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<< Landmine detection robot >>

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Group members

London Met ID	Student Name
22068044	Nayendra Gurung
22068132	Prabhab Khanal
22068066	Bishista Bajracharya
22068071	Pranish Maharjan

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I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

Acknowledgement:

We would like to thank our esteemed respective teachers Mr. Sugat Man Shakya, Mr. Suryansh Mathema,Mr Shishir K.C sir for providing such a valuable informative opportunity to work as a team and create an IOT project developing real world skills to be needed. Their descriptive guidance, teachings and suggestions really helped us in gaining valuable knowledge, skills and in the completion the IOT project successfully. A heartfelt thankful for our Islington college for providing us with the essential hardware components needed for the IOT project.

Special thanks to our teachers for comprehensive understanding of IoT concepts, hardware components, cloud computing, and essential teamwork skills that played crucial part in completing this project collaboratively.

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Abstract

An innovative way to address the problem of landmines in areas recovering from conflicts is the Landmine Detection Bot. Huge areas of ground, including public spaces, building sites, and agricultural fields, have become dangerous and useless due to these hidden bombs, which has tragically ended in human fatalities and wasted land. With the use of a metal sensor, our smart bot can locate landmines and emit a buzzer to alert others of their existence via buzzer also giving an alert message through whatsapp. It guarantees user safety when traversing hazardous terrain when operated remotely. By using the device, landmine-related hazards should be greatly reduced, unused land should be reclaimed and rebuilt, and unused land should be made more easily into productive, usable

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1. Introduction

Landmines remains one of the most dangerous weapons both during and after wartime. Their trap-based nature poses a significant threat to human lives and the surrounding environment due to their explosive characteristics. Even post-battle, numerous sectors worldwide, including fertile lands suitable for agriculture, construction sites, infrastructure development, and areas for public use, remain inaccessible and unused due to undetected landmines. These hidden dangers are challenging to identify with the naked eye, leading to the tragic loss of human lives and even test animals attempting to clear these areas. Countless valuable landscapes capable of supporting irrigation, farming, and various beneficial purposes lie dormant, their potential unrealized due to the presence of landmines. To address this critical issue, the proposed solution is the Landmine Detection Bot. This device uses a metal sensor to detect landmines and promptly alerts the user through a buzzer. The device is fully remote-controlled, enabling users to navigate the bot with precision in specific patterns from a safe distance, ensuring user safety.

By implementing such technology, one can mitigate the risks associated with landmines, reclaim unused lands, and unlock the potential of these areas for productive and life-enhancing purposes.

1.1 Current scenario

Nepal is one of the top 10 nations in the world for civilian deaths from mine and IED explosions, according to the International Campaign to Ban Landmines. Children make up around 57% of the victims, and they are particularly vulnerable since the devices were haphazardly positioned next to homes and in fields where kids play. The Nepalese Army reports that there are more than 12,000 mines in 50 land minefields, including anti-personnel and command-detonated landmines in 37 districts. According to UNICEF and the local human rights organization INSEC, there were around 86 explosions in 2006 that resulted in 146 deaths. These explosions were caused by landmines laid by government forces and IEDs planted by the Maoists. Their data indicated an eighty percent rise over events in 2005. (Integrated Regional Information Networks (IRIN), part of the UN Office for the Coordination of Humanitarian Affairs (OCHA)., 2007)

The minefield in Phulchowki is one of the 53 locations throughout the country where landmines were laid by the Nepal Army to protect military installations and physical infrastructure such as communications and hydropower stations. During the decade-long armed conflict, Nepal was contaminated by landmines and other explosive

remnants of war which remain as a threat to the safety and security of the communities and continued to kill people even today. (United Nations Development Programme, 2024)As of right now Nepal does not pose that much of a threat of having undetected landmines areas but the past records and casualties shows how the undetected landmine is a serious threat to the community and human lives. The detection of these landmines itself is a huge threat and challenging task to do as many lives has died during the process.

1.2 Problem Statement and Project as a solution

Remains from previous wars, landmines pose a serious threat to public safety and the advancement of society. The conventional techniques for identifying these are risky, life threatening labour-intensive, and time-consuming, which results in a delayed and ineffective procedure for removing landmines. In addition to putting lives in danger, this problem made large tracts of potentially productive land useless. The situation is made worse by the standard landmine detecting method lack of real-time data gathering and remote monitoring, which hinders community growth and results in protracted periods of economic stagnation in the impacted areas.

The creation of a landmine detection robot presents a ground-breaking answer to this problem. By incorporating technologies including sensors, data processing algorithms, and wireless communication networks, this robot significantly raises the standard of landmine detecting safety, effectiveness, and accuracy. It greatly lowers the hazards related to landmine detection by enabling quicker, more informed decision-making through data transmission and remote monitoring capabilities. This creative method not only results for the quicker detection of landmines but also for the restoration and socioeconomic growth of areas that were previously affected.

1.3 Aim and Objectives:

Aim:

The aim of this project is to establish an easily deployable and secure method for landmine detection using metal detector.

Objectives:

- Metal Detection System: The core of the Landmine Detection Bot is its metal detection system. The device utilizes a sensitive metal detector that can identify metallic objects within a specific range.

- Buzzer Alert Mechanism: Upon detecting metal, the system triggers a buzzer alert, providing a real-time warning to the user.

- Wireless and Hands-On Control: The wireless control system offers a hands-on approach, giving operators the ability to guide the robot in a targeted manner. This not only ensures a more thorough and efficient landmine detection process but also minimizes the need for human presence in high-risk zones.

- Transforming Hazardous Areas into Safe Zones: The foremost goal is to identify and detect landmines effectively, thereby converting hazardous areas into safe zones. This approach aligns with promoting environmentally sound practices and ensures the safety of the surrounding ecosystem.

- User-Friendly Control System: Develop a control system that is user-friendly and straightforward, enabling operation by individuals easily. This emphasis on user-friendliness aims to facilitate ease of use for anyone interacting with the system.

- Ensuring User Safety in Case of Explosions: Design the system to detect landmines across expansive areas, all within a safe operational range. This involves remotely controlling the bot through a transmitter/receiver.

- GPS Location Tracking of Detected Landmines: Incorporate GPS technology to precisely identify and record the location of detected landmines. This ensures accurate tracking of landmine locations, enhancing the overall effectiveness of the detection process.

- Obstacle warning: Use of ultrasonic sensor to detect and warn the user through buzzer sound when encountered upon an obstacle when operating

2. Background

2.1. System Overview

The landmine detection bot system is an IOT based landmine detection via metal detector. The system when encountered near a landmine/metal generates a buzz sound through buzzer via metal detector within a specific range. The metal detector consists of a 220ohm resistor, 103nf capacitor and a 1N14001 diode, a copper coil wire which is connected to an Arduino uno powered by batteries. The car/bot is remote controlled via transmitter and receiver hence a remote-controlled car. When metal is detected, a message is sent in whatsapp via text alerting user the presence of the landmine detected through node MCU. The car when encountered on an obstacle while operating the ultrasonic sensor detects the obstacle, when detected within a certain range a buzz sound is generated alerting user about the obstacle ahead

2.2. Design Diagrams (Hardware Architecture, Flowchart, Circuit diagram)

Block diagram

A block diagram is a graphical representation of a functional perspective of the system illustrating the connections between its many components.

The various components that make up a system are represented by the blocks that give the block diagram its name. The connections between the blocks are portrayed by the lines and arrows. These graphic components offer an easy-to-read, high-level functional overview of the system.

. (miro, 2023)

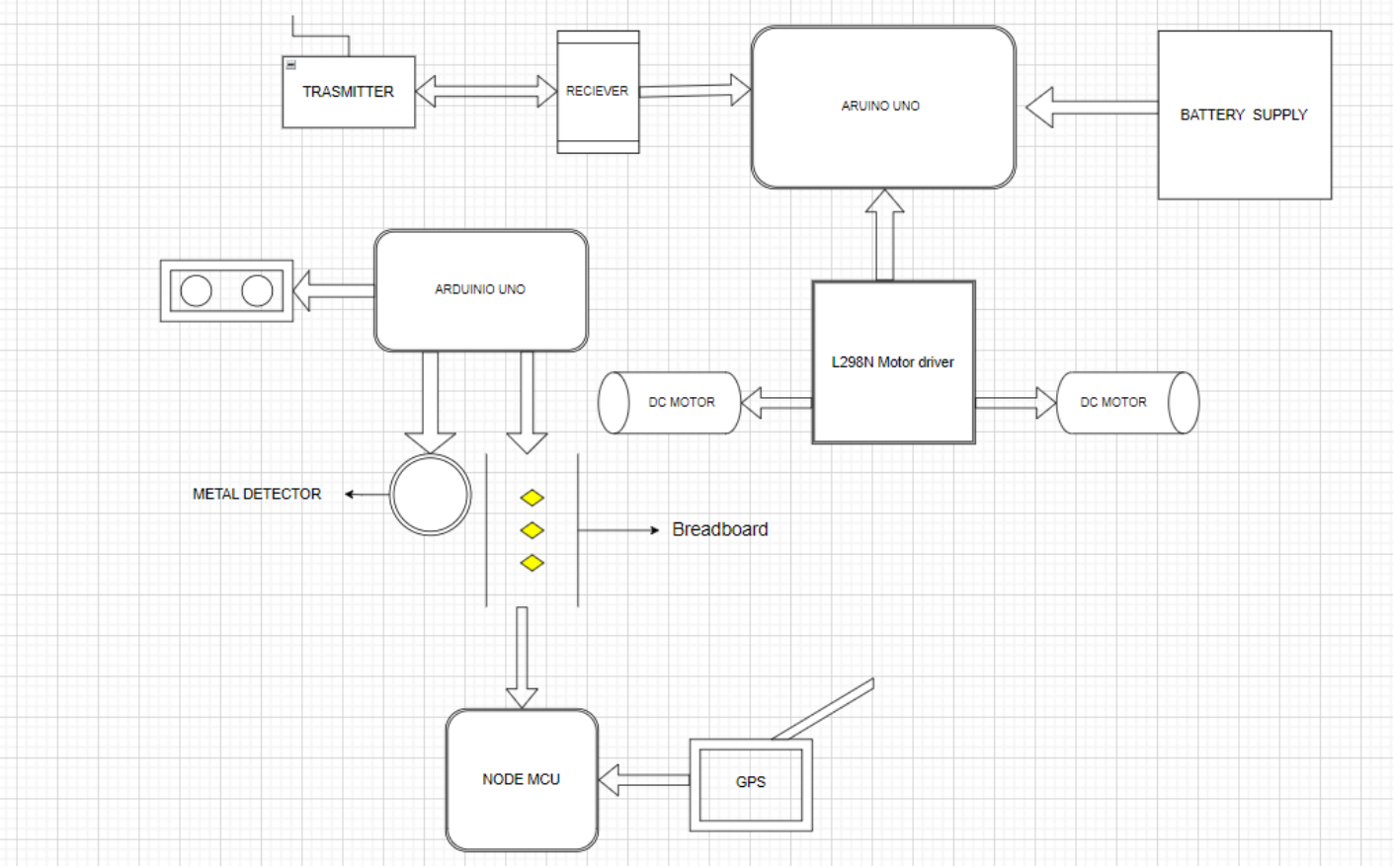

Figure 1 block diagram of the entire system

System architecture

The conceptual model that describes the system's perspectives, structure, and behaviour is called the system architecture. System architecture is the depiction and explanation of how the system functions and interacts with other parts of the system overall. (EdrawMax, 2023)

System architecture diagram of the remote-control car

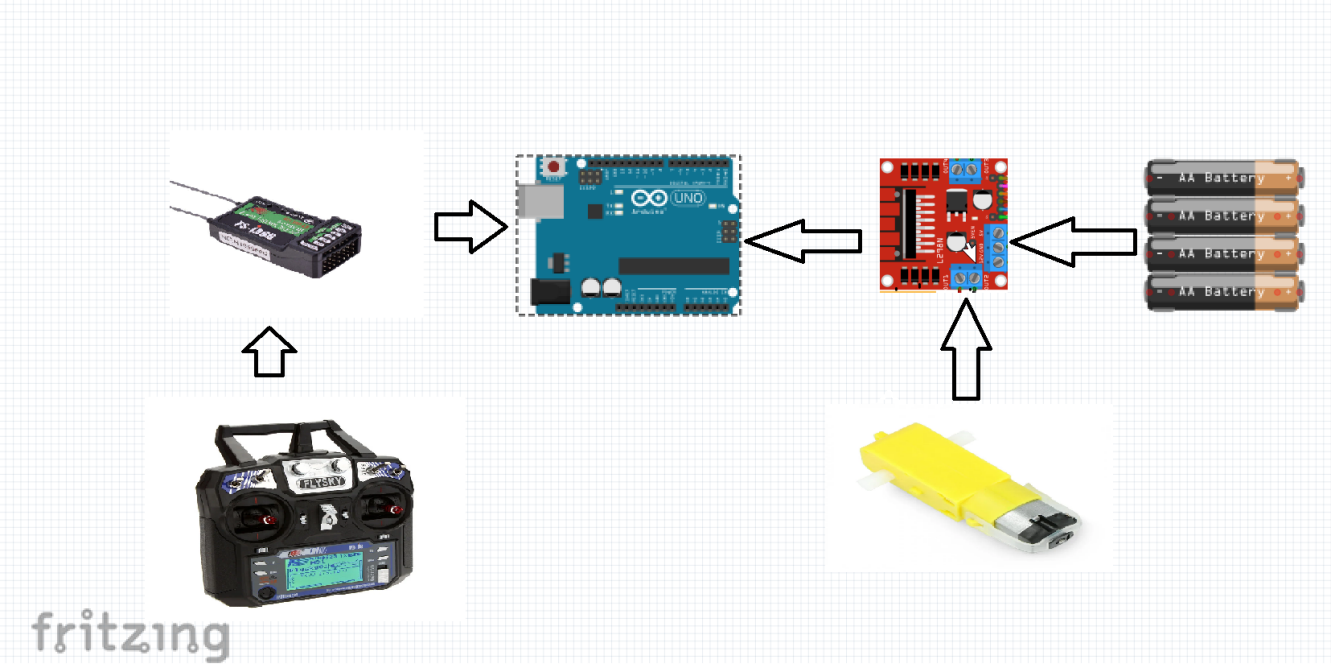

Figure 2 System architecture diagram of the remote-control car

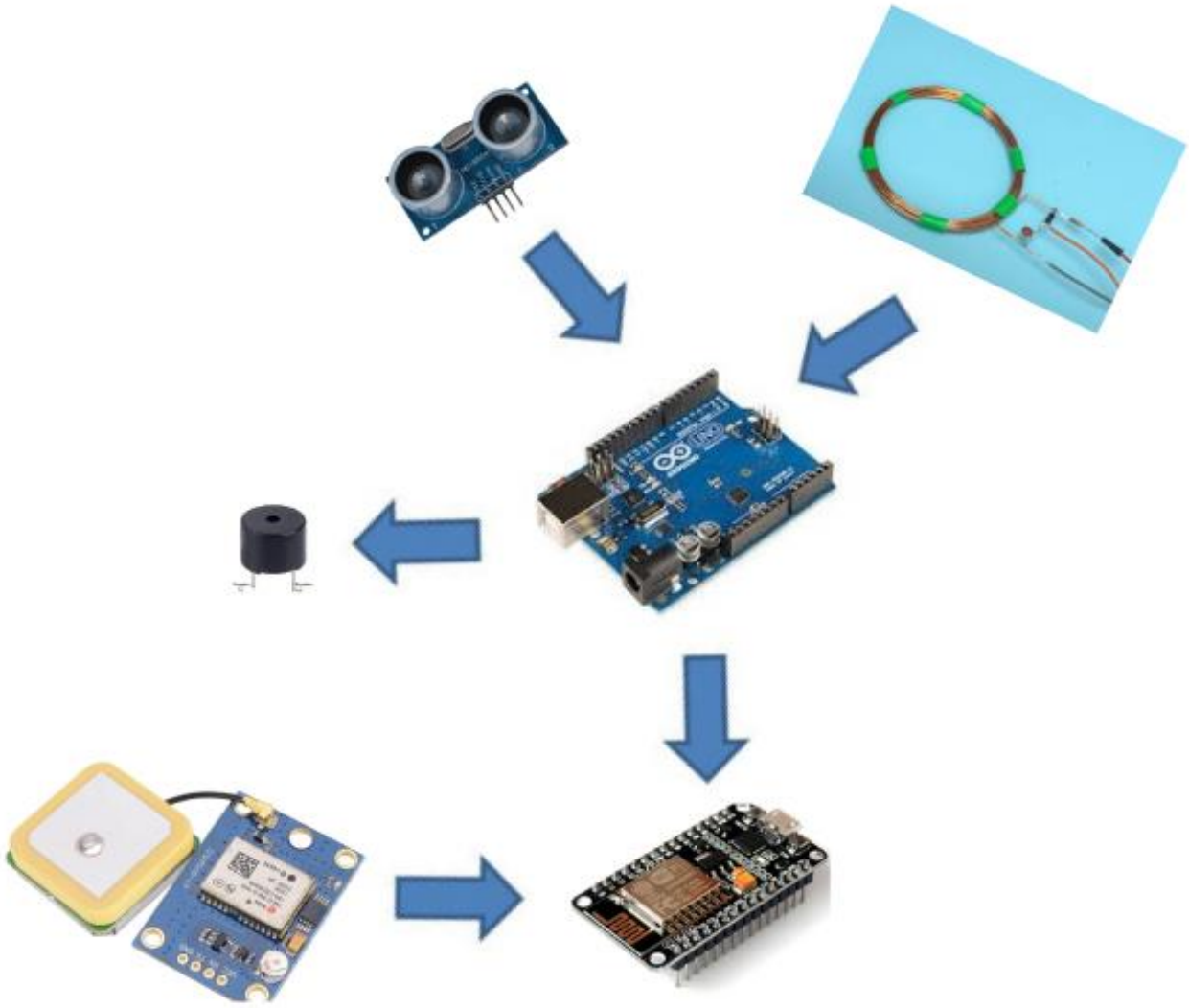

Figure 3 system architecture diagram of the metal detector, ultrasonic sensor and node mcu,gps

