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Wireless Gesture Controlled Robot for Landmine Detection

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Abstract: ***Most prominent problems today in society are terrorism and insurgency. Soldiers are risking their lives to keep a check on the above problems. Soldiers are facing difficulties to reach challenging places. Landmine explosions killed more and more amputations than ordnance. A lot of research is going-on in defence systems which are capable of safeguarding citizens from terrorist threats. This has motivated us to work on Unmanned Ground Vehicle (UGV) which could serve military operations. Robots are utilized to increase the warrior's capacity in an open territory. Gestures involve motion of human hands, arms and head and are used within a certain context. This robot is based on the Gesture control mode or Hand wave mode. Gesture Controlled car is a robot which can be controlled by simple human gestures. User can interact with the robot in more friendly way due to wireless communication. The old method of detecting landmines such as direct sweeping is very risky for stepping the landmine unintentionally. In this project, the robot system is equipped with a metal detector useful to detect the metal presence based on coil induction when it's approaching the metal. When the robot detects the metal presence, the buzzer sound will be triggered. These robots can be used in the place of the spy team and also for the Investigation process. This robot will help in detecting the landmines and saving the precious lives of military. It will also help in detecting injured soldiers and send information to the base station. This robot has a potential to be incredibly useful for applications like surveillance, military operations and Industrial robotic arms for physically challenged people.***

Keywords: Unmanned Ground Vehicle(UGV), Gesture Controlled Robot, Glove-based technique, Gesture-based recognition, Landmine detection.

I. INTRODUCTION

The robot is usually an electro-mechanical machine that can perform task automatically. Some robots require some degree of guidance, which may be using a remote control or with a computer interface. Robots can be autonomous, semi- autonomous or remotely controlled. Robots have evolved so much and are capable of mimicking humans that they seem to have a mind of their own. An important aspect of a successful robotic system is the human machine interact. In the early years the only way to communicate with a robot was to program which required extensive hard work. With the development in science and robotics, gesture based recognition came into life. Gestures originate from any bodily motion or state but commonly originate from the face or hand. Gesture recognition can be considered as a way for computer to understand human body language This has minimized the need for text interfaces and GUIs (Graphical User Interface).Gesture recognition technologies are much younger in the world of today. At this time there is much active research in the field and little in the way of publicly available implementations. We know a variety of materials including metal and non-metal materials. In general, metals are divided into ferrous metals and non-ferrous metals. The existence of mines buried in the ground is difficult to know without the aid of tools. One of the tools used to detect the presence of mines is a metal detector. Several approaches have been developed for sensing gestures and controlling robots glove based technique is a well-known means of recognizing hand gestures. It utilizes a sensor attached to a glove that directly movements.

II. LITERATURE SURVEY

Majd Ghareeb, et.al. proposed a system for landmine detection using Robotics, communication and data analysis. The system mainly consists of raspberry pi, camera board, metal detector circuit and GPS shield. A raspberry pi based moving unit for detection, data collection and transferring to the central unit that will be later investigating the received data. Metal detector circuit is used for metal detection. GPS shield is used to detect the exact location of the detected object. The type of detector and camera resolution capacity has to be considered to improve the performance of the system. [1] V. Abilash and J. Paul Chandra Kumar implemented a Landmine Detection Robot controlled by ardunio.

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The system consists of Arduino UNO microcontroller, ultrasonic sensor, buzzer, metal detector and GPS. Metal detector for detection of mine, buzzer for warning alert, the robot is controlled with help of computers using the zigbee module, ultrasonic sensor fixed to it in order to locate and avoid the obstacle, robot actuation is done with high powered DC motor supported by H bridge circuit that allows robot to move in any direction, GPS sensor for latitude and the longitude detection. The advantage of wheeled robot proposed is less expensive, robust and it is a helpful tool in military for surveying and monitoring purpose. [3] J. Bharath presented a robot design, capable of detecting buried land mines and changing their locations, while the robot can be controlled wirelessly from a distance. This technology uses the metal detector circuit present in robot to search the land mines. The metal detector circuit that is interfaced with robot, is left on the search area to detect metallic components used in landmine production. It detects the uneven landmines present under the ground and generates an alarm to the user and can consequently change the place of landmine by taking it safely from one place to another, without risk of detonation. [4]

III. AIM, OBJECTIVES AND PROPOSED SYSTEM

A. *Aim*

To detect landmines and produce an alert sound using gesture controlled robot.

