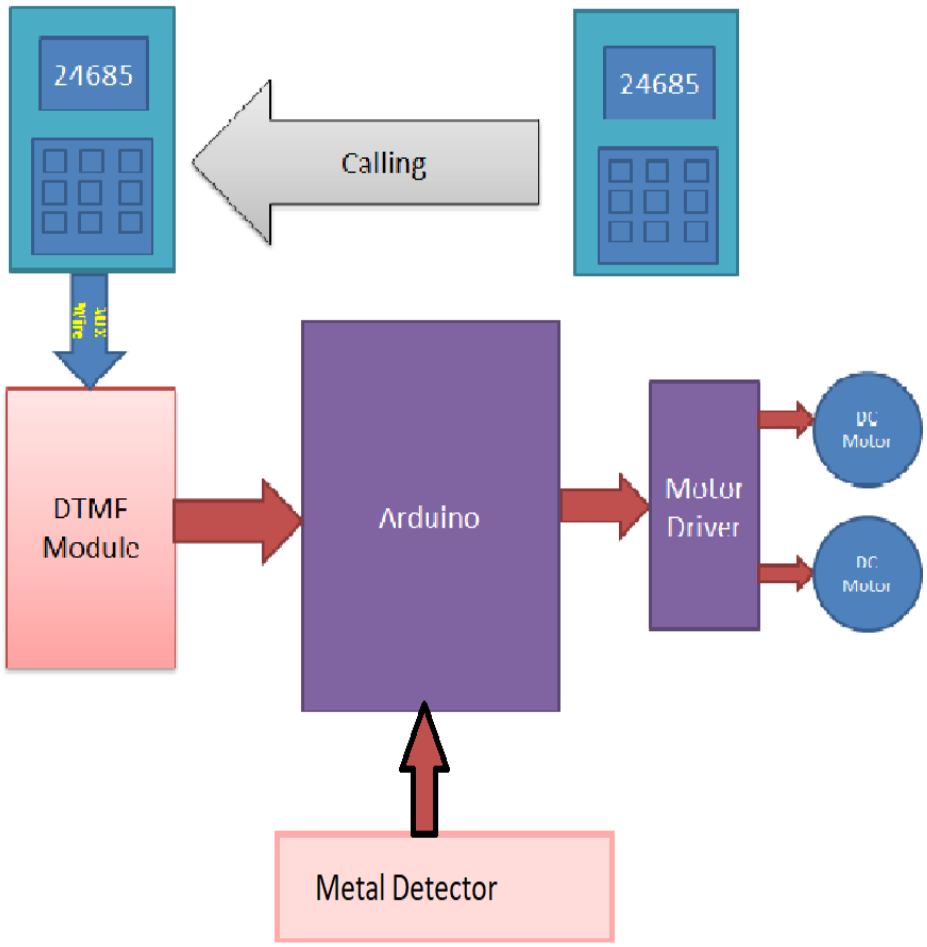
```
#define D1 18
#define D2 17
#define D3 16

void forward()
{
  digitalWrite(m11, HIGH);
  digitalWrite(m12, LOW);
  digitalWrite(m21, HIGH);
  digitalWrite(m22, LOW);
}
void backward()
{
  digitalWrite(m11, LOW);
  digitalWrite(m12, HIGH);
  digitalWrite(m21, LOW);
  digitalWrite(m22, HIGH);
}
void left()
{
  digitalWrite(m11, HIGH);
  digitalWrite(m12, LOW);
  digitalWrite(m21, LOW);
  digitalWrite(m22, LOW);
}
void right()
```

```
{
  digitalWrite(m11, LOW);
  digitalWrite(m12, LOW);
  digitalWrite(m21, HIGH);
  digitalWrite(m22, LOW);
}
void Stop()
{
  digitalWrite(m11, LOW);
  digitalWrite(m12, LOW);
  digitalWrite(m21, LOW);
  digitalWrite(m22, LOW);
}
void setup()
{ pinMode(D0, INPUT);
 pinMode(D1, INPUT);
 pinMode(D2, INPUT);
 pinMode(D3, INPUT);

 pinMode(m11, OUTPUT);
 pinMode(m12, OUTPUT);
 pinMode(m21, OUTPUT);
 pinMode(m22, OUTPUT);
}
void loop()
{
```