Circuit diagram

Circuit diagram refers to a graphical depiction of an electrical circuit that is also called an electrical diagram or electronic schematic. When designing, building, and maintaining electrical and electronic equipment, it acts as a visual aid. (byjus.com, 2023)

Circuit diagram of remote-control car

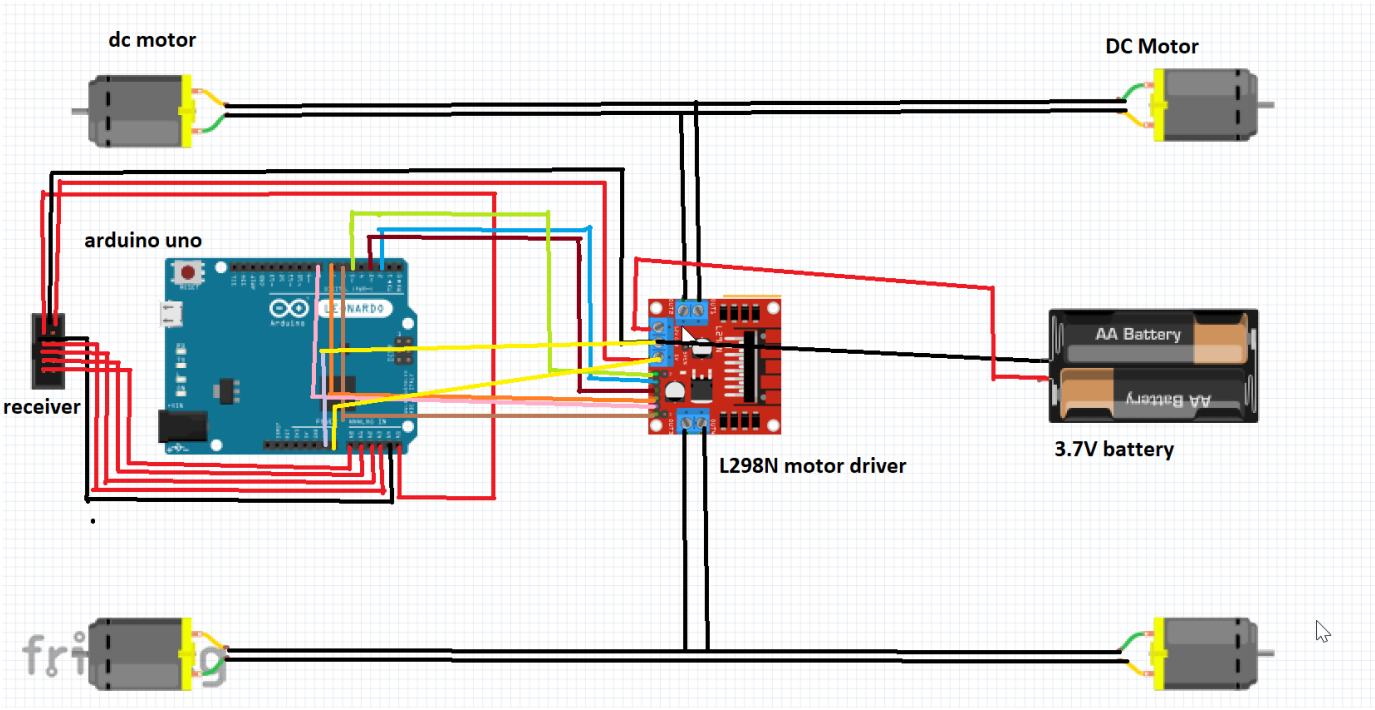

Figure 4 circuit diagram for the remote-control car

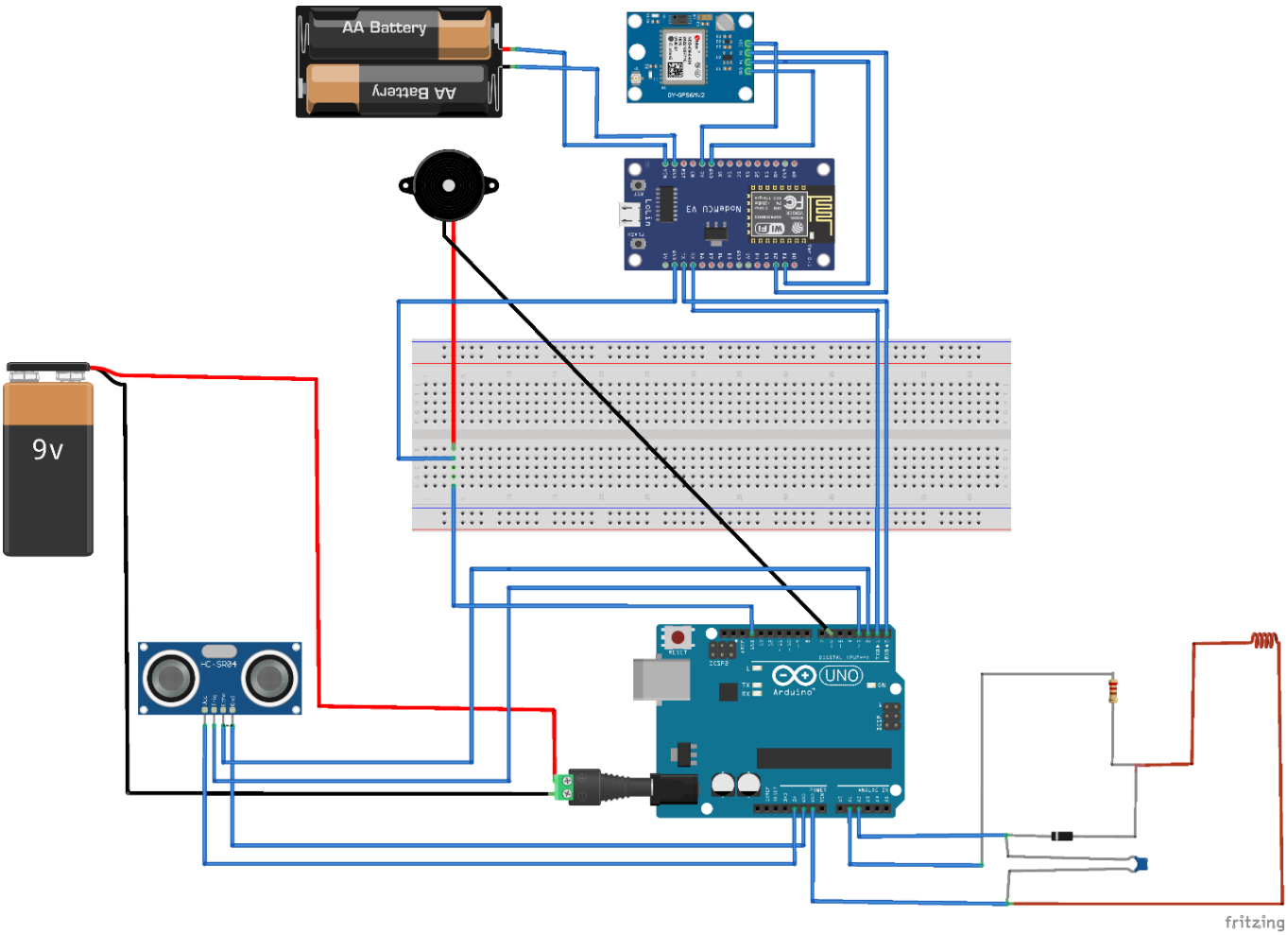

Figure 5 circuit diagram for the overall components in the car-metal detector, ultrasonic sensor,nodemcu and gps

Schematic diagram

schematic diagrams, as opposed to actual images, use visual and abstract symbols to represent the components of a system. “A schematic diagram is a drawing of the circuit, with wires represented by lines and special symbols used for the various electronic components.” (High Point University, 2023)

Schematic diagram of remote-control car

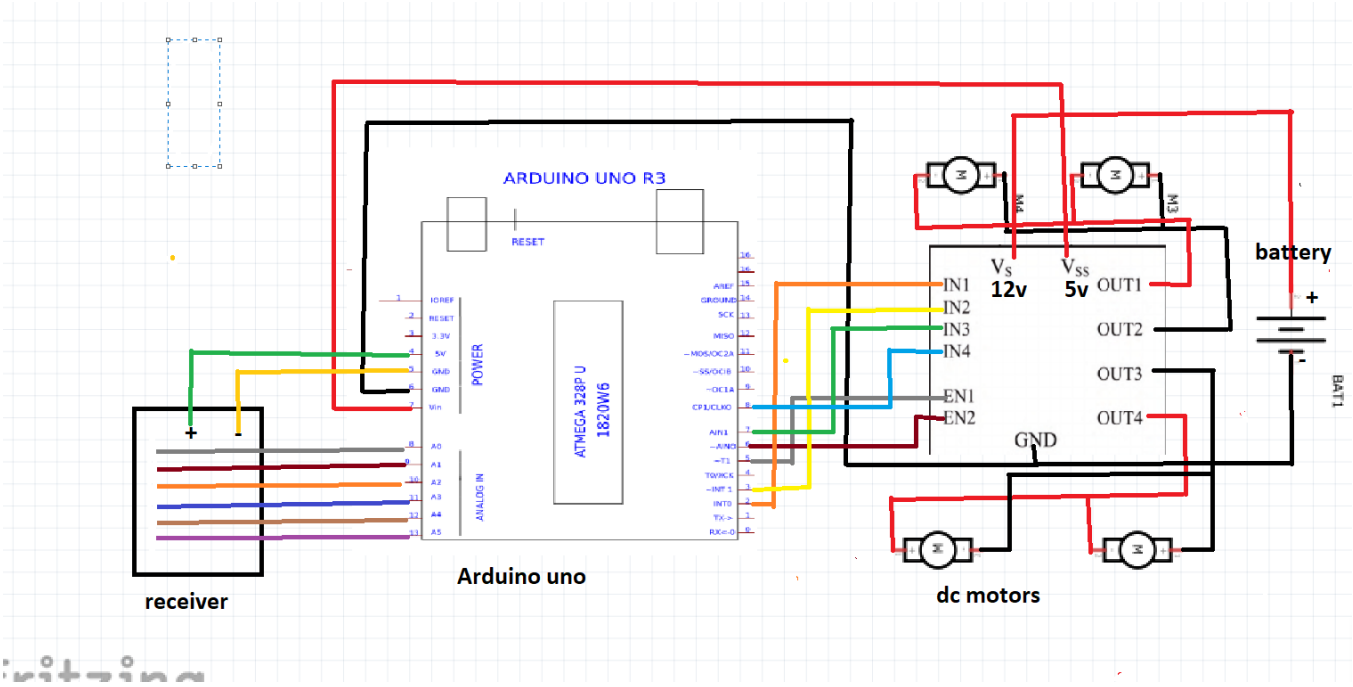

Figure 6 schematic diagram of the remote-control car

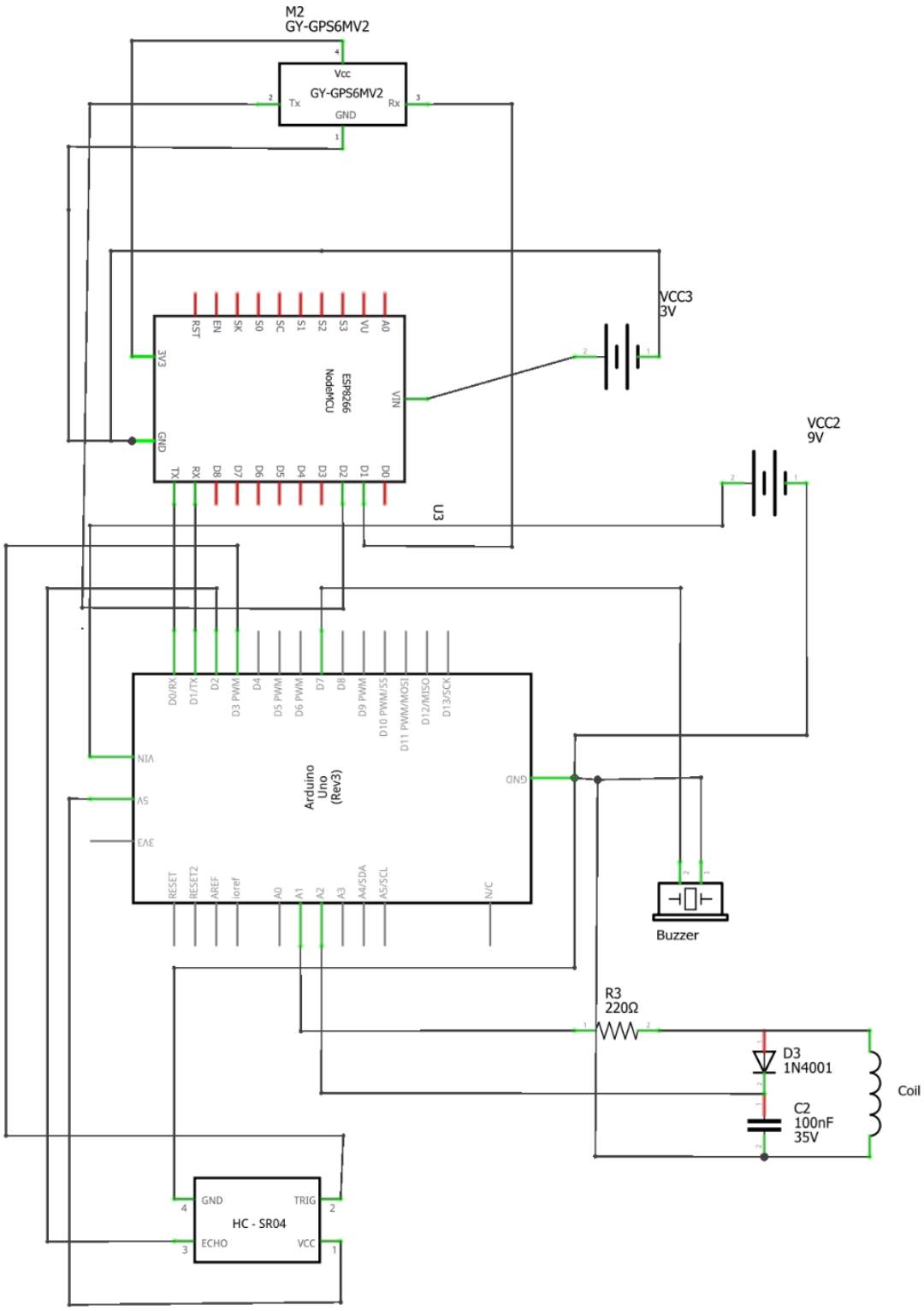

Figure 7 schematic diagram for the overall components in the car-metal detector, ultrasonic sensor,nodemcu and gps