B. *Objectives*

1) To detect landmines in open area.
2) To stop movement of robot when landmine is detected and notify the user.
3) To increase transmission range upto 500 meters using high frequency RF module(2.4GHz) .

C. *Proposed System*

The purpose of the project is to control a toy car using MEMS sensors attached to a glove and detect the landmines present inside the ground in it's path of operation. The sensors are intended to replace the remote control that is generally used to run the car. Then the next task is to process the sensor data to Arduino NANO and then transmit data to robot's Arduino UNO which controls motor driver of the car. For wireless communication between Arduino UNO and Arduino NANO, the RF Modules becoming handy to control the motion of car. Then the work of the mechanical aspects of the car is been done so that it can be easily controlled through gesture. This robot have the sensors that distinguishes the nearness of any metallic item(bomb) through signal alert(buzzer).

IV. HARDWARE USED

A. *Inductive Proximity Sensor*

The inductive proximity sensor detects the metallic object which is present next to their active side. This sensor operates under the electrical principal of inductance where a fluctuating current induces an electromotive force(EMF) in a target object. These non-contact proximity sensors detect ferrous targets, ideally mild steel thicker than one millimetre. They consist of four major components: a ferrite core with coils, an oscillator, a Schmitt trigger, and an output amplifier.
An inductive proximity sensor has the frequency range from 10 to 20 Hz in ac, or 500 Hz to 5 kHz in dc. Because of magnetic field limitations, inductive sensors have a relatively narrow sensing range like from fractions of millimetres to 60 mm on an average.

B. *Antenna*

An antenna or aerial is the interface between radio waves propagating through space and electric currents moving in metal conductors, used with a transmitter or receiver. In transmission, a radio transmitter supplies an electric current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves). In reception, an antenna intercepts some of the power of a radio wave in order to produce an electric current at its terminals, that is applied to a receiver to be amplified. Antennas are essential components of all radio equipment.

C. *RF Module*

An RF module (short for radio-frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices with 2.4 GHZ frequency range and transmission range of 500 feets. This wireless communication may be accomplished through optical communication or through radio-frequency (RF) communication. RF communications incorporate a transmitter and a receiver. They are of various types and ranges. Some can transmit up to 500 feet. RF modules are typically fabricated using RFCMOS technology.

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D. Arduino UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.

E. Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

F. Accelerometer

This ADXL345 Accelerometer module consists of an ADXL345 Accelerometer IC, Voltage Regulator IC, Level Shifter IC, resistors, and capacitors in an integrated circuit. Different manufacturers use a different voltage regulator IC.ADXL345 IC from Analog Devices is the brain of this module. The ADXL345 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±16g. ADXL345Accelerometer module consists of 8 pins.

G. L298N Motor Module

An L298N motor module is a heavy-duty dual H-bridge controller, which is used to control the direction and speed of single or two direct current (DC) motors of up to 2A each, having a voltage between 5V to 35V. It has principally four output pins for the connection of the DC motors, four input pins to receive the signal from the microcontroller, two enable jumpers (remove one of the corresponding jumpers and connect to the pulse width modulation pins to control the speed of DC motors). It also has an onboard 5V regulator, removes that regulator if the supply voltage is up to 12V.