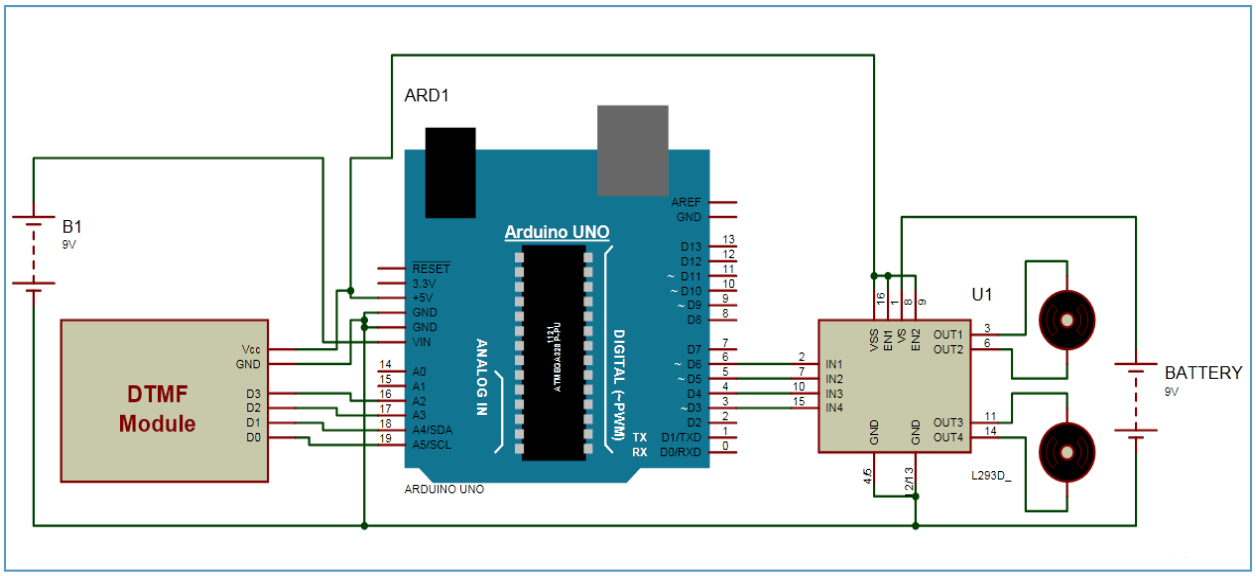
```
  Metal =digitalRead(MetalS);

 int temp1=digitalRead(D0);
 int temp2=digitalRead(D1);
 int temp3=digitalRead(D2);
 int temp4=digitalRead(D3);
if(Metal == LOW)
 {
  Stop();
  delay(211);
 }


 if(temp1==0 && temp2==1 && temp3==0 && temp4==0)
 forward();
 else if(temp1==0 && temp2==0 && temp3==1 && temp4==0)
 left();
 else if(temp1==0 && temp2==1 && temp3==1 && temp4==0)
 right();
 else if(temp1==0 && temp2==0 && temp3==0 && temp4==1)
 backward();
  else if(temp1==1 && temp2==0 && temp3==1 && temp4==0)
 Stop();
}
```