Flowchart

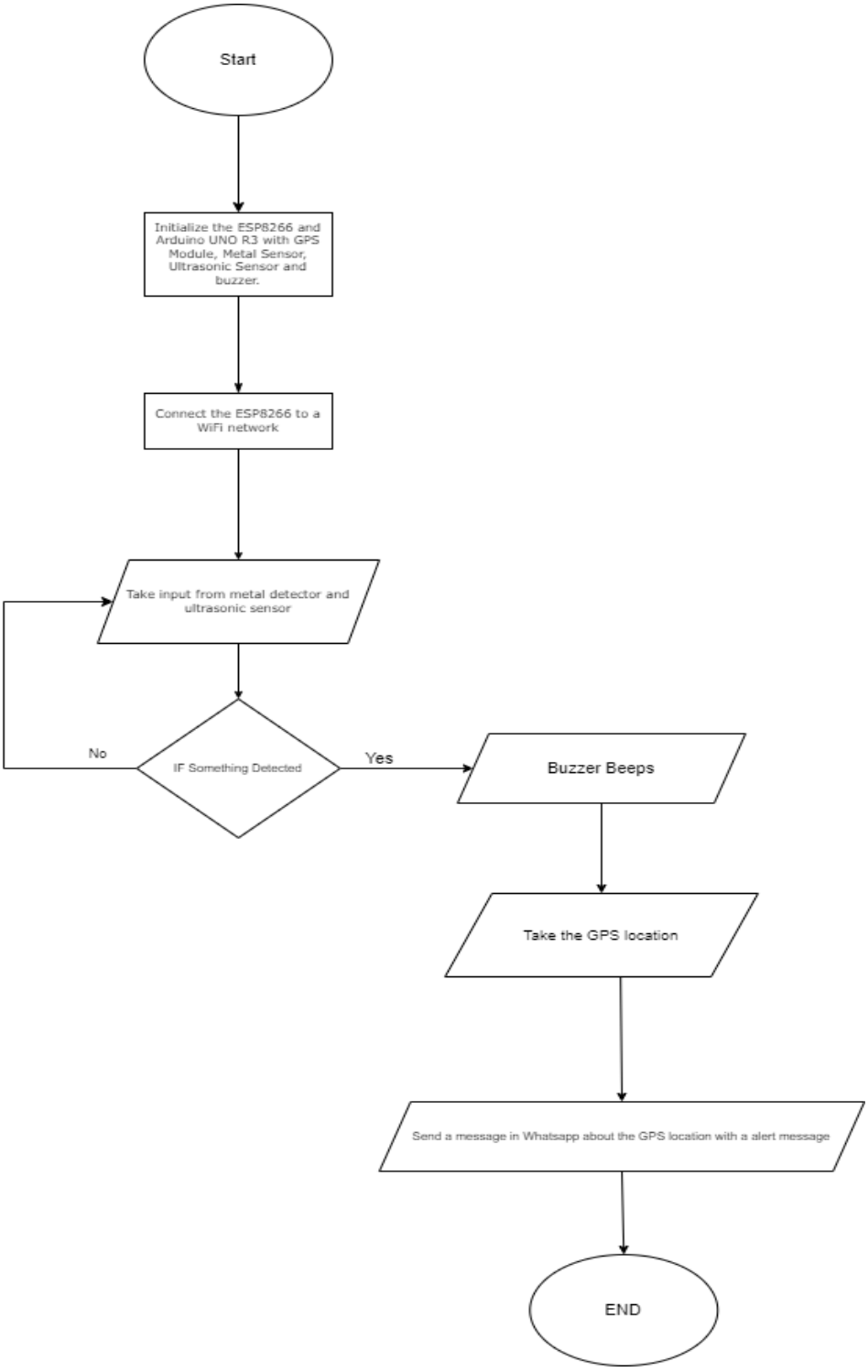

Figure 8 flowchart of the landmine detection bot system

2.3. Requirement Analysis

- **Arduino uno**

The Arduino Uno is a microcontroller board which uses ATmega328P processor. There are six analog inputs, a reset button, a power jack, an ICSP header, a USB port, and fourteen digital I/O pins. (Flyrobo, 2023)

The picture below shows the vital components of the Arduino

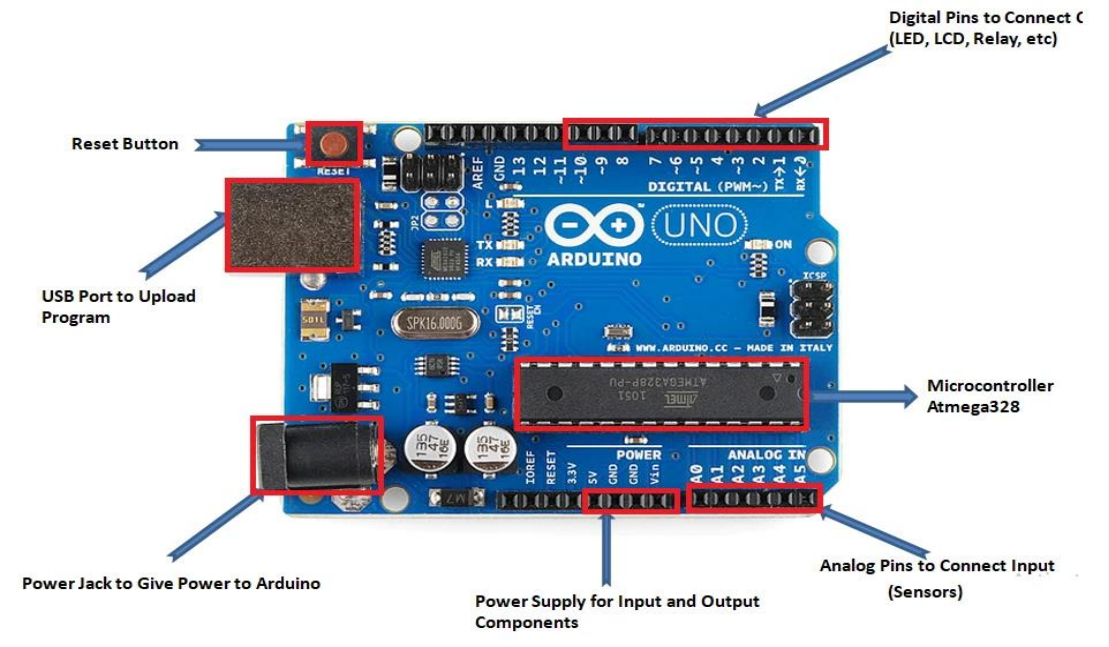

Figure 9 picture showing the components of Arduino

- **L298 Motor driver**

The L298N module is a dual full-bridge motor driver module designed to operate stepper and DC motors at high voltage and high current. It has the ability to regulate two DC motors; rotational speeds and directions. An L298 dual-channel H-Bridge motor driver IC makes up this module. This module controls the DC motors; rotational direction and speed using two different methods.

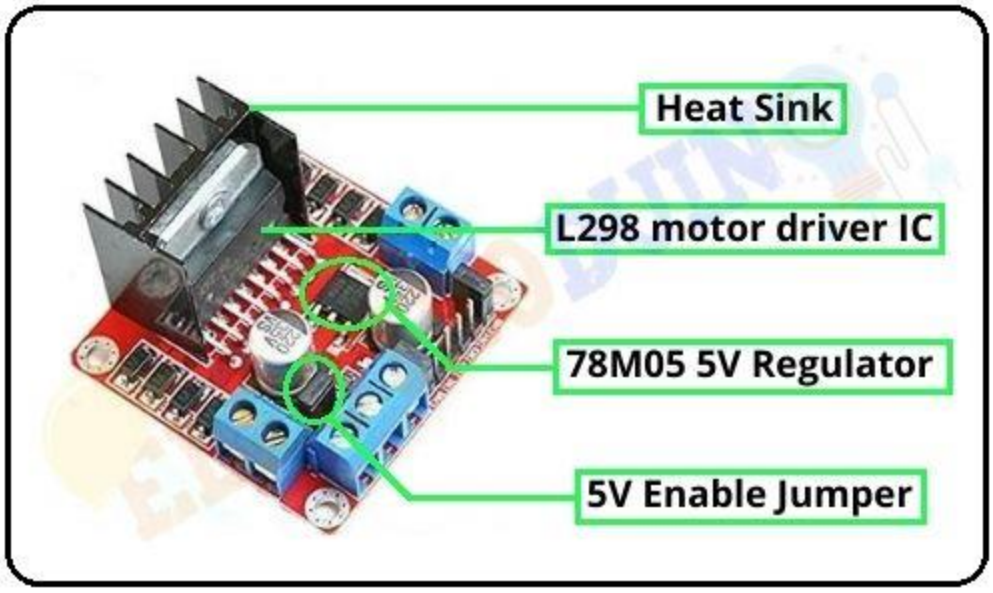

Figure 10 picture showing L298n motor driver

Pin diagram for L298 motor driver

- VCC, +5V and GND are known as power supply pins

  VCC is used to provide power supply to the module. Its voltage ranges from 5V to 35V

- IN1, IN2, IN3, IN4

  These are the control pins which controls the rotating directions of the motors

- ENA, ENB

  These are the speed control pins which is used to control the speeds of the motor

- OUT1, OUT2, OUT3, OUT4

  These are the output pins which provides output for the motors

(ElectroDuino, 2023)

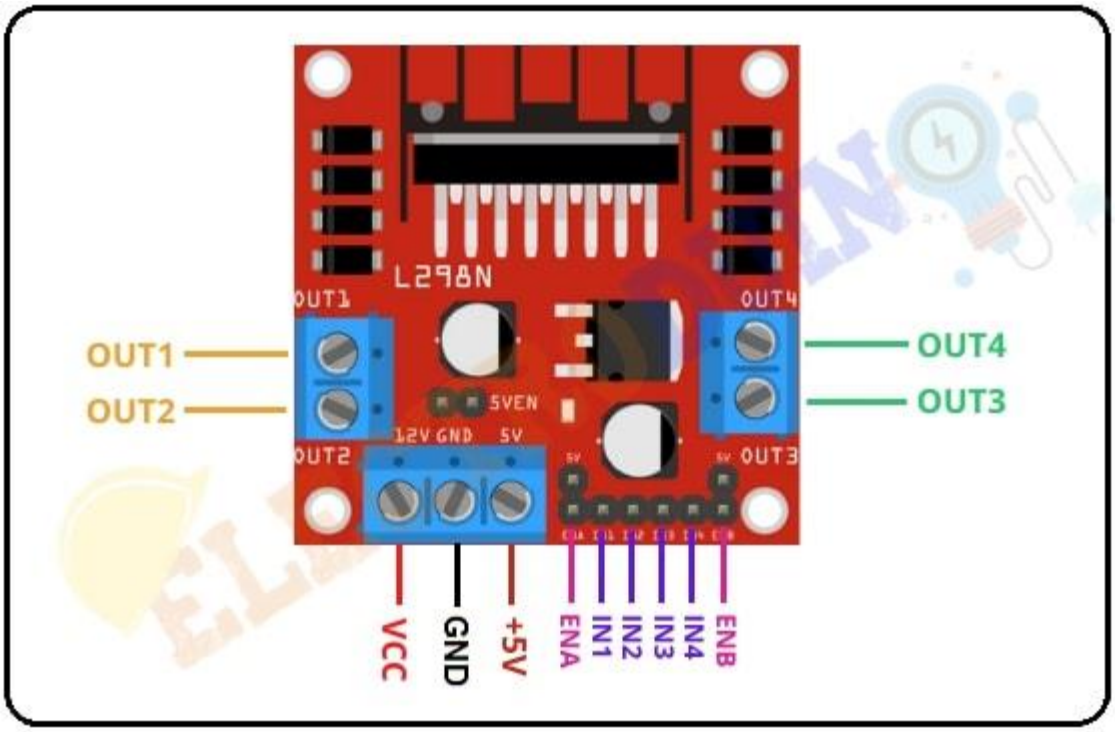

Figure 11 picture showing the pin diagram of the motor driver

- **Transmitter /Receiver:**

An RF receiver receives and interprets radio frequency (RF) signals for use in control system integration, whereas an RF transmitter emits RF signals in response to user inputs. With this wireless communication configuration, real-time communication between the transmitter and the receiving device is made possible for a variety of applications, including remote control capability.

- **Direct Current (DC) motors:**

A direct current motor is an electrical device that uses direct current to create a magnetic field in order to convert electrical energy into mechanical energy. A DC motor stator generates a magnetic field when it is energized. The rotor rotates as a result of the magnets on it being attracted to and repelled by the field. The commutator, which is affixed to brushes linked to the power source, supplies current to the motor wire windings in order to maintain the motor constant rotation

(IQS Directory, 2023)

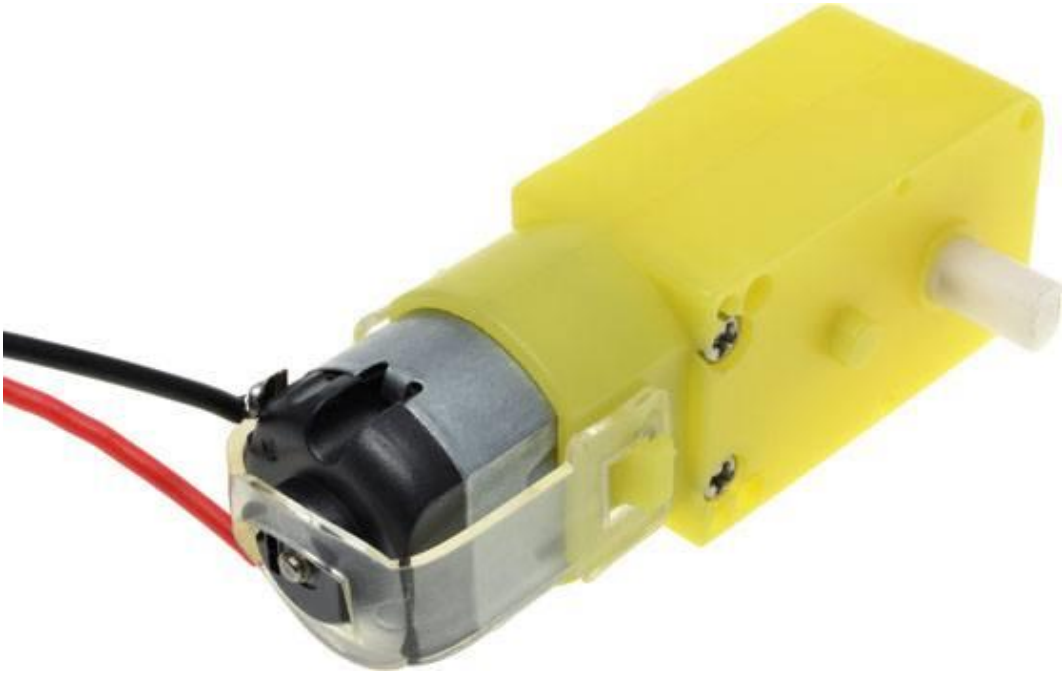

Figure 12 picture of DC motor

- **Jumper wires:**

Jumper wires are wires used to make connection between two different devices with the connector pins at the end. There are three types of jumper wires: male-to-male, male-to-female and female-to-female. The difference between them is in the end point of the wire. Male ends have a pin protruding and can plug into things but the female ends do not and are used to plug things into. (CityOS Air, 2023)

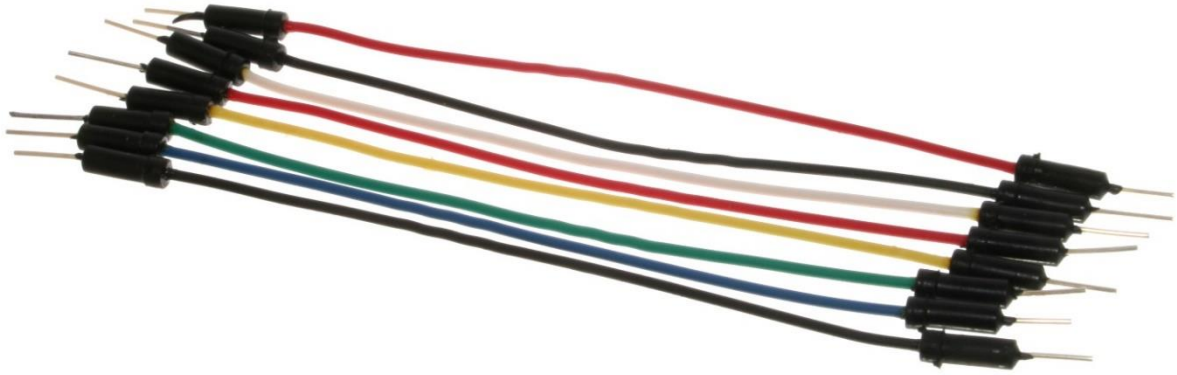

Figure 13 picture of jumper wires

- **Diode:**

A diode is an electrical device that permits electrical currents to flow only in one direction. It is used to convert alternating current (AC) to direct current (DC) in rectifier circuits. Furthermore, by stopping current reversals and guaranteeing controlled voltage Levels inside a circuit, diodes protect electronic equipment and circuits. (Study.com, 2023)

Figure 14 picture of diode

(MakeStore, 2023)

- **Capacitor:**

A capacitor, which is a device that stores electrical energy between two closely spaced plates. commonly ranging from picofarads to millifarads, their storage capacity is measured in Farads; specialized variants achieve larger capacitance at the expense of reduced performance. (Bishop, 2023)

Figure 15 picture of capacitor

(EEPower, 2023)

- **Resistor:**

An electrical component that prevents electrical current from flowing is called a resistor. It is a passive component used to control or obstruct the passage of electrical current in a circuit by adding resistance, which causes a voltage drop across the apparatus. (DAS, 2023)

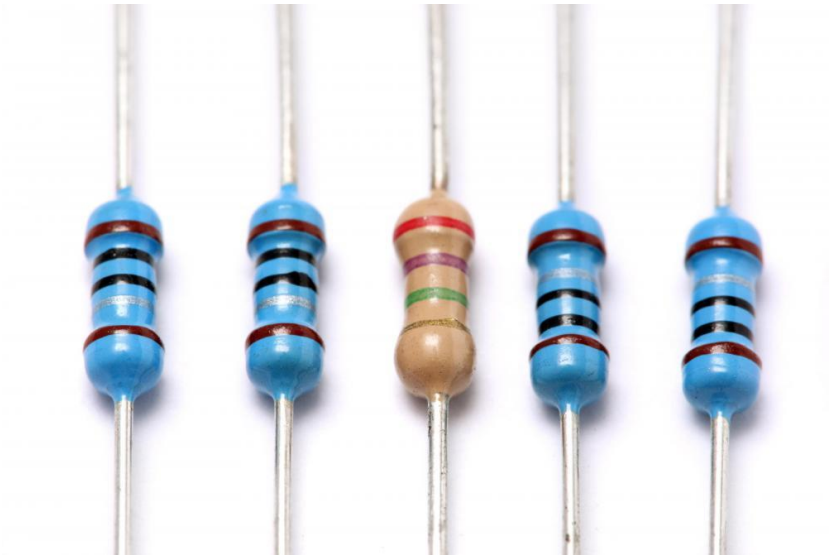

Figure 16 picture of resistor

(Lee, 2023)

- **Ultrasonic Sensor:**

A device that uses ultrasonic sound waves to measure an object distance is called an ultrasonic sensor. An ultrasonic sensor transmits and receives ultrasonic pulses using a transducer to determine the proximity of an item. The sensor transducer receives and transmits ultrasonic sound like a microphone. By monitoring the time intervals between delivering and receiving the ultrasonic pulse, the sensor calculates the distance to a target.