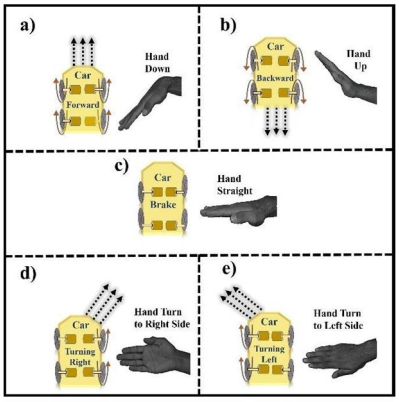


Fig 1: Car movements for gestures

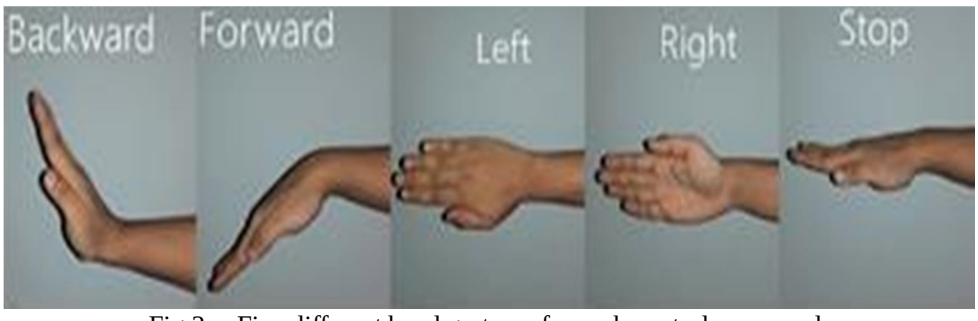
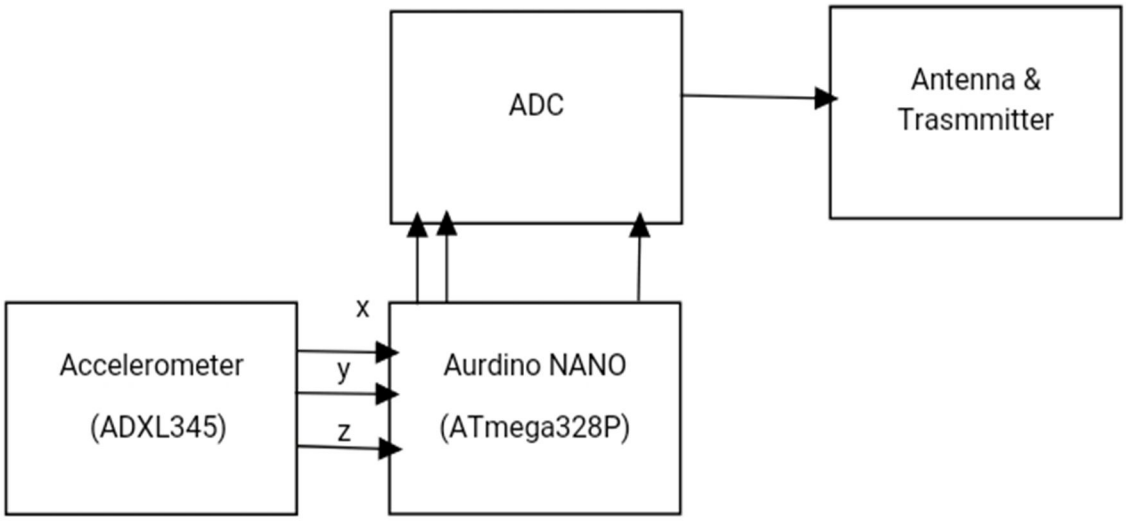


