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DESIGN AND DEVELOPMENT OF ARDUINO BASED METAL DETECTOR ROBOT

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Abstract—Metal Detector robot is an instrumentcontrolled by an Android based smartphone that detects the presence of metals, especiallylandmines on a designated location .The old method of landmine detecting such as direct sweeping is very risky for stepping the land mine unintentionally .In this Research, therobot system is equipped with a metaldetector useful to detect the metal presence based on coil induction when it is approaching the metal. LCD works as an interface showing frequencies of detected metals. The robot movement is controlled byDC's current motor programmed using Arduino UNO .When the robot detects the metal presence ,the buzzer sound will be triggered ,and the LCD shows the detected metal frequency.

keywords- Metal detector, ArduinoUNO, DC Motor, Android smart phone, Motor driver.

INTRODUCTION

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 ofmines is metal detector. Metal detection robots are tool to detect the presence of metalor materials containing metal, this robot will notify the presence of metal around the robotby using metal detector. Several recentstudies in robot design are based on Arduino or some research based on android. Metaldetectors work on the principle transmitting amagnetic field and Analysing are turn signal from the target and environment. In the technology World Robotics play savital role. Robotics is designed for manufacturing work

purpose to reduce Man power efforts. There are many applications of Industrial Robots it includes Assembly, packaging, &labeling, product inspection, etc. Similarly, there are many applications of robots that are designedin different fields for different purposes. In this current period robots are also used incomputers to do manual work. Humanoid conjointly includes a full set of tools that has developers with high productivity and deep insight into their applications. BluetoothMaybe a technology with associate open normal specification for a frequency(RF)- based short vary property technology that changes the face of computing and wireless communication. The data received by the Blue-tooth module from humanoid sensible phone is fed as input to the controller. Thereby, the controller acts accordingly on the DC motors to maneuver within the entire golem all told the four directionsvictimization the humanoid phone. Metal detectors vary in their effective operating ranges and the amounts and types of metals necessary to generate a signal. The electric induction caused by the coil will change between the presence of metal and nonmetal.The results of this research describe the application of using an inductive proximity sensor in a metal detector robot based on microcontroller. The purpose of this researchis to design an android based metal detectionRobot which can be controlled by a wireless controller. Design of Components aredescribed as follows: BluetoothModule- BluetoothmoduleHC-05 is used that will transmit the commands to a microcontroller that are received from the Android Application. Arduino UNO Board-Robot is operated by a microcontroller which isprogrammed with the help of software i.e. Arduino. When

two devices are connected, commands are sent to the Bluetooth module and it transmits the command to the Arduino UNO microcontroller. Sensor- Sensor is usedto detect an obstacle, the buzzer alerts the user

by LED which is connected with the sensor. An Android Application on mobile phone willcontrol the robot by giving the commands. Asthe mobile phone will act as a remote controller for the robot.

Components- DC Motor, Arduino UNO, Bluetooth Module, Motor driver, Buzzer, Proximity sensor, Battery.

DC Motor- The DC motor is the motor whichconverts the direct current into the mechanicalwork. It works on the principle of Lorentz Law, which states that "the current carrying conductor placed in a magnetic and electric field experience a force".
The drive used for this robot is to use a DC motor. The use of a gear box is needed to make efficient space on the chassis and change the shaft position of the DC motor because by using a gearbox, a dc motor that should be placed horizontally to distribute itsrotation to the wheels can be positioned vertically with a fixed axle.
The capacity of the DC motor we are using is9V which can produce upto 120 rpm with no load. The current produced by the DC motor is 60mA with no load.

FIG 1- Battery

Arduino UNO- Arduino is an open-sourceplatform that is easy to use on hardware as well as on software. It is a microcontroller board of AT mega 328P. Arduino UNO occupies 14 digital input and output pins. 6 pins can be operated as PWM output, 6 pins as analog inputs, 16 MHz ceramic resonators,a USB attachment, are set button, a jackscrew,and an ICSP header. It works on 12V. The board can be provided with power each fromthe DC power jack, the USB connector, or theVIN pin of the board. The WIFI Module is a self-sustaining SoC with a combined TCP/IPprotocol stack that can provide admittance toa WIFI network. Sciences, doing cool stuff with system and elements. Arduino is an Embedded System Devices that got very popular in the maker's community due to its unrestricted and open-source creation.