(MaxBotix, 2023)

Figure 17 picture of ultrasonic sensor

- **Node MCU:**

Node MCU is open-source firmware, hardware, and software development environment project developed initially for the ESP8266 Wi-fi SoC chip based on LUA. The most spectacular features like it is a low-cost, small and powerful board. It is specifically designed for IoT applications. It is compatible with Arduino IDE and micro python making prototyping a lot faster. (Robocraze, 2023)

Figure 18 picture of node mcu

- **Breadboard**

  A white rectangular board with tiny integrated holes for electrical component insertion is called a breadboard. A breadboard also is as a prototype that serves as the foundation for building circuits. (Javatpoint , 2021)

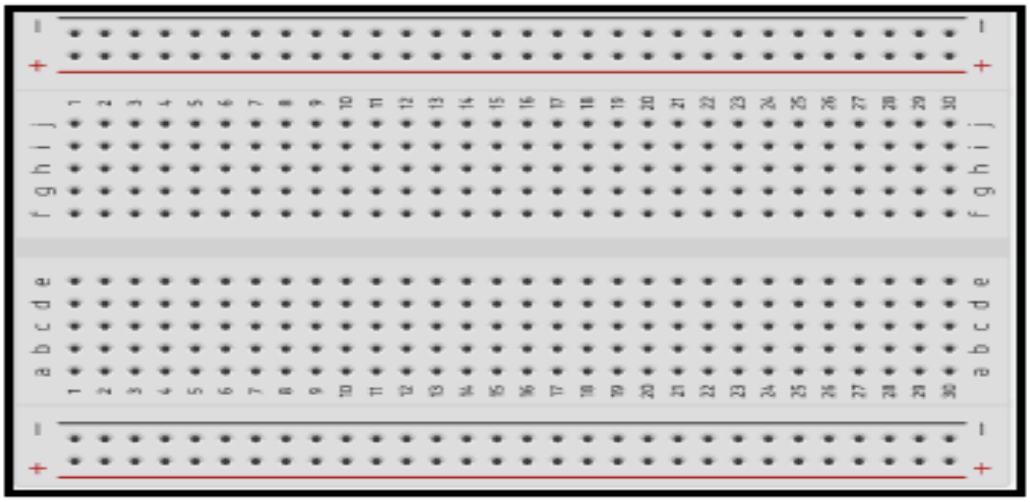

Figure 19 picture of breadboard

2.4 Software Resources

Arduino IDE:

It is an open-source programming tool that enables code writing and uploading to an Arduino board. The programming languages C and C++ are supported by it. IDE refers to the Integrated Development Environment in this context. It functions on several operating systems, including Linux, Mac OS X, and Windows. (Javatpoint, 2022)

Draw.io

It is a web-based, open-source, self-hosted diagramming tool that allows you to import and export diagrams in different formats. With the help of pre-designed templates and a drag-and-drop interface, team can create flowcharts, diagrams, mind maps, organization charts, and much more visual charts**.** (Paraschiv, 2023)

Fritzing:

Fritzing is an open-source software which provides CAD software for designing electrical hardware, enabling artists and designers, students to construct more permanent circuits from prototypes. (wikipedia, 2023)

3. Development

3.1 Planning and design

The given system is planned to design to detect landmines/metal through metal detector which generates buzz sound through buzzer. The system component architecture and the circuit connection are visualised and planned using the fritzing software before the resources collection assembly and component connection. The main hardware components for the projects needed are Arduino, ultrasonic sensor, node MCU, GPS module and motor driver, DC motor. The car is designed to run via remote control using transmitter and receiver. Metal detector will be attached to the car and when the car is controlled to operate in specific area the metal detector detects sending a buzz sound and an alert message via node MCU through a text in whatsapp. If possible, GPS module will also send the coordinates of the location. In case of near obstacle, the ultrasonic sensor detects the obstacle sending a buzz sound,

The system is planned to be created separately hence the car, the metal detector, ultrasonic obstacle warning detection component to be created. All the members will partake in a specific component of the system and will incorporate the components together. At last, we plan to join all the components together making a well-built landmine detector system bot.

3.2 Resource Collection

The main resources need for the project completion are as follows

- Arduino uno
- node MCU
- ultrasonic sensor
- L298n motor driver
- GPS module
- resistor
- capacitor
- DC motor

The above resources are collected with the help of college IOT resources through request application letter. The components we didn't found here we bought them from the outside stores like Himalayan solutions and online e commerce sites like daraz.

3.3 System development

Phase 1:

In this phase we connected all the dc motors red and black wire through soldering. The dc motors are connected to the motor driver as shown following

Output1	**Red wire**
Output2	Black wire
Output3	Black wire
Output4	Red wire

Table 1 connection of the motor driver and the wires of dc motor

The motor driver is powered using four 3.7V battery. The connection between the dc motors and the motor driver is tested using male to male jumper wire giving one end 5v and touching the other end to the IN1, IN2, IN3, IN4.If the motor turns forwards backwards then the connection is successful.

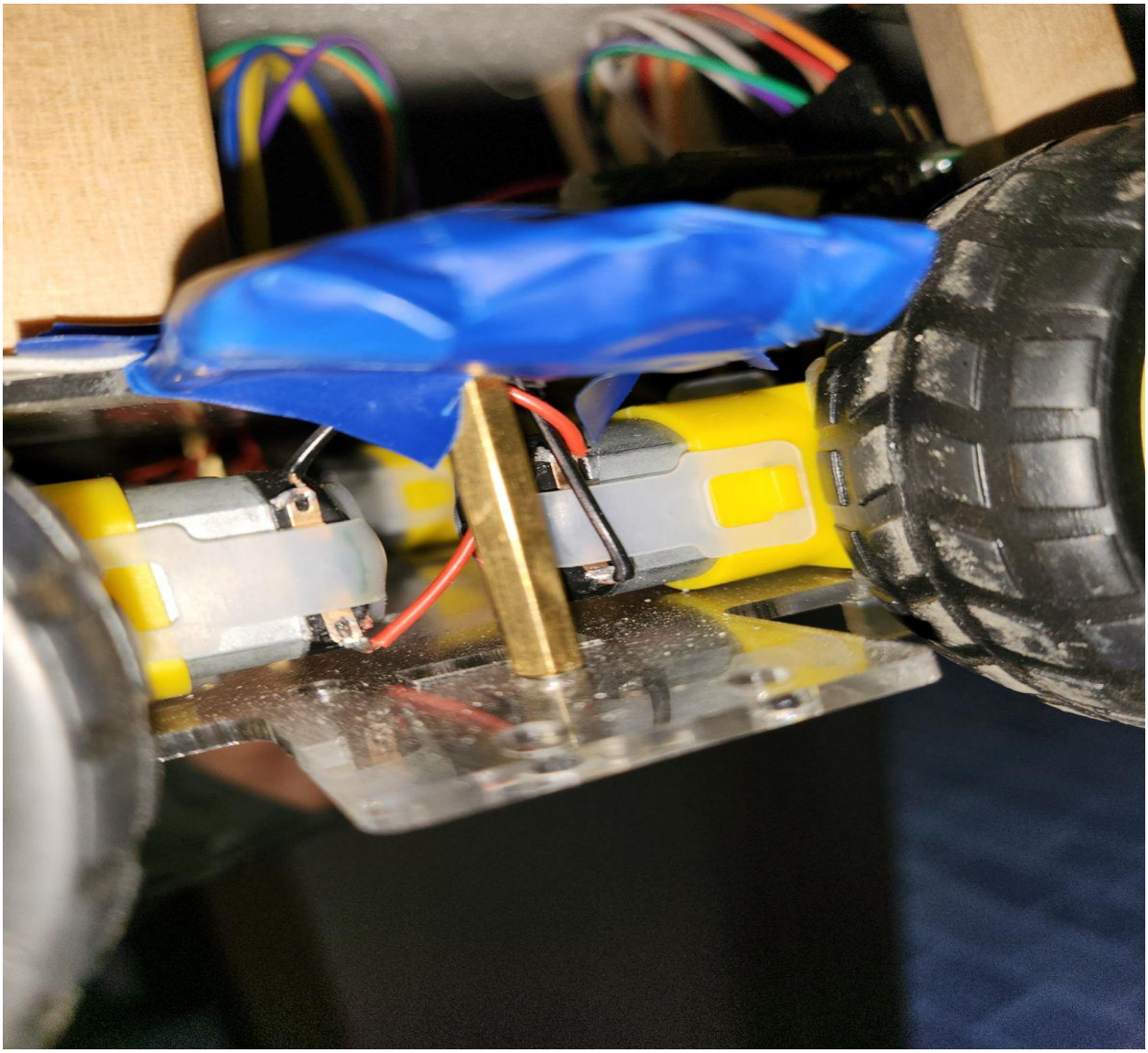

Figure 20 the black and red wires soldered in dc motor

Figure 21 connection between Arduino and motor driver

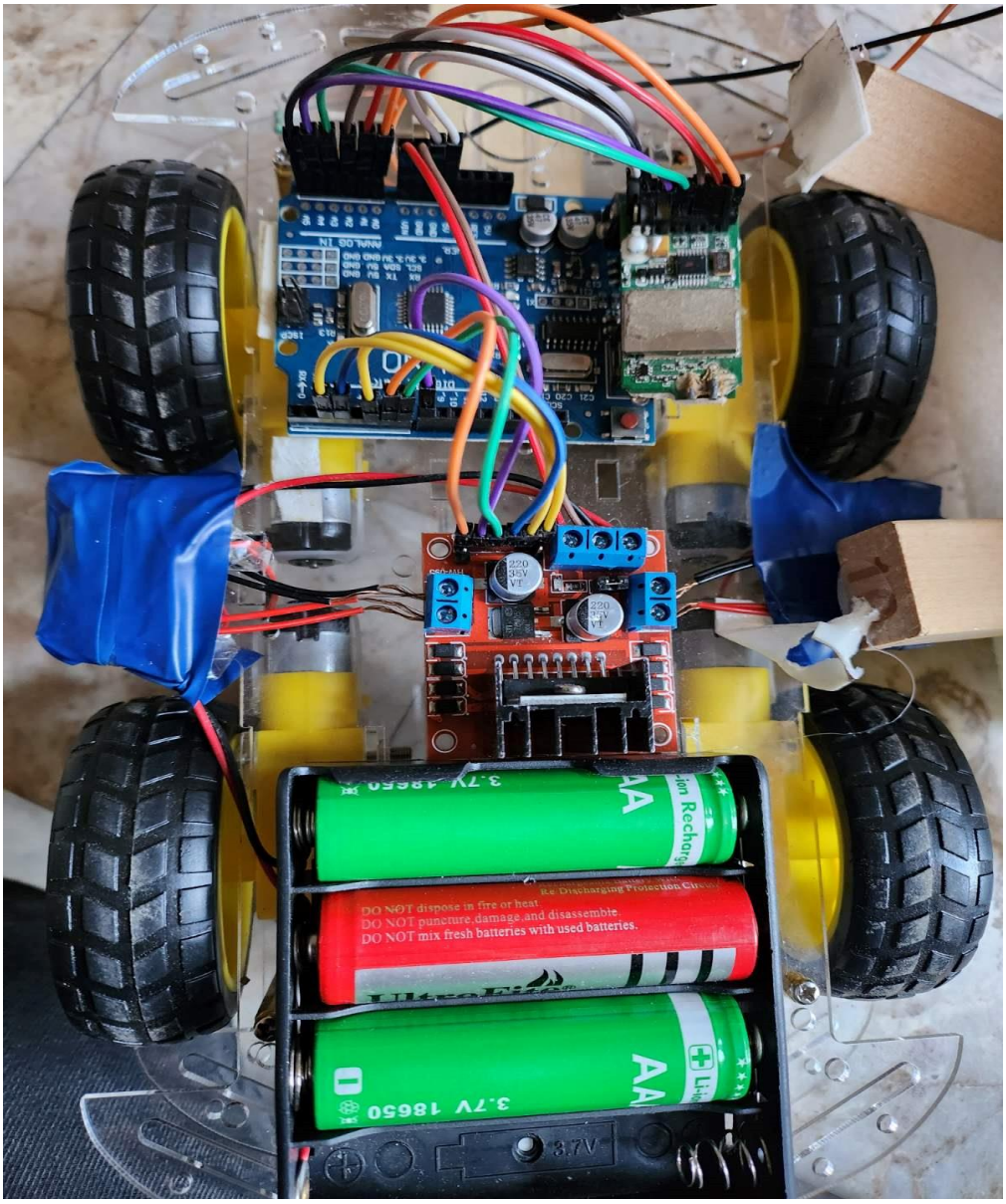

Figure 22 overall connection of the car

Phase 2:

The Arduino is powered through 12 V motor driver port to the Vin and ground port of the Arduino using male to male jumper wire. The motor driver is then connected to the Arduino uno digital pins as following:

L298N motor driver	Arduino digital pins
ENA	5
IN1	2
IN2	3
IN3	7
IN4	8
ENB	6

Table 2 pin connection detail between motor driver and Arduino uno

The receiver is powered connecting through the 5V and the ground wire in the Arduino. The receiver channel pins are connected to Arduino as following

Receiver channel pins	Arduino analogue pins
CH1	1
CH2	2
CH3	3
CH4	4
CH5	5
CH6	6

Table 3 pin connection detail of receiver and Arduino uno

After all the connections, the code is uploaded to the Arduino Uno. The car is then tested to operate using the transmitter device and the car runs smoothly controlled via transmitter.

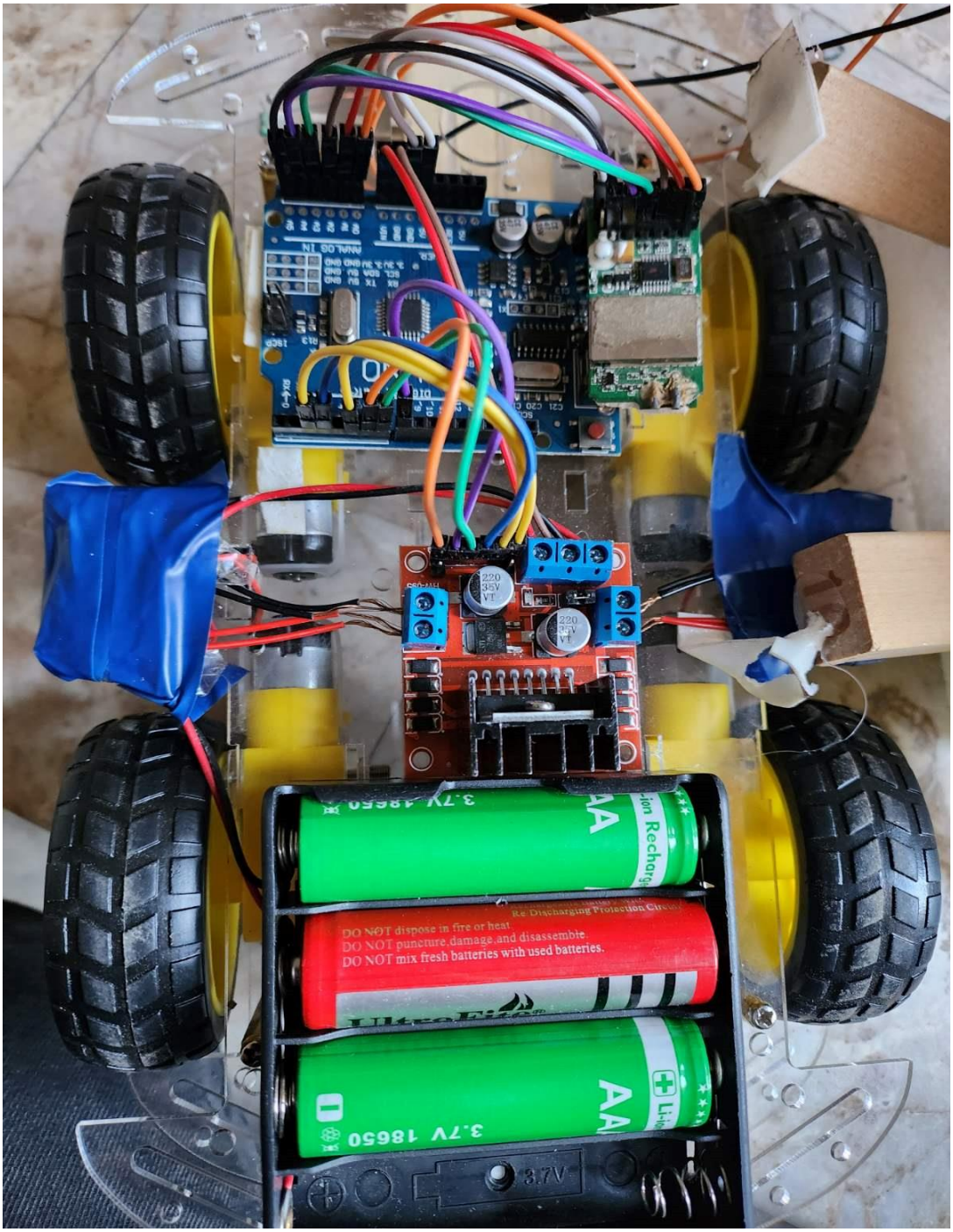

Figure 23 Overall connection of the car

Phase 3:

Firstly, a coil is setup with 30-40 spins to detect the metal. The coil was then soldered to a 220ohm resistor, 103nf capacitor and a 1N14001 diode which was then connected to Arduino Uno.