Fig 2: . Five different hand gestures for each control commands

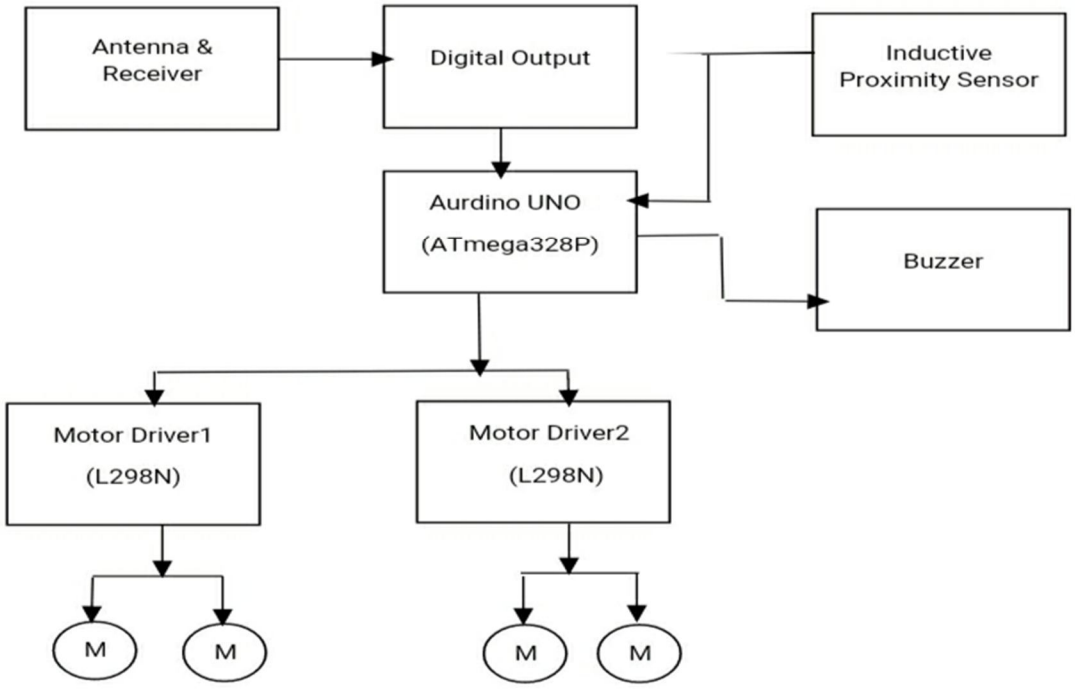
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V. ARCHITECTURE