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FIG 2: Arduino UNO

Bluetooth Module- Bluetooth device is interfaced with the control unit for sensing thesignals that are transmitted by the android app. The data is transmitted to the control units that guide the robot in different directions. A microcontroller (HC-05) is usedas a control device in the project. Distant operation is accomplished by any smartphone with Android OS, upon a GUI (Graphical User Interface). We applied the HC-05 module to pair the Android application with the robot. Communicating end uses an android application device through which commands are conveyed to the robot. At the receiver end, these commands are used for controlling the robot in any direction such asforward, backward and left, or right.

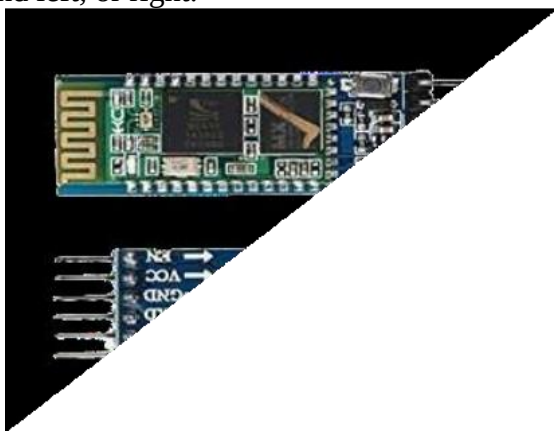

FIG 3: Bluetooth module

Motor driver- The motor driver is used to control the direction of rotation and speed ofthe DC motor, which is the main driving force of the robot. This motor driver will be controlled using a micro controller by digitalinput data.

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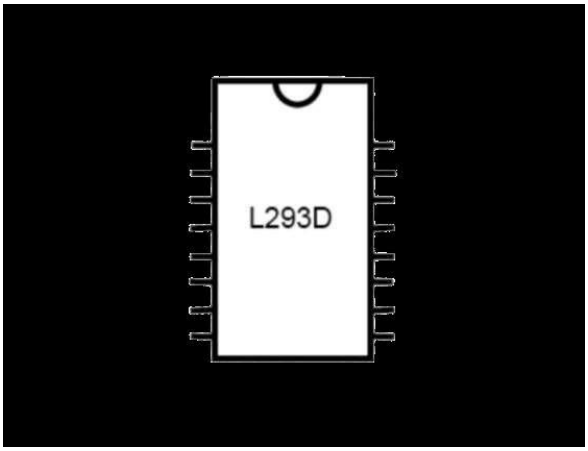

FIG 4: Motor driver

Inductive proximity sensor- This component is the most important part in the design of a metal sensor robot, with this component where the detected metal can be detected.
Metal detectors work by broad casting anelectromagnetic field from the sensor to the ground. Any metal deep down will retransmitan electromagnetic field of its own back to the

sensor. Usually, metal detectors can identify different metals such as iron, copper, aluminum, tin, nickel, brass, and lead. We have to fix the device that only transmits a specific electromagnetic field to detect thetarget metal.
For this study, we used metal sensors with thefollowing specifications. (a)Detectiondistance:0-5mm; (b)Object of detection : Metal (Iron, Aluminum etc.); (c)Working voltage:5-15VDC; (d)current Output:150mA;(e)There are indicators: Yes(Red); (f)Working temperature:-25to+70C; (h)Cable length:1.5m.

FIG 5: Inductive proximity sensorWorking

The metal detector robot works on the basis 5-volt power supply by using Arduino UNO Controller. The purpose of this robot is for military security. Arduino UNO is the heart ofthe project which works

on 5VDC. It controlsthe overall circuit to give desired output for provided input commands.

In this implemented hardware design metal sensor is used. A metal sensor detects the presence of metal nearby. Metal sensors are useful for finding metal objects. They often consist of a handheld arm to hold, with a sensor probe which can be swept over the ground or other objects. This is very useful forthe military area.

Next by using an ultrasonic sensor we can measure the distance by utilizing ultrasonic waves. The sensor head transmits an ultrasonic wave and takes the wave reflected from the destination and ultrasonic sensors measure the distance to the target by measuring the time difference between the radiation and response of the wave.