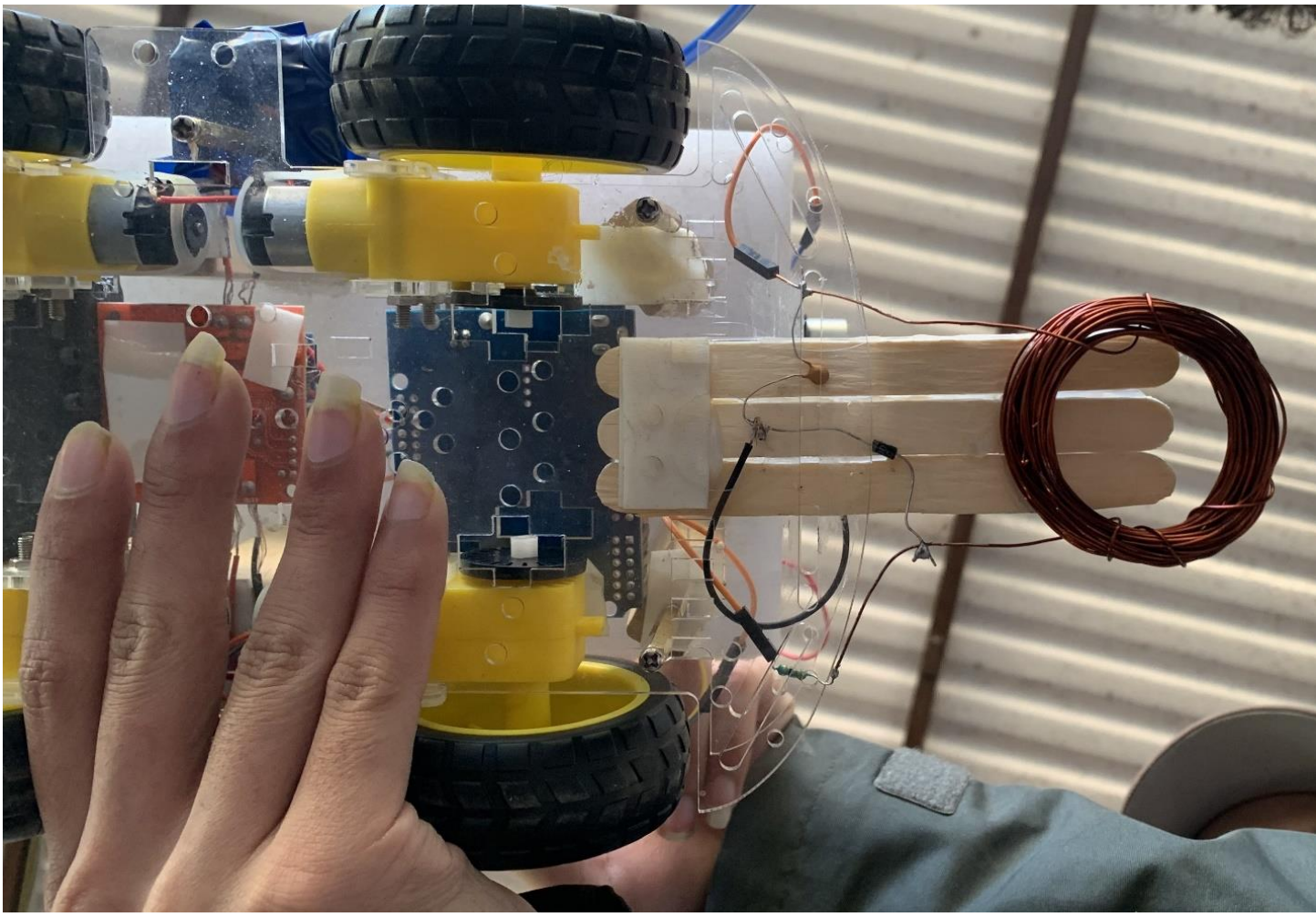

Figure 24 showing the connections of the metal detector

Induction Coil	Arduino Pins
Having Resistor at End	A1
Middle Wire between Capacitor and Diode	A2
Having Capacitor at End	GND
Buzzer (+, -)	6, GND

Table 4 pin connection detail of induction coil and Arduino uno

When a secure connection was established, a threshold is to be sent to the coil for metal detection where if the threshold exceeds a certain limit the buzzer beeps and stops also when a certain limit is met. Initially it was set for 16800 and 16000 but it varies with terrain solely. And a message is seen in serial monitor which is also accessed by the node MCU

Phase 4:

Now, we connect the ultrasonic sensor to the Arduino through jumper wires.

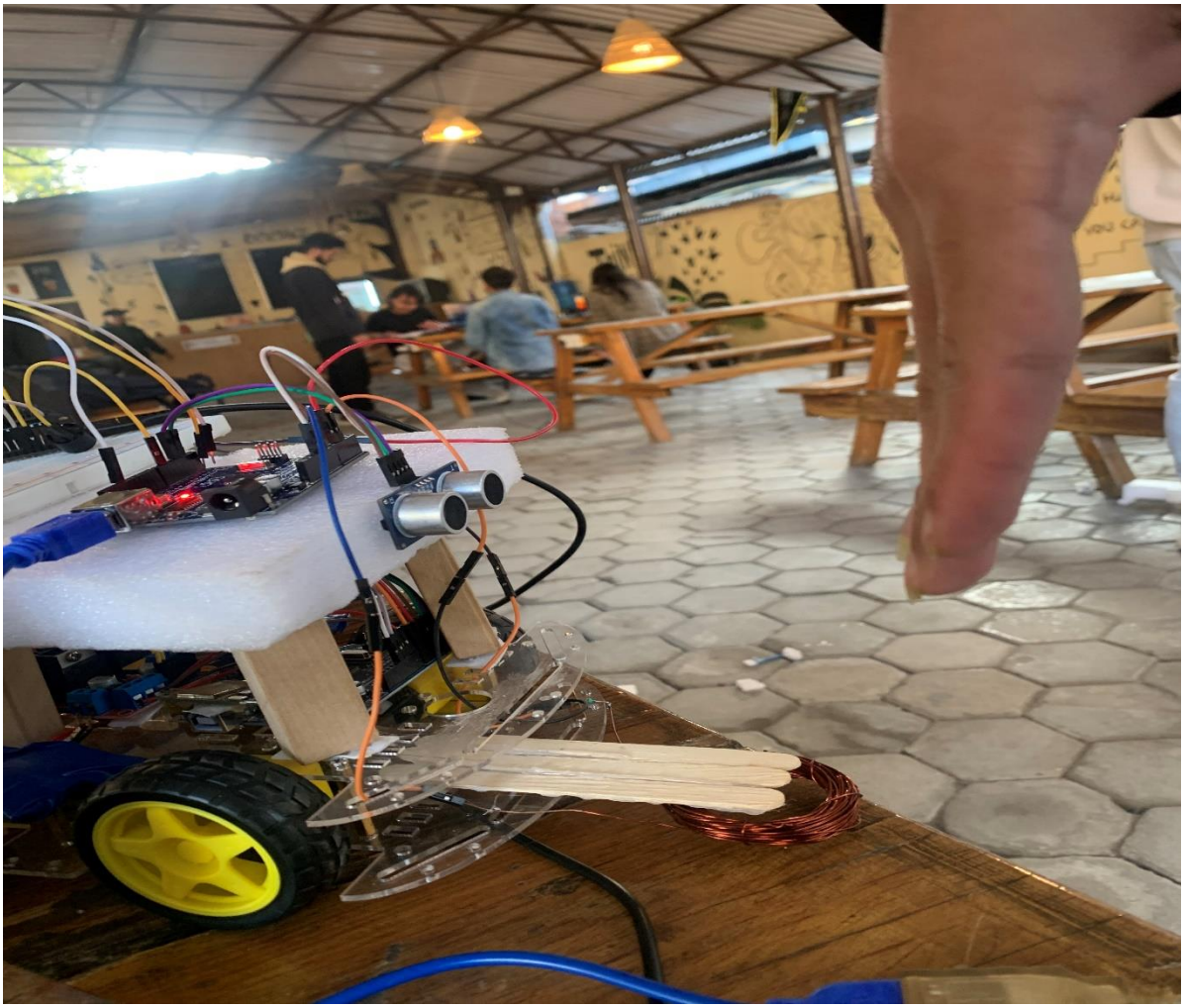

Figure 25 showing the connection and how the ultrasonic detector works

Ultrasonic Sensor	Arduino Pins
Trig Pin	3
Echo Pin	2
VCC	5V
GND	GND

Table 5 pin connection detail of ultrasonic sensor and Arduino uno

There is also a logic that if something comes in the range of ultrasonic

Phase 5:

Now we connect GPS Module to the Node MCU.

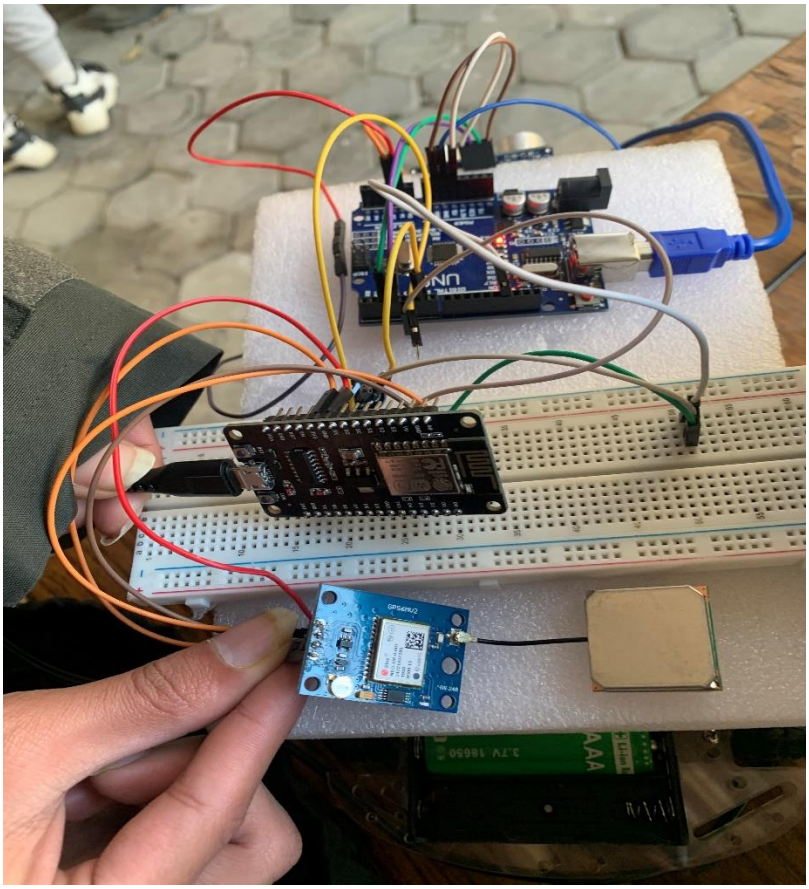

Figure 26 showing the connection of Arduino, node mcu and gps module

GPS Module	Arduino Pins
GND	GND
VCC	3v3
RX	4
TX	5

Table 6 pin connection detail of Arduino uno and gps module

A code is also uploaded in NodeMCU to detect the latitude and longitude.

Phase 6:

Connecting Node MCU And Arduino for sending a notification in Whatsapp.

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Node MCU	Arduino Pins
TX	RX
RX	TX
GND	GND

Table 7 pin connection detail of Arduino uno and nodemcu

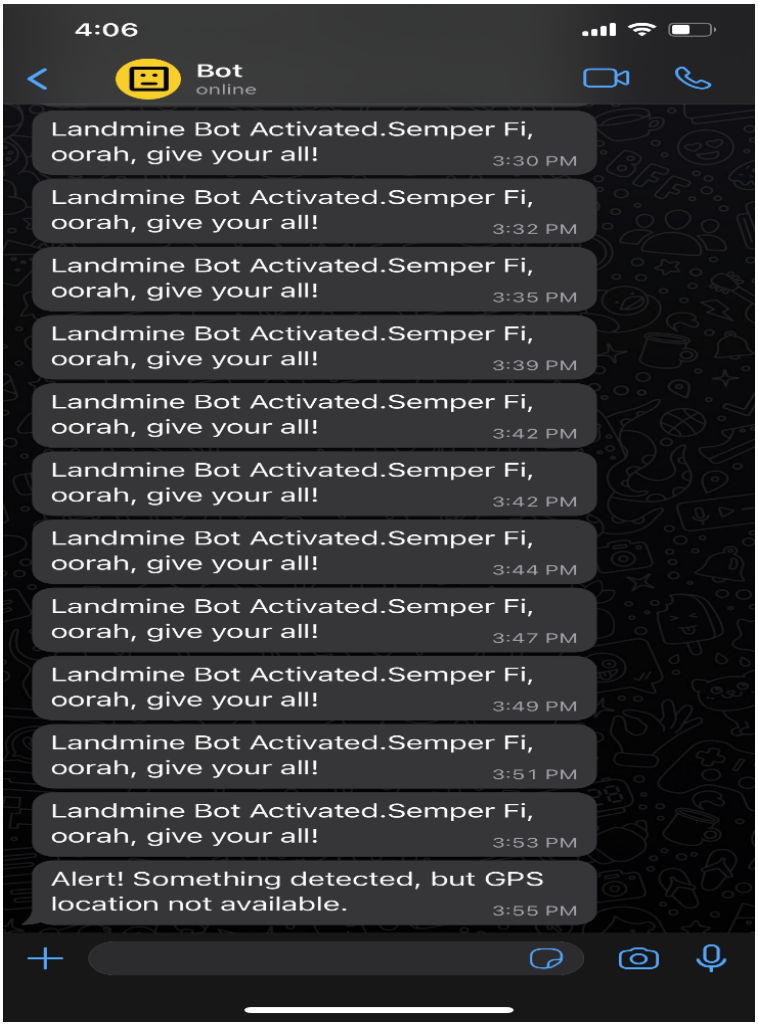

Figure 27 proof showing the message being sent in whatsapp when landmine is detected

This connection enables transferring data but prevents the uploading of code from the IDE after the connection is established. Now from Serial Monitor both of this device are connected when something is detected by the sensor it writes on serial monitor sending data to Node MCU which then activates the code to send a message to WhatsApp.

3.4 Deployment

In the deployment phase we tested/deployed the device in a prototype surrounding placing metals on the ground. we operated the car in an open ground heading towards the direction of metals placed and found the metal detector to be working within a closed specific range. We also operated the car to test the range that can be operated which we found to be 100 m via transmitter and receiver. We also checked how much the car can be operated via power supply which is estimated around to be 10 minutes. we operated the car in obstacles and found the car to buzz alerting user of obstacle ahead within 30 cm range.

3.5 Feedback iteration

In this phase we showcased the given IOT project to the teachers and seniors for improvements to be made. We found suggestions like to increase the range of ultrasonic sensor to detect be increased for better alert which we implemented the suggestion and increased to 50m. Feedbacks like to send texts with the information received for clear understanding and better output was also implemented and made changes.