4. System Design

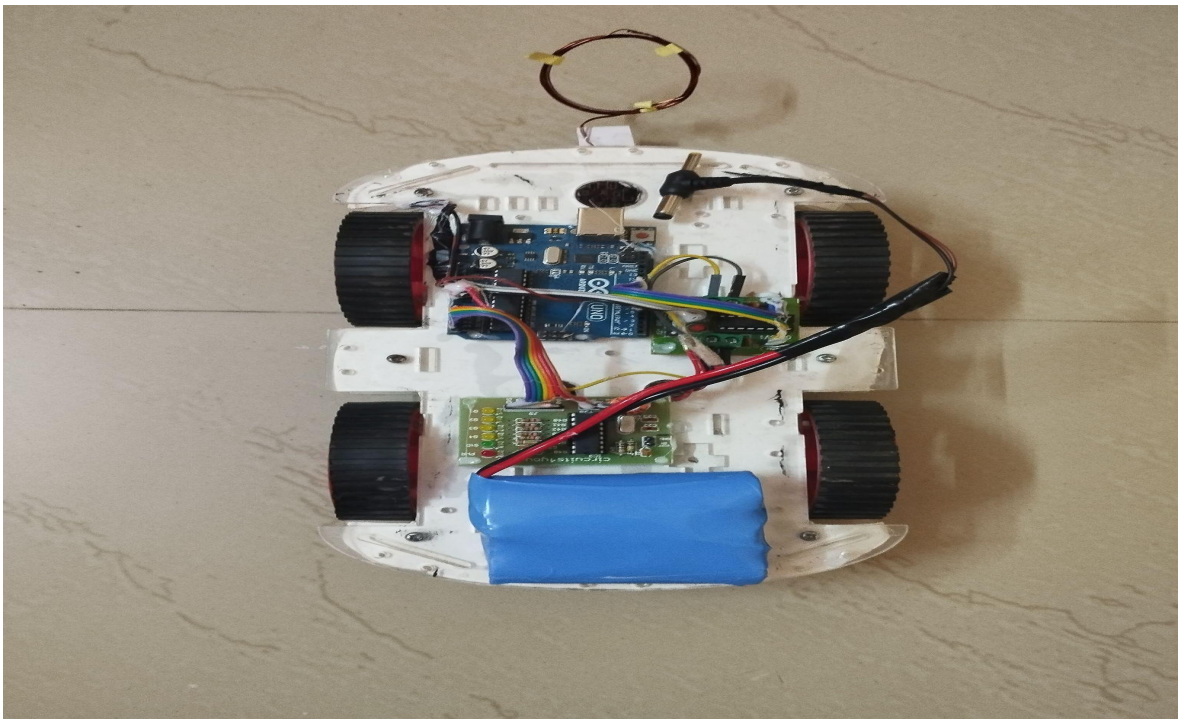
4.1. Block Diagram

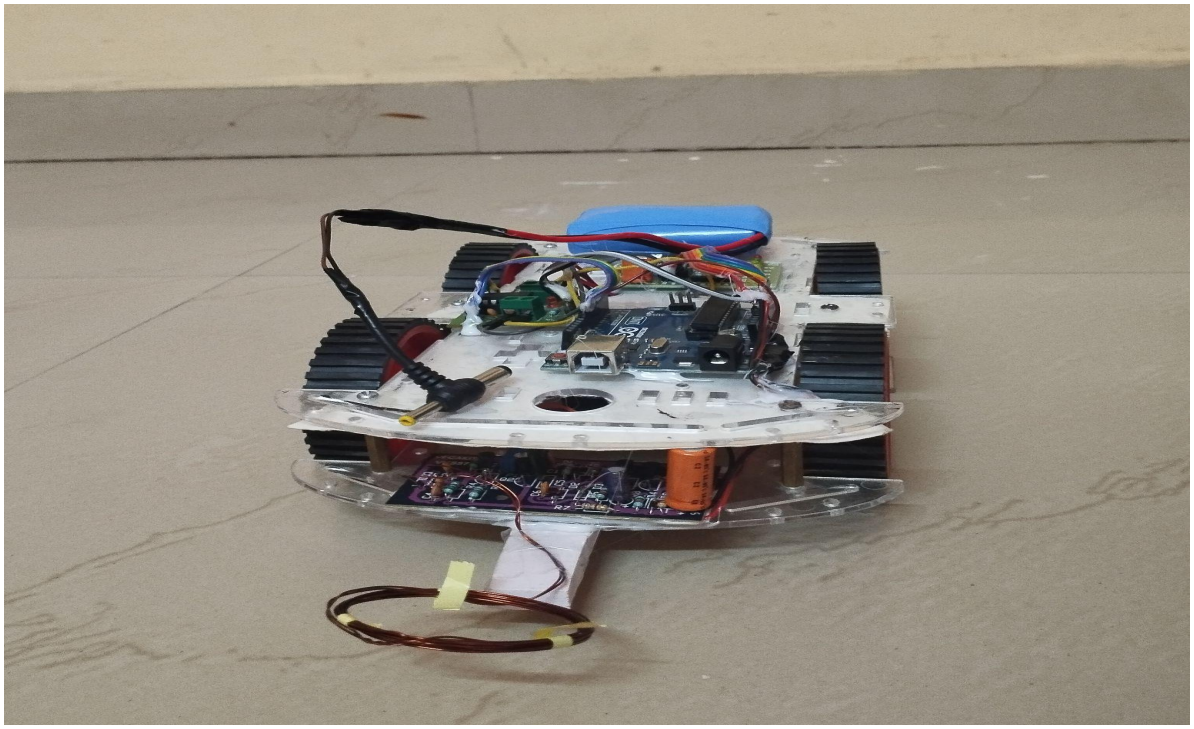