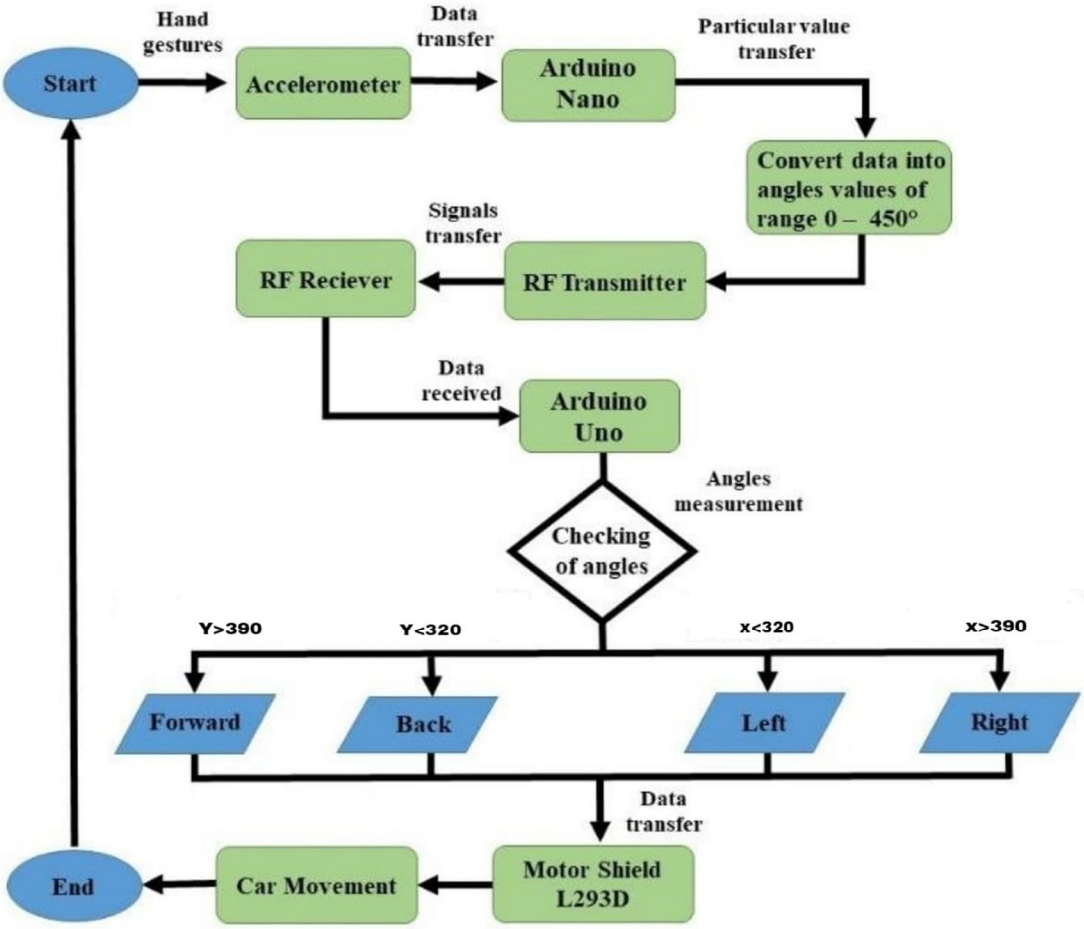
Transmitter section



Receiver section

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VI. USE-CASE DIAGRAM



The robot movement is based on accelerometer orientation. ADXL345 is a 3-axis accelerometer where x-axis is used to move robot in front(+y) and back (-y) directions while y-axis is used to move robot in left(+x) and right(-x) direction and stable is used to stop car movement. The Z-axis is considered to be gravity of earth assumed as 0g.

DIRECTION	ACCELEROMETER ORIENTATION
Front	+y
Back	-y
Left	+x
Right	-x
Stop	Reset

Direction and orientation

DIRECTION	Motor 1	Motor 2	Motor 3	Motor 4
Front	HIGH	LOW	HIGH	LOW
Back	LOW	HIGH	LOW	HIGH
Right	HIGH	LOW	LOW	HIGH
Left	LOW	HIGH	HIGH	LOW
Stop	LOW	LOW	LOW	LOW

Direction and Motors

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VII. SOFTWARE DESCRIPTION

A. Arduino IDE

The Arduino software (IDE) is an open source software, which is used to programme the Arduino boards, and is an integrated development environment, developed by arduino.cc. Allow to write and upload code to Arduino boards. And it consist of many libraries and a set of examples of mini projects. Arduino software (IDE) is compatible with different operating systems (Windows, Linux, Mac OS X), and supports the programming languages (C/C++) The Arduino software is easy to use for beginners, or advanced users. It uses to get started with electronics programming and robotics, and build interactive prototypes. So Arduino software is a tool to develop new things. and create new electronic projects, by Anyone (children, hobbyists, engineers, programmers, … etc).

B. C

C is an imperative procedural language, supporting structured programming, lexical variable scope and recursion, with a static type system. It was designed to be compiled to provide low-level access to memory and language constructs that map efficiently to machine instructions, all with minimal runtime support. Despite its low-level capabilities, the language was designed to encourage cross-platform programming. A standards-compliant C program written with portability in mind can be compiled for a wide variety of computer platforms and operating systems with few changes to its source code.

VIII. RESULTS

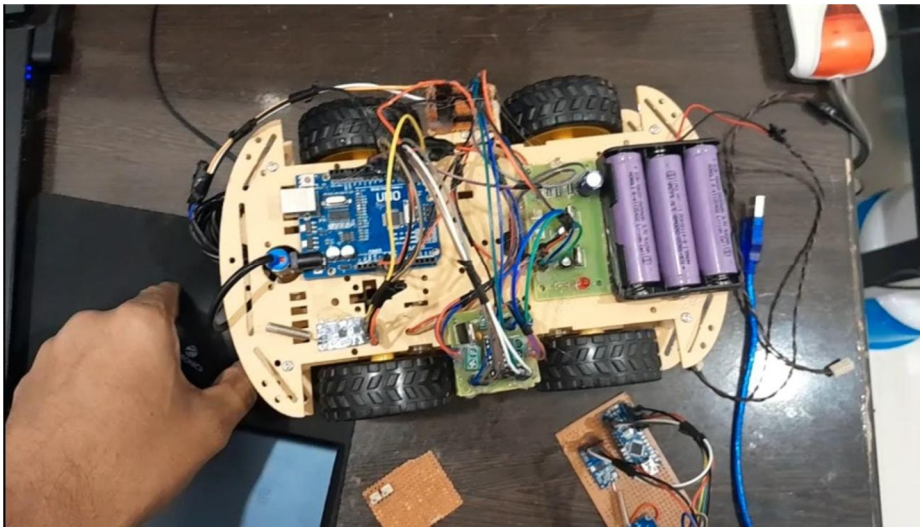


Fig. 3 Robot (Receiver part)