4. Results and Findings

4.1 Project results

After the completion of planning designing system development and testing the IOT project land mine detector bot detects the landmine /metal via metal detector. The car is first operated using the transmitter signalling to the receiver. When the car is operated towards the direction of the landmine zone consisting of landmines/ metals the metal detector detects and generates a buzz sound via buzzer. After the detection a message is sent to user via text alerting the user in whats app using node MCU. When operating the car, the ultrasonic sensor detects any obstacle ahead within 50 cm range if detected any a buzzer sound is also generated via buzzer alerting the controlled user successfully.

The video linked down below shows the device operating successfully

https://youtube.com/shorts/QjM5QLW2Qns?feature=shared

4.2 Testing

Test1:
Test for the dc motor runs or not

Test	1
Objective	To test the dc motor runs using powered motor driver
Activity	• Power the motor driver through 12v port • Connect the dc motors to the motor driver output port 1,2,3,4 • Using male to male jumper wire put one end to 5V port of the motor driver and the other end to IN1, IN2, IN3.IN4 making sure that 2 ports ENA and ENB is connected with the clip
Expected result	The DC motor should run forward and backwards
Actual result	The dc motor runs forwards and backwards
Conclusion	The test was successful

Table 8 test 1

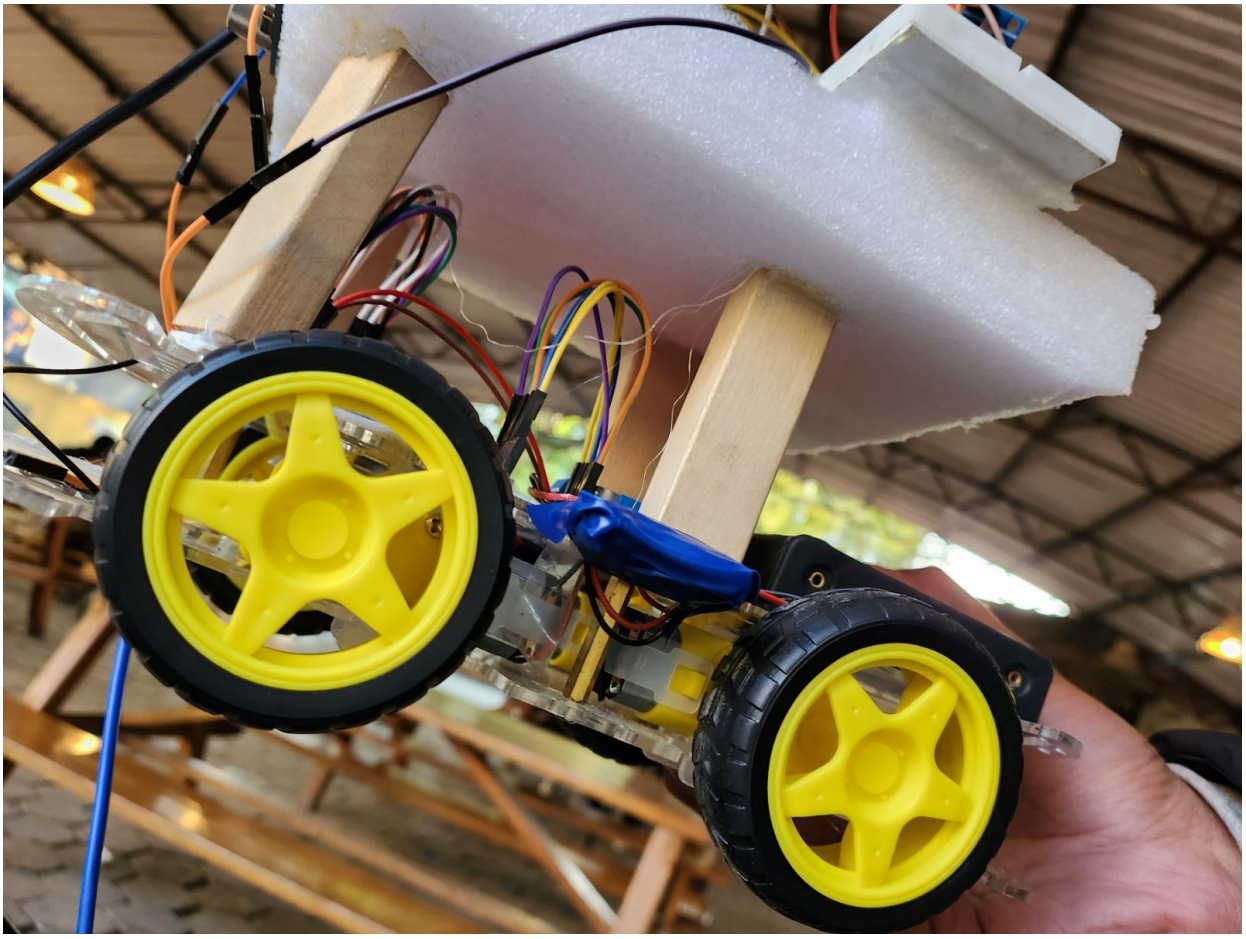

Figure 28 the dc motor running powered with the motor driver

Test 2:

If the car operated using transmitter and receiver

Test	2
Objective	To test the car operates using transmitter
Activity	• Turn on the transmitter, the receiver should stop blinking red light after turning the transmitter on • Set the mode to drive mode by switching the joystick up • Move the joystick forward backwards left right
Expected result	The car should operate successfully
Actual result	The card runs successfully as per controlled in the transmitter
Conclusion	The test was successful

Table 9 test 2

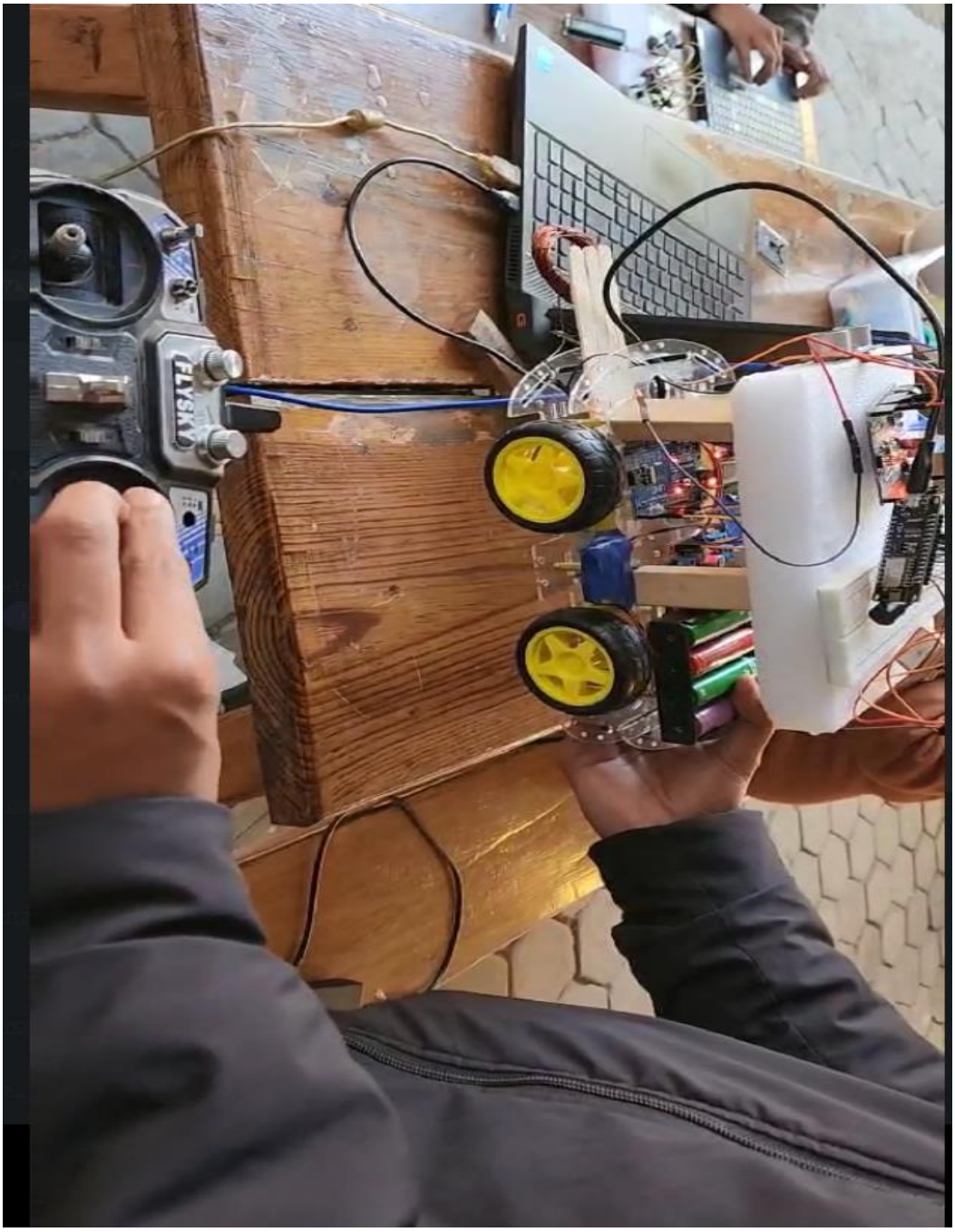

Figure 29 the car being operated using transmitter

The working mechanism video for the test is linked down below:

https://youtube.com/shorts/3yflig7-j6U?feature=shared

Test 3:

To test the range of the operation of the car which can be controlled

Test	3
Objective	To test the car operates within a range
Activity	• Turn on the transmitter, the receiver should stop blinking red light after turning the transmitter on • Set the mode to drive mode by switching the joystick up • Operate the car forward as possible until the car stops operating • The maximum distance we can operate the car is 100 m
Expected result	The car should operate within 100m range via transmitter and receiver
Actual result	The card runs successfully within the estimated range
Conclusion	The test was successful

Table 10 test 3

Figure 30 testing the range of the car operation in an open field

The link below shows the video for the car operation testing

https://youtube.com/shorts/QjM5QLW2Qns?feature=shared

Test 4:

To check the complete compilation of the code and upload to Arduino uno

Test	4
Objective	To test the code successfully compiled and uploaded
Activity	The code is written in Arduino ide
Expected result	The code should be compiled and upload to Arduino
Actual result	The code is successfully compiled and uploaded to Arduino
Conclusion	The test was successful

Table 11 test 4

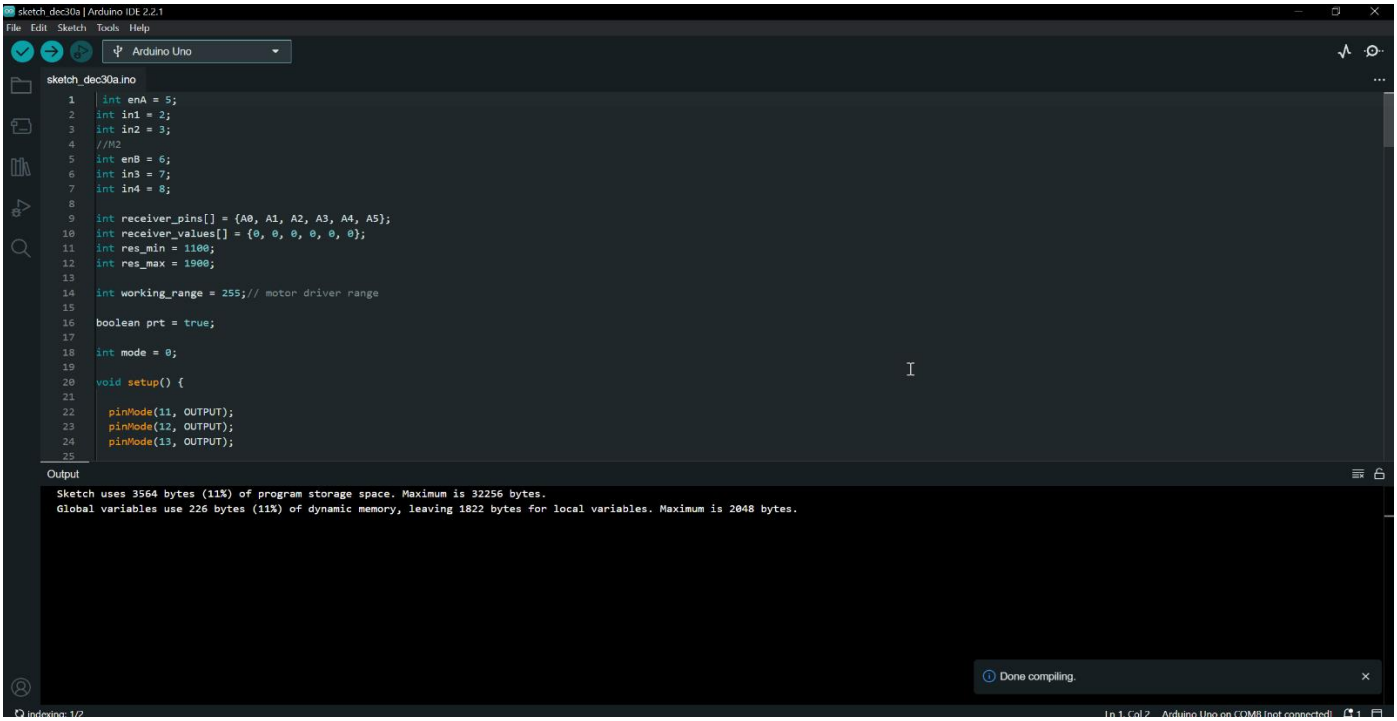

Figure 31 picture showing the code being compiled and uploaded to Arduino

Test 5:
To test the Ultrasonic sensor

Test	5
Objective	To test the Ultrasonic sensor
Activity	An object is placed in front of the ultrasonic sensor.
Expected result	Distance will be seen in serial monitor and buzzer beeps.
Actual result	Distance is seen in serial monitor and buzzer beeps.
Conclusion	The test was successful

Table 12 test 5

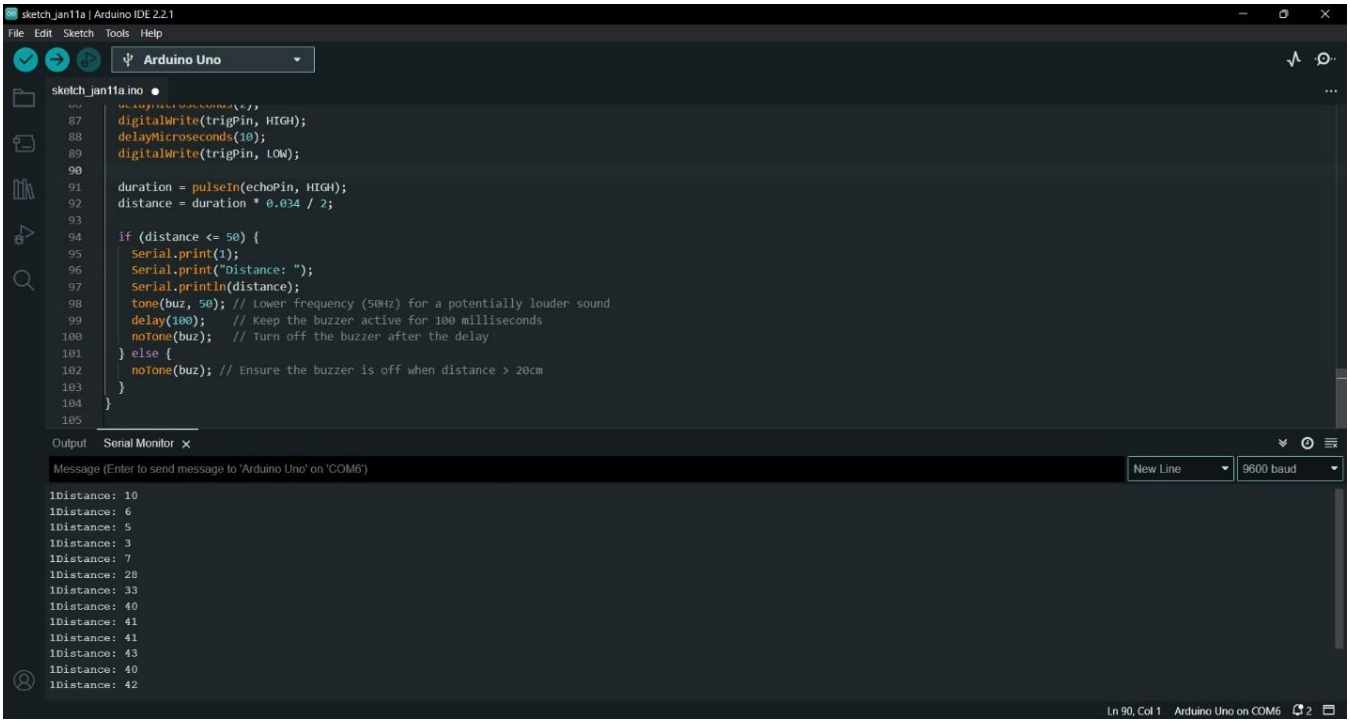

Figure 32 picture showing the output distance detected by the sensor hence the sensor working