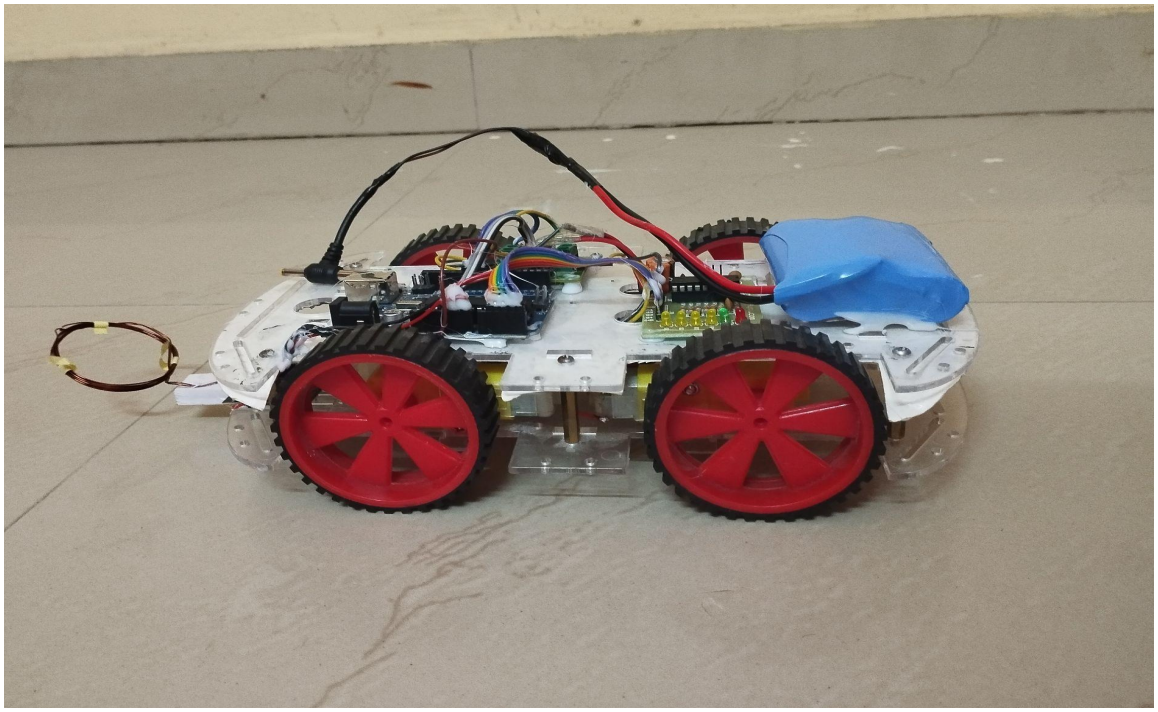
4.2. Circuit Diagram and Working Explanation