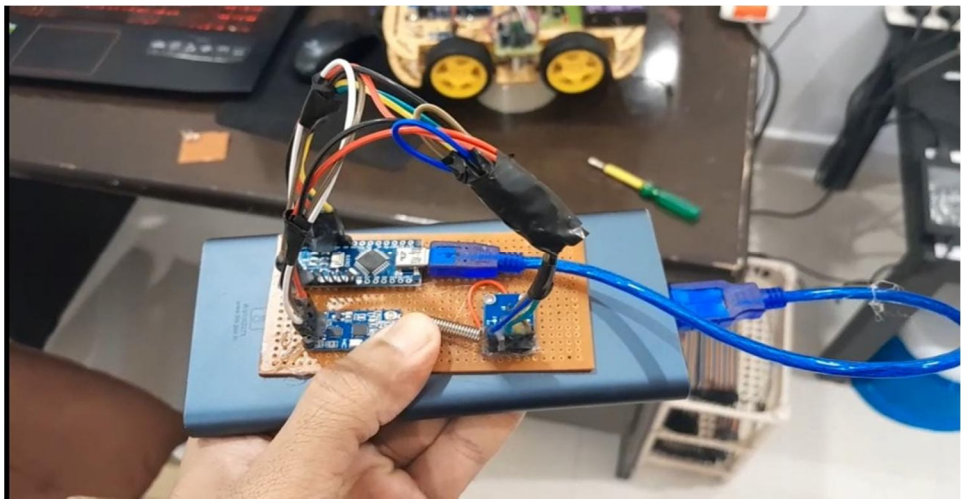


Fig. 4 Transmitter part



Fig. 5 Metal detector

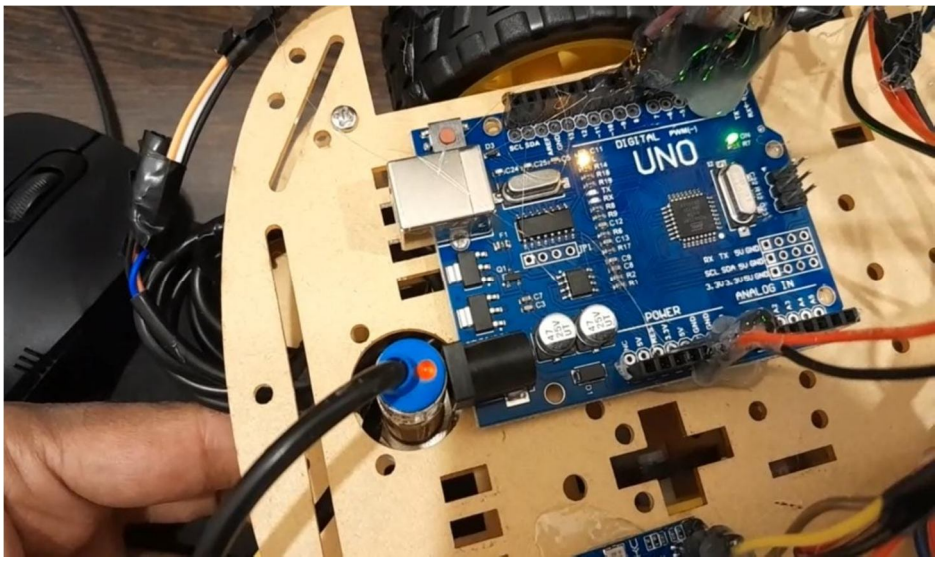


Fig. 6 Produce beep sound

IX. CONCLUSION

In this study, we have looked at how well gesture controlled robot can recognize and produce beep sounds after detecting landmines. First, using gestures supplied by user using glove-based technique, we created an algorithm for movement of robot by recognizing gestures and move according to the directions specified respectively. Second, we used Inductive proximity sensor to identify various metals present inside ground. Third, we established that robot should stop its movement if it detected any landmine in its path of operation and produce beep sound from the buzzer attached on robot. The RF module will be working on the frequency of 2.4 GHZ and has a range of 100-500 meters.