The video linked below shows the ultrasonic sensor detecting obstacle ahead

https://youtube.com/shorts/DDUknF-lxG8?feature=shared

Test 6:
To test Metal Detector Sensor

Test	6
Objective	To test the Metal Detector sensor
Activity	A metal is kept under the detector and reading is noticed.
Expected result	The sum will be displayed and the buzzer beeps if the threshold number greater than sum.
Actual result	The sum is displayed and the buzzer beeps if the threshold number greater than sum.
Conclusion	The test was successful

Table 13 test 6

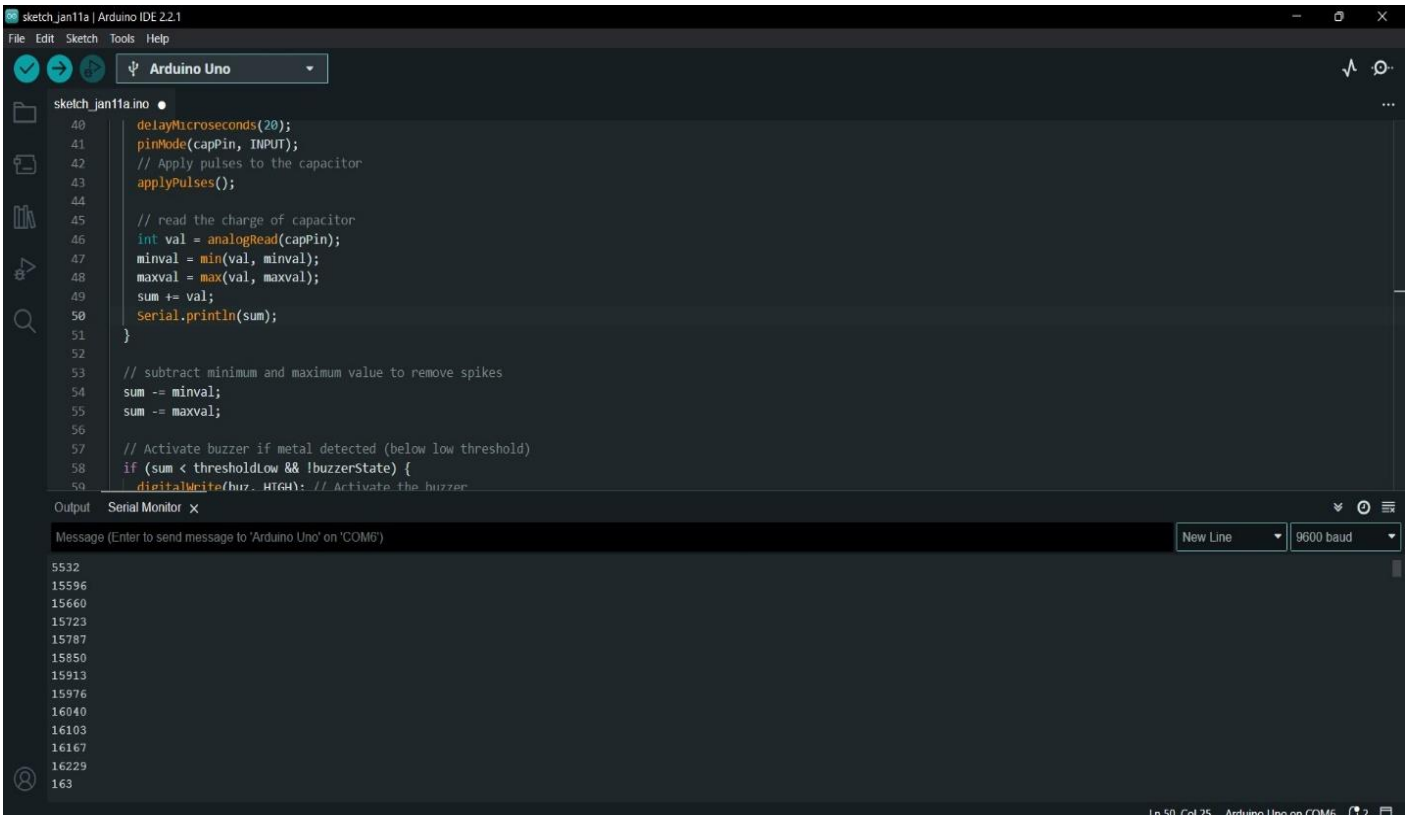

Figure 33 picture showing proof that the sum is displayed and the buzzer beeps if the threshold number greater than sum showing metal detector works

Test 7:
To test GPS Module on Node MCU

Test	7
Objective	To test GPS Module on Node MCU.
Activity	GPS module was connected as the pins mentioned and data is to be seen.
Expected result	Latitude and Longitude is to be displayed.
Actual result	Location Data was not available
Conclusion	The test was not successful

Table 14 test 7

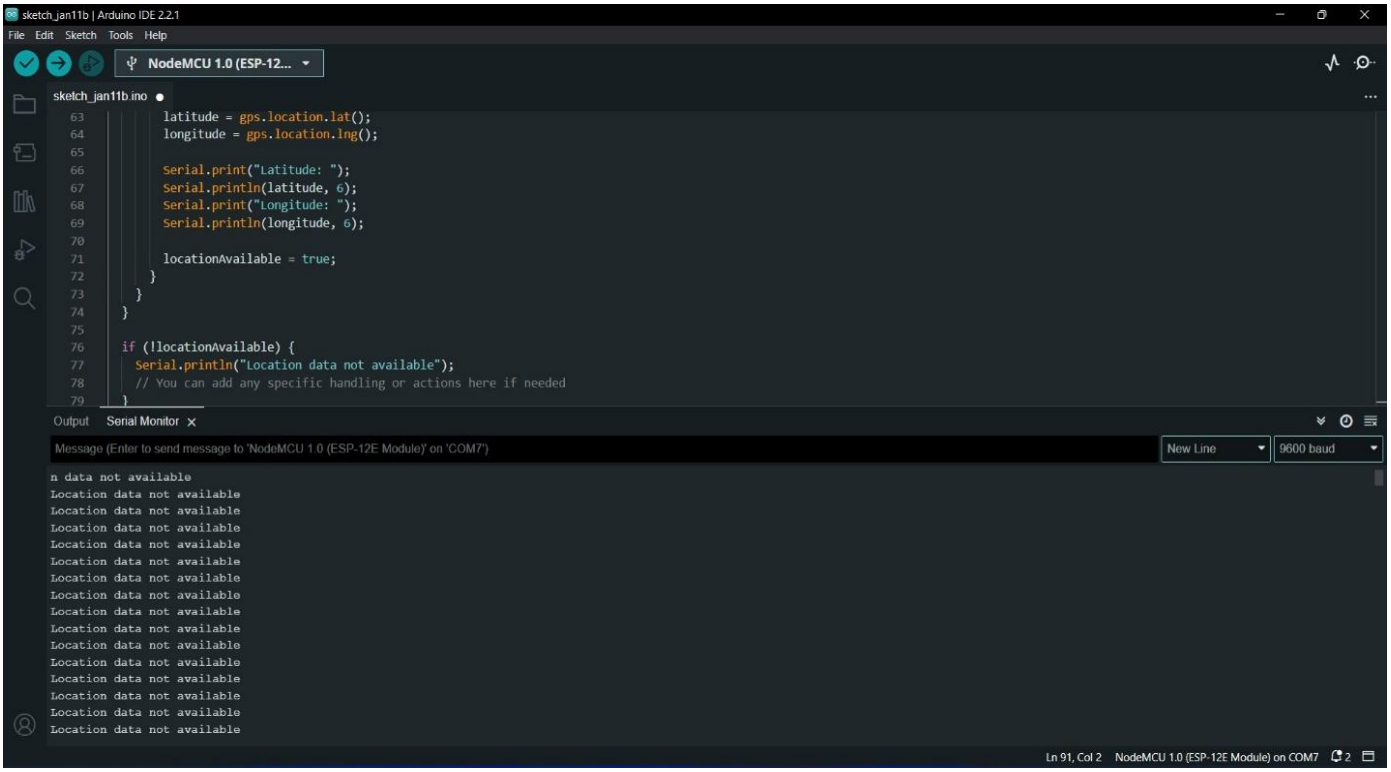

Figure 34 picture showing the location data not being sent clarifying the gps module doesn't work

Test 8:
To Establish connection between NodeMCU and Arduino

Test	8
Objective	To establish connection between NodeMCU and Arduino.
Activity	Make the sensor run and checking the serial monitor in both the IDE.
Expected result	Same message is to be printed in serial monitor.
Actual result	Same message is printed in serial monitor.
Conclusion	The test was successful.

Table 15 test 8

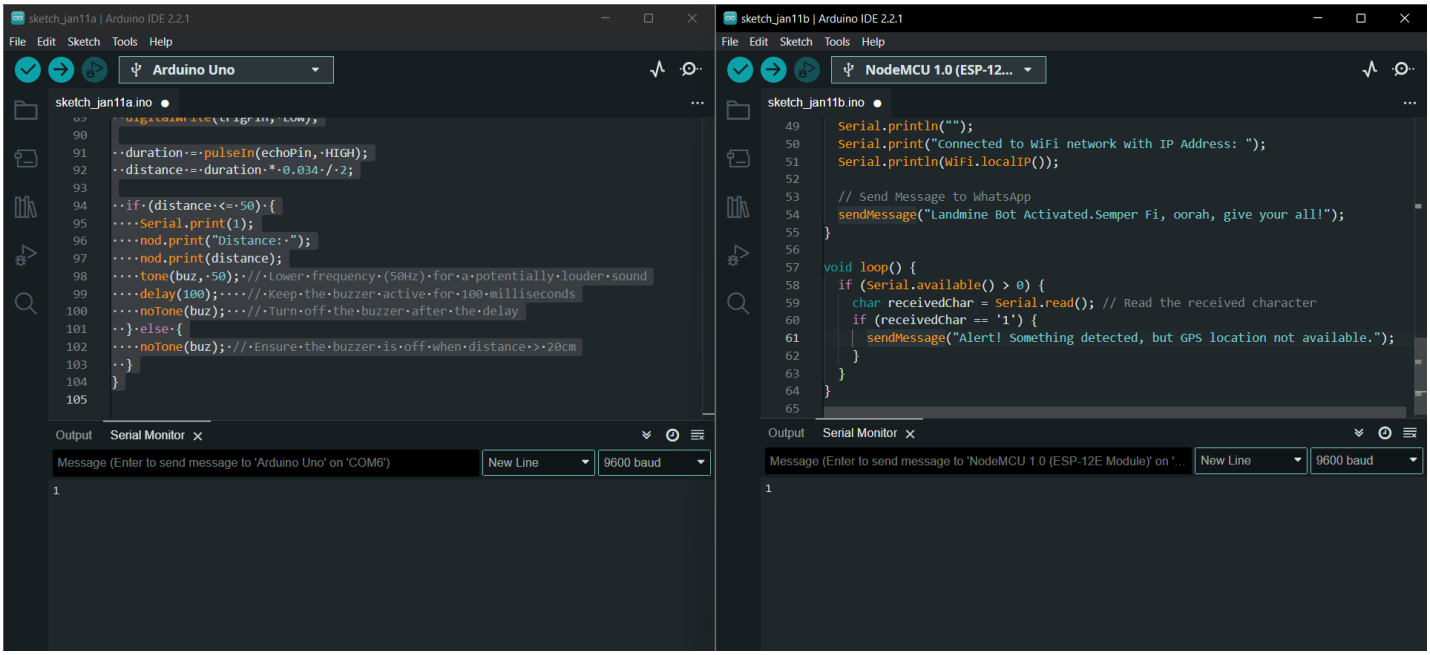

Figure 35 picture showing successful connection between node mcu and Arduino as same message is printed in serial monitor.

Test 9:
To compile and upload the code

Test	9
Objective	To compile and upload the code
Activity	The code is written then compiled and uploaded
Expected result	Without error upload message is to be displayed.
Actual result	Without error upload message is displayed.
Conclusion	The test was successful

Table 16 test 9

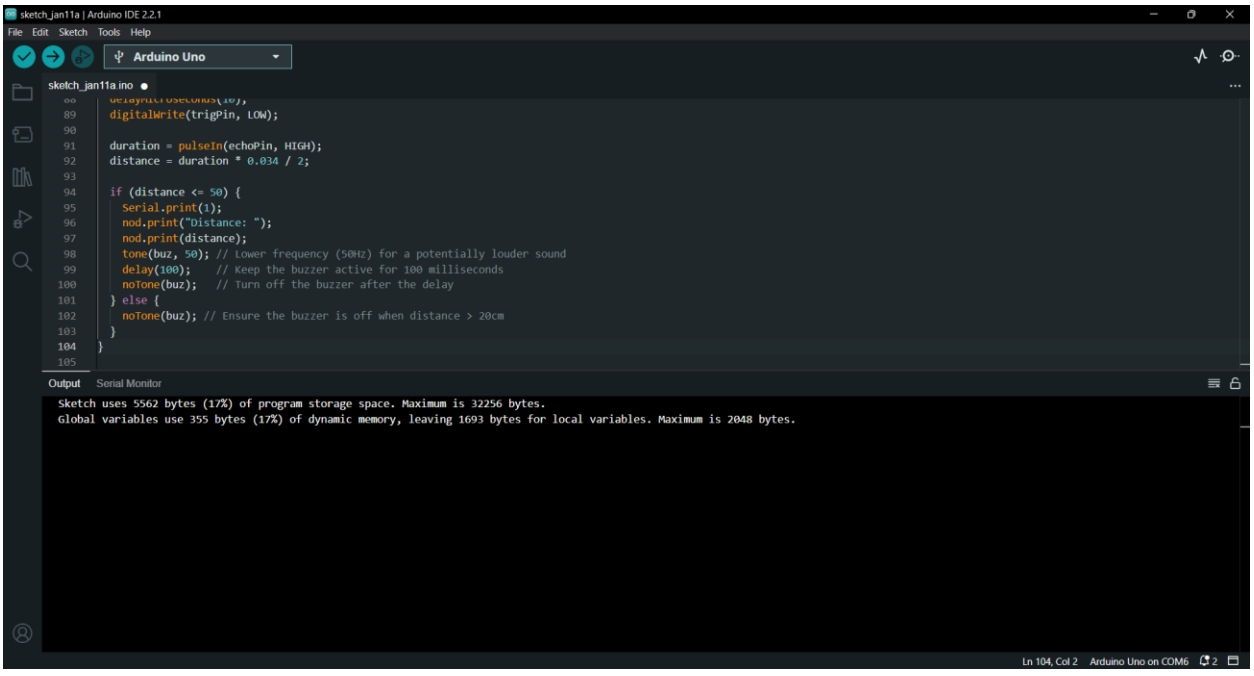

Figure 36 picture showing the successful compilation and uploading of the code in Arduino

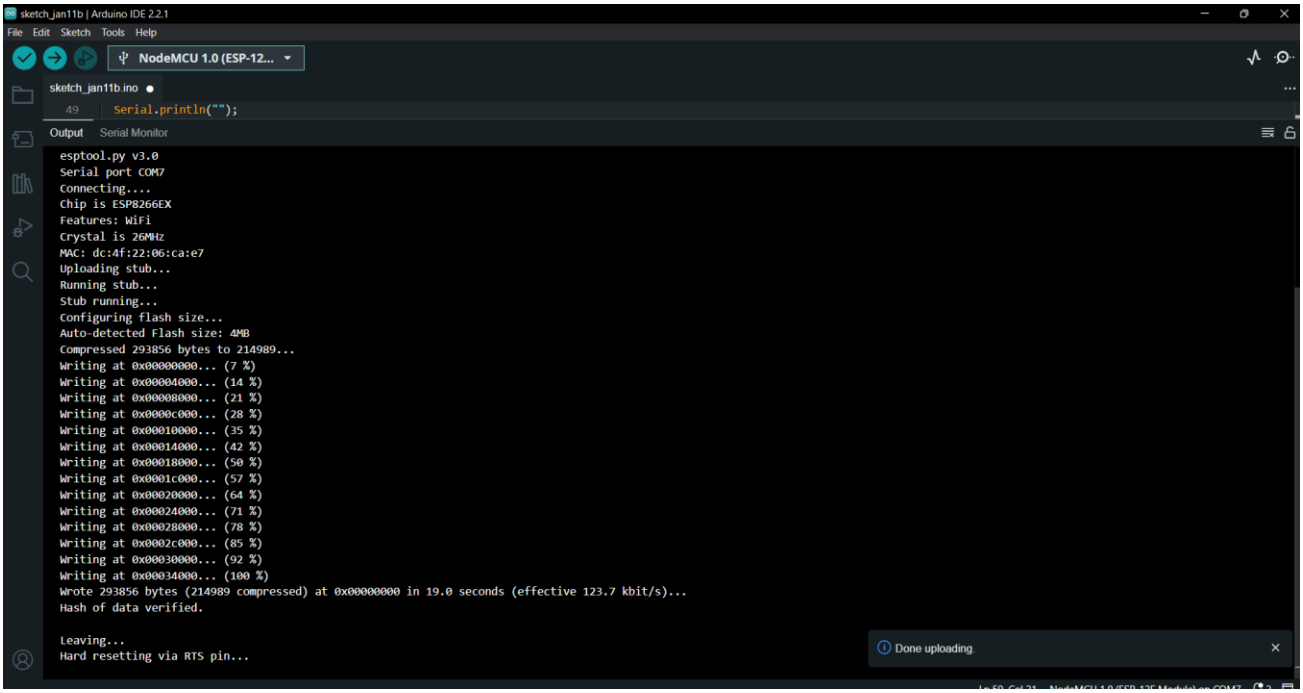

Figure 37 picture showing the successful compilation and uploading of the code in node mcu

5. Future Works

In the future we could add LED display to make more visualized showing the detection in text displayed in the screen. We can also add esp32 camera in car to able to control the car visually in long distance through screen and see the surroundings real time far away through a screen.

we could also add GSM module with GPS, when the metal is detected the GPS sends the location coordinates as well as call and send text message to the bomb diffuse centre to alert them about the findings of landmine.