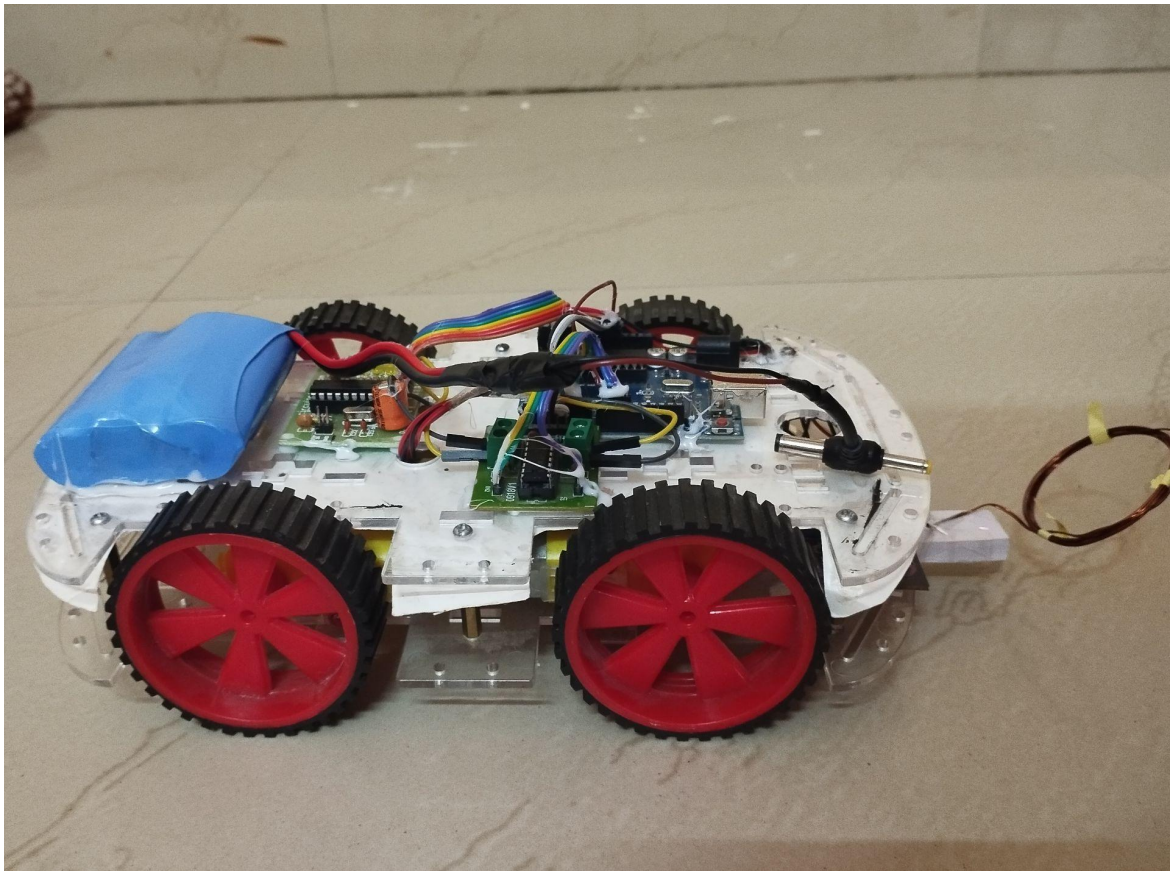


Circuit digram for Arduino based DTMF Controlled Rangeless Robot is very similar with our other robot like PC controlled robot, Line Follower, Gesture Controlled Robot, etc.. Here one motor driver is connected to arduino for driving robot. Motor driver's input pin 2, 7, 10 and 15 is connected at arduino digital pin number 6, 5, 4 and 3 respectively. Here we have used two DC motors to driver robot in which one motor is connected at output pin of motor driver 3 and 6 and another motor is connected at 11 and 14. A 9 volt Battery is also used to power the motor driver for driving motors. A DTMF decoder attached with this circuit and this decoder is plugged into a mobile using an aux wire for receiving command or DTMF Tone. DTMF decoder pin D0-D3 is directly connected with Arduino's pin number 19,18,17,16. Two 9 Volt batteries are used to power the circuit in which one is used for power the motors, connected at motor driver IC pin number 8. And another battery is connected to power the remaining circuit.









5.1. Future Scope

A future scope would be to install a camera in the robot to survey the minefield and to give real time images to the user or human controller so that the exact position of the landmine can be detected and can be easily diffused.

The future scope of landmine detector robots is vast and promising. These robots can play a crucial role in ensuring the safety of people and minimizing the risk of injuries and fatalities caused by landmines. Here are some potential areas of development and application for landmine detection robots:

Enhanced accuracy and efficiency: Future landmine detector robots could be designed to have greater accuracy and efficiency in detecting landmines. They could use advanced sensors and imaging technologies to detect landmines more precisely, thereby reducing false alarms and increasing detection rates

Autonomous operation: As robotics and AI technologies continue to advance, landmine detector robots could become more autonomous in their operation. This would enable them to navigate challenging terrain and detect landmines without human intervention, making them ideal for use in remote or dangerous areas.

Multi-functionality: In addition to detecting landmines, future robots could be designed to have other functionalities, such as mapping and surveying terrain