X. FUTURE SCOPE

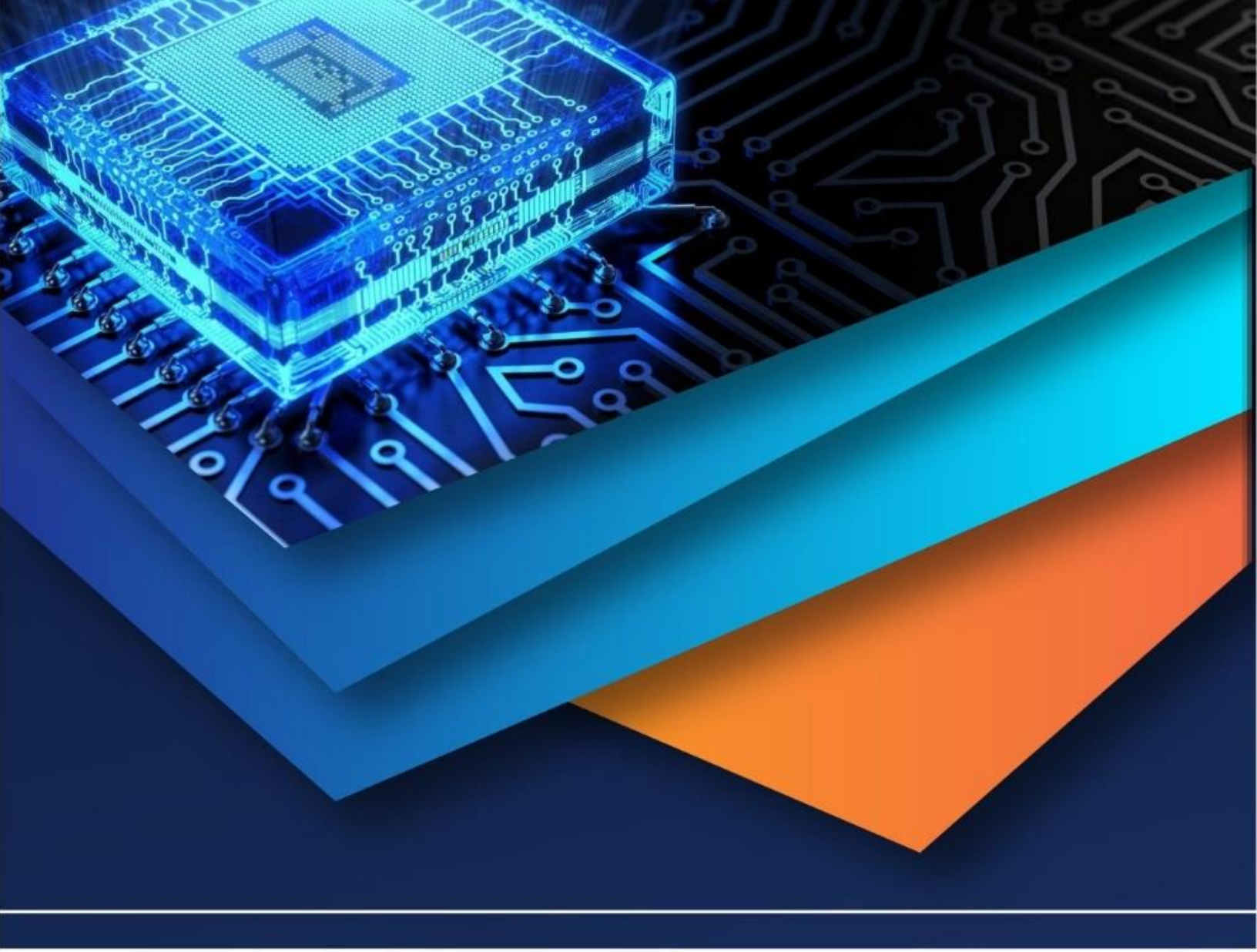
The project can be worked on in one specific area. This service robot executing many different tasks from private movement to a full-fledged advanced automotive that can make disabled to able in all sense. It can be upgraded to bomb detecting robot as it can be connected to robotic arm ,it can also lift the bomb. GPS System can be added to the robot by the help of which its location can be tracked. Also use of image processing techniques can be implemented for pre-processing and extraction of relevant data. Combining different kinds of sensors can obtain better results in landmine detection.

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