A robotic arm could be added to physically interact with the detected landmine by safely picking it up or marking the location on the ground.

Incorporate GPS technology to precisely identify and record the location of detected landmines. This ensures accurate tracking of landmine locations, enhancing the overall effectiveness of the detection process

5.1 Sustainable development plan

The IOT project can be made sustainable contributing positively to environmental and social goals as follows:

- implementing a rechargeable battery source like solar panel as a power supply promoting promote sustainability and reduce reliance on traditional power grids.
- Opting for eco-friendly and recyclable materials like bioplastics,wood,acryclics in the construction of the landmine detection bot
- The use of rechargeable battery powering the bot to reduce battery consumptions and waste, use of recycling wiring like copper or aluminium wiring

6.Conclusion:

In conclusion, the Landmine Detection Bot project provides a unique and creative answer to the long-standing problem of landmine removal and detection. This project uses components, including the Arduino Uno, L298 Motor Driver, ultrasonic sensors, DC motors, and the integration of IoT with NodeMCU, to solve the pressing need for a safer, more effective, and efficient means of identifying landmines. These modern parts ensure that the Landmine Detection Bot can accurately locate landmines, cross challenging terrain, and transmit real-time data for informed decision-making. By including safety features like resistors, capacitors, and diodes in addition to using GPS technology for accurate position, the bot becomes even more secure and efficient. This project not only represents a major advancement for us in learning of system development and provides motive for our works ahead, but it also has the potential to save countless lives, reclaim and restore land for productive use, and foster socioeconomic growth in landmine-affected areas. Ultimately, the Landmine Detection Bot represents progress and hope in our ongoing work to create safer communities throughout the world.

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8.Appendix

Our gps module didn't work as planned as the module was working fine the day before but during final test trials the module seemed to stop working .We even tried with multiple different gps module exchanged from it resources module as the code was fine and with other peoples to check out but still it didn't work. Later we found out that nobody's gps module component was working so as ours. So, we told this concern to our respective teacher and found out that the gps module did have a defect.

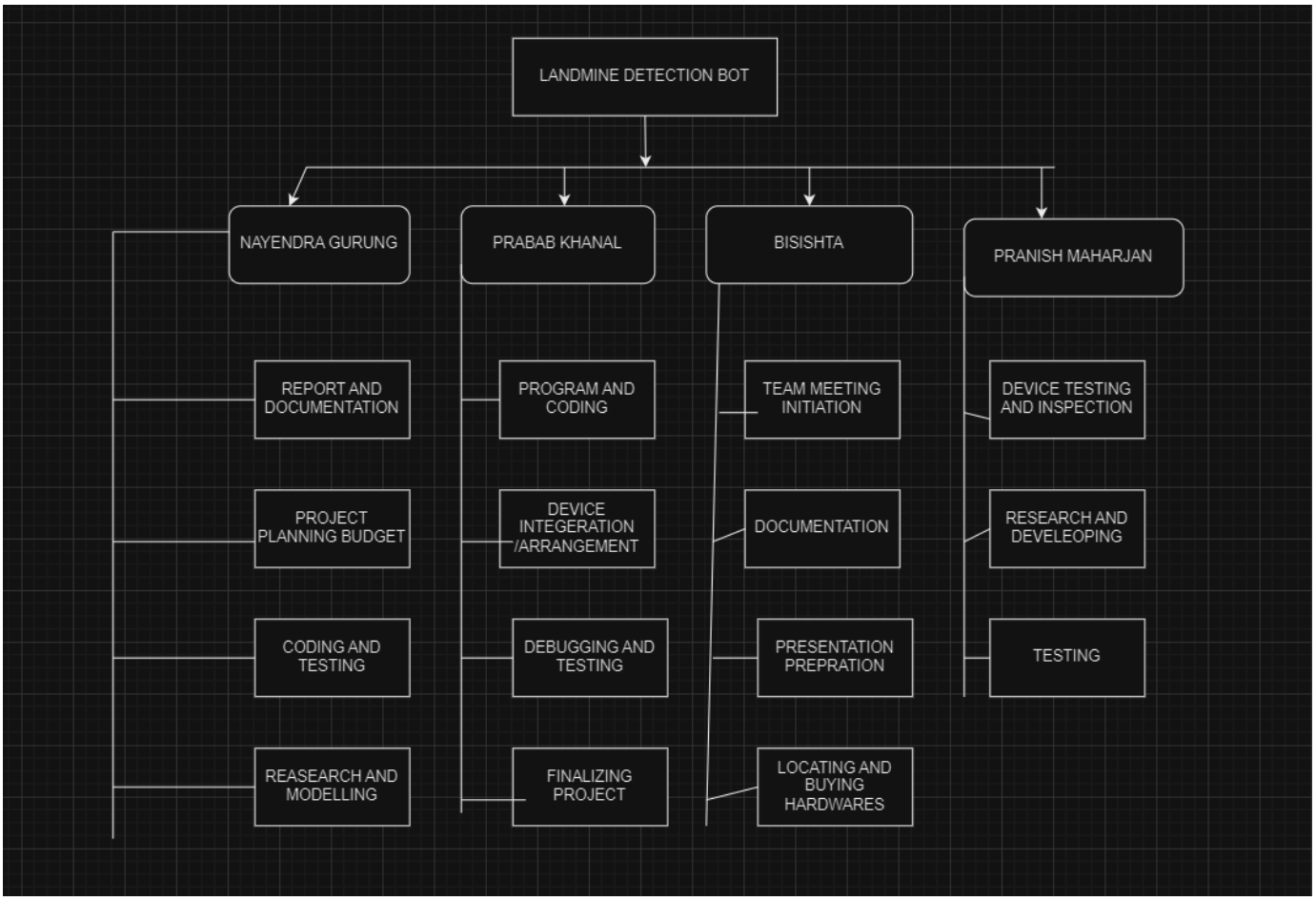

Figure 38 work break structure of the given project

Code of remote-control car

```
int enA = 5;
int in1 = 2;
int in2 = 3;
//M2
int enB = 6;
int in3 = 7;
int in4 = 8;

int receiver_pins[] = {A0, A1, A2, A3, A4, A5};
int receiver_values[] = {0, 0, 0, 0, 0, 0};
int res_min = 1100;
int res_max = 1900;

int working_range = 255;// motor driver range

boolean prt = true;

int mode = 0;

void setup() {

  pinMode(11, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(13, OUTPUT);

  pinMode(enA, OUTPUT);
  pinMode(enB,  OUTPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  pinMode(in3, OUTPUT);
  pinMode(in4, OUTPUT);

  Serial.begin(115200);
  //Staring delay with LED
  setLED(1);
  delay(300);
  setLED(1);
  delay(300);
  setLED(2);
  delay(300);
  setLED(3);
  delay(300);
  setLED(0);// put your setup code here, to run once:
```

```
}

void loop() {
  receive();
  setModeLED();

  int m1 = 0;
  int m2 = 0;

  int rot = receiver_values[0];

  if (mode == 1) {
    m1 = receiver_values[1] / 2 + (rot );
    m2 = receiver_values[1] / 2 - (rot );

  } else if (mode == 2) {

    m1 = receiver_values[1] + rot / 2;
    m2 = receiver_values[1] - rot / 2
         ;
  }

  mpower(1,  m1);
  mpower(2,  m2);


}
int rp = 0;
void receive() {

  receiver_values[rp] = map(pulseIn (receiver_pins[rp], HIGH), res_min, res_max,
-1 * working_range, working_range);
  rp++;
  if (rp == 6) {
    rp = 0;
  }
  boolean activevalues = true;
  for (int i = 0; i < 6; i++) {
    if (prt) {
      Serial.print("CH");
      Serial.print(i);
      Serial.print(" : ");
      Serial.print(receiver_values[i]);
      Serial.print(",\t");
```

```
    }
    if (receiver_values[i] < -500) {
      activevalues = false;
    }
  }
  mode = 0;
  if (!activevalues) {
    mode = -1;
  } else if (receiver_values[4] > -100) {
    mode = 2;
  } else if (receiver_values[5] > -100) {
    mode = 1;
  }
  if (prt) {
    Serial.println("");
  }

}

void setModeLED() {
  if (mode == -1) {
    setLED(-0);
  } else if (mode == 0) {
    setLED(1);
  } else if (mode == 1) {
    setLED(2);
  } else if (mode == 2) {
    setLED(3);
  }
}
void setLED(int led) {
  for (int i = 1; i < 4; i++) {
    if (led == i) {
      digitalWrite(10 + i, LOW);
    } else {
      digitalWrite(10 + i, HIGH);
    }
  }
}
void mpower(int motor,  int spd) {
  int rotation = 0;
  if (spd > 0) {
    rotation = 1;
  } else if (spd < 0) {
    rotation = -1;
```

```
    spd *= -1;
  }
  if (spd > 255) {
    spd = 255;
  }
  int pwm;
  int pA;
  int pB;
  if (motor == 1) {
    pwm = enA;
    pA = in1;
    pB = in2;
  } else if (motor == 2) {
    pwm = enB;
    pA = in3;
    pB = in4;
  } else {
    return;
  }

  if (rotation == 0) {
    digitalWrite(pA, LOW);
    digitalWrite(pB, LOW);
  } else if (rotation == 1) {
    digitalWrite(pA, HIGH);
    digitalWrite(pB, LOW);
  } else if (rotation == -1) {
    digitalWrite(pA, LOW);
    digitalWrite(pB, HIGH);
  }
  analogWrite(pwm, spd);

}
```

Code of metal detector and ultrasonic sensor

```
#include <SoftwareSerial.h>

#define capPin A2
#define buz 6
#define pulsePin A1
#define trigPin 3
#define echoPin 2

SoftwareSerial nod(0, 1);

// Thresholds for metal detection
const int thresholdHigh = 16800; // Set a higher threshold for turning off the buzzer
const int thresholdLow = 16600;  // Set a lower threshold for activating the buzzer

bool buzzerState = false; // To track the buzzer state

void setup() {
  Serial.begin(9600);
  nod.begin(9600); // Initiate SoftwareSerial for NodeMCU
  pinMode(pulsePin, OUTPUT);
  digitalWrite(pulsePin, LOW);
  pinMode(capPin, INPUT);
  pinMode(buz, OUTPUT);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
}
```

```
void loop() {
  ultrasonicSensorLogic(); // Integrate ultrasonic sensor logic

  int minval = 1023;
  int maxval = 0;
  long unsigned int sum = 0;

  // Read capacitance values multiple times to calculate the sum
  for (int i = 0; i < 256; i++) {
    // reset the capacitor
    pinMode(capPin, OUTPUT);
    digitalWrite(capPin, LOW);
    delayMicroseconds(20);
    pinMode(capPin, INPUT);
    // Apply pulses to the capacitor
    applyPulses();

    // read the charge of capacitor
    int val = analogRead(capPin);
    minval = min(val, minval);
    maxval = max(val, maxval);
    sum += val;
    Serial.println(sum);
  }

  // subtract minimum and maximum value to remove spikes
  sum -= minval;
  sum -= maxval;
```

```
  // Activate buzzer if metal detected (below low threshold)
  if (sum < thresholdLow && !buzzerState) {
    digitalWrite(buz, HIGH); // Activate the buzzer
    Serial.print('1');
    Serial.write('0');
    nod.print("Alert! Metal detected."); // Send alert to NodeMCU
    buzzerState = true;
  }
  // Turn off buzzer if above high threshold
  else if (sum > thresholdHigh && buzzerState) {
    digitalWrite(buz, LOW); // Turn off the buzzer
    buzzerState = false;
  }

  delay(500); // Adjust delay as needed
}

void applyPulses() {
  for (int i = 0; i < 3; i++) {
    digitalWrite(pulsePin, HIGH); // take 3.5 uS
    delayMicroseconds(3);
    digitalWrite(pulsePin, LOW); // take 3.5 uS
    delayMicroseconds(3);
  }
}

void ultrasonicSensorLogic() {
```

```
  // Ultrasonic sensor logic
  long duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2;

  if (distance <= 50) {
    Serial.print(1);
    nod.print("Distance: ");
    nod.print(distance);
    tone(buz, 50); // Lower frequency (50Hz) for a potentially louder sound
    delay(100);    // Keep the buzzer active for 100 milliseconds
    noTone(buz);   // Turn off the buzzer after the delay
  } else {
    noTone(buz); // Ensure the buzzer is off when distance > 20cm
  }
}
```

Code of node mcu

```
#include <ESP8266HTTPClient.h>
#include <WiFiClient.h>
#include <UrlEncode.h>
#include <TinyGPS++.h>
#include <SoftwareSerial.h>

const char* ssid = "Islington College";
const char* password = "I$LiNGT0N2024";
TinyGPSPlus gps;  // The TinyGPS++ object
SoftwareSerial ss(4, 5); // The serial connection to the GPS device
SoftwareSerial dd(1, 3);
// +international_country_code + phone number
// Portugal +351, example: +351912345678
String phoneNumber = "9779843347222";
String apiKey = "8021513";

float latitude, longitude;

void sendMessage(String message) {
  String url = "http://api.callmebot.com/whatsapp.php?phone=" + phoneNumber + "&text=" + urlEncode(message) + "&apikey=" + apiKey;

  WiFiClient client;
  HTTPClient http;
  http.begin(client, url);
  int httpResponseCode = http.GET(); // Use GET for WhatsApp API
```

```
  if (httpResponseCode == 200) {
    Serial.println("Message sent successfully");
  }
  else {
    Serial.println("Error sending the message");
    Serial.print("HTTP response code: ");
    Serial.println(httpResponseCode);
  }

  http.end();
}

void setup() {
  Serial.begin(9600);

  WiFi.begin(ssid, password);
  Serial.println("Connecting");
  while(WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.print("Connected to WiFi network with IP Address: ");
  Serial.println(WiFi.localIP());

  // Send Message to WhatsApp
  sendMessage("Landmine Bot Activated.Semper Fi, oorah, give your all!");
}
```

```
void loop() {
  if (Serial.available() > 0) {
    // Read the incoming signal from Arduino
    char incomingSignal = Serial.read();

    if (incomingSignal == '1') {
      // Arduino detected something, check if GPS location is available
      if (gps.location.isValid()) {
        latitude = gps.location.lat();
        longitude = gps.location.lng();

        // Send the location as a message
        String message = "Landmine detected at\nLatitude: " + String(latitude, 6) +
"\nLongitude: " + String(longitude, 6);
        sendMessage(message);
      } else {
        // GPS location is not valid, send an alert
        sendMessage("Alert! Landmine detected, but GPS location not available.");
      }
    } else {
      // Signal from Arduino is not recognized
      sendMessage("Alert! Unknown signal received from Arduino.");
    }
  }

  // You can add other non-blocking tasks here if needed
  delay(100);
}
```

Individual Contribution Plan

Student Name	Role	Contribution
Nayendra Gurung (Team leader)	**Report:**Aim,objectives,block diagram, system architecture, circuit diagram, schematic diagram, testing system development, future works **System Development**: Installing software and testing trials Identifying errors and debugging **Application Implementation**: setting up the hardwares,coding testing **Presentation**: about working mechanism of the device, explaining about the aim and objectives for the project	25%
Prabhab Khanal	**Report:** block diagram, system architecture, circuit diagram, schematic diagram,flowchart,system development, testing **System Development**: purchasing hardware, developing codes. Installing new resources **Application Implementation:** setting up Arduino board, coding Testing **Presentation:** about how the code works and reciprocates in the device	25%
Bishista Bajracharya	**Report:**conclusion,abstract,introduction **System Development:** Allocating hardware resources, determining user requirements **Application Implementation**: test trials of the device ensuring it works **Presentation:** about the test trial we did for the final product	25%

Pranish Maharjan	**Report:**Abstract,Acknowlegement **System Development**: evaluating hardware resources, inspection **Application Implementation:** reviewing feedbacks from the hardwares,testing trying out new codes **Presentation:** about how the device functions	25%

Table 17 table showing individual contribution plan