or collecting environmental data. This would make them useful for a range of applications beyond just landmine detection.

Collaborative operation: Future landmine detector robots could be designed to work collaboratively in teams, sharing information and data to improve accuracy and efficiency. This would enable them to cover larger areas more quickly and thoroughly, reducing the time and resources required to clear landmines.

Improving clearance speed: The speed of landmine clearance is a significant challenge, with millions of landmines still buried worldwide. Future robots could be designed to work faster and more efficiently, reducing the time required to clear landmines and improving the safety of affected communities.

5.2. Conclusion

The future scope of landmine detector robots is promising, with the potential to improve the safety of people and communities affected by landmines. As technology continues to advance, we can expect to see more sophisticated and effective landmine detector robots in the coming years. It is a helpful tool for the military for surveying and monitoring purpose.The robot is equipped with a camera for monitoring the condition of the robot.The power system is developed by replacing the battery with the solar panels to produce continuous power.

5.3. References

We have found various research papers and Reference Books on Landmine Detector Rangeless Robot , some of which are as follows:

a. Brown C, Zoubir A.M, Chant, I.J, Abeynayake, C., "Landmine detection using single sensor metal detectors," in Acoustics, Speech, and Signal Processing.

b. “ Arduino Controlled Landmine Detection Robot”by V. Abilash J. Paul Chandra Kumar.This paper has described overall design for robot for landmine detection purpose and implementation.

c. Zhenjun He, Jiang Zhang, Peng Xu, JiahengQin andYunkai Zhu, "Mine detecting robot based on wireless communication with multi-sensor".

d. . Kuo-Lan Su, Hsu-Shan Su, Sheng-Wen Shiao and Jr-Hung Guo (2011), “Motion Planning for a Landmine-Detection Robot”, Artificial Life and Robotics.

e. Minh Dao-Johnson Tran, CaniciousAbeynayake, Lakhmi C Jain and Lim C P (2010), “An Automated Decision System for Landmine Detection and Classification Using Metal Detector Signals”, Innovations in Defence Support Systems.