Command for DC motorCase1: Forward

Case2: ReverseCase3: left Case4: right Case 5: stop

The robot works and navigates as per the above commands. The motor driver is connected to the Arduino Uno board. Bluetooth is used for controlling the robot. Inthis way, the system work is based on Arduino UNO Controller, sensors, DC motor.

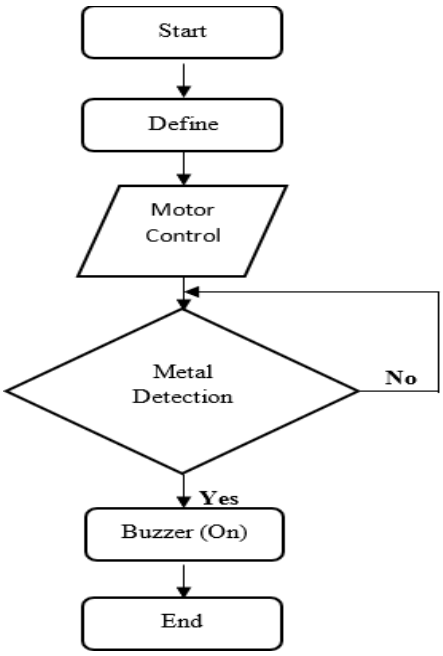

FIG 6: Flowchart of the process.

Algorithm/code used:

```
unsigned int a=0; voidsetup()
{
pinMode(8,INPUT); pinMode(11,OUTPUT); pinMode(4,OUTPUT);
pinMode(5, OUTPUT);
pinMode(6, OUTPUT); pinMode(7,OUTPUT); digitalWrite(11,LOW);
digitalWrite(4,LOW); digitalWrite(5,LOW); digitalWrite(6,LOW);
digitalWrite(7,LOW); Serial.begin(9600);
}
void loop() { if(digitalRead(8)==LOW&&a==0)
{ a=1;
digitalWrite(4,LOW); digitalWrite(5,LOW); digitalWrite(6,LOW);
digitalWrite(7,LOW); digitalWrite(11,HIGH);
Serial.print("Alert!Metaldetected with frequency 5kHz\n\r");
}
if(Serial.available()>0)
{
char c = Serial.read(); if(c
=='F')
{
digitalWrite(11, LOW); Serial.print("Forward\n\r");
digitalWrite(4,HIGH); digitalWrite(5,LOW); digitalWrite(6,HIGH);
digitalWrite(7,LOW); delay(500);
a=0;
} if(c=='B')
{
digitalWrite(11,LOW);digitalWrite(4,LOW); digitalWrite(5,HIGH);
digitalWrite(6,LOW); digitalWrite(7,HIGH);
Serial.print("Backward\n\r");delay(500);
a=0;
} if(c=='L')
{
digitalWrite(11,LOW); digitalWrite(4,LOW); digitalWrite(5,HIGH);
digitalWrite(6,HIGH); digitalWrite(7,LOW);
Serial.print("Left\n\r");delay(500);  a=0;
} if(c=='R')
{
digitalWrite(11,LOW); digitalWrite(4,HIGH); digitalWrite(5,LOW);
digitalWrite(6,LOW); digitalWrite(7,HIGH);
Serial.print("Right\n\r");delay(500);
a=0;
} if(c=='S')
{
digitalWrite(11,LOW); digitalWrite(4,LOW); digitalWrite(5,LOW);
digitalWrite(6,LOW); digitalWrite(7,LOW);
Serial.print("Stop\n\r");delay(500);
```

```
a=0;
}
}
```

Android Application- Android is a very familiar word in today's world. Millions of devices are running on Android OS and millions are being developed every day.

Android Studio is an application that is usedto develop the android application that controls the robot.

The first phase of application design goesthrough the writing the code as per our requirements. The second phase is coding forconnecting the Bluetooth of our device with robot.

In this app development, the **Android Studio** provides a versatile opportunity to develop a customized application that starts with establishing a Bluetooth connection by searching the available Bluetooth devices andmake pair with them. For robotic movement, a character is assigned for each operation suchas Forward-"F", Backward-"B", Left-"L", Right-"R" and Stop-"S".

Design of the robot using Catia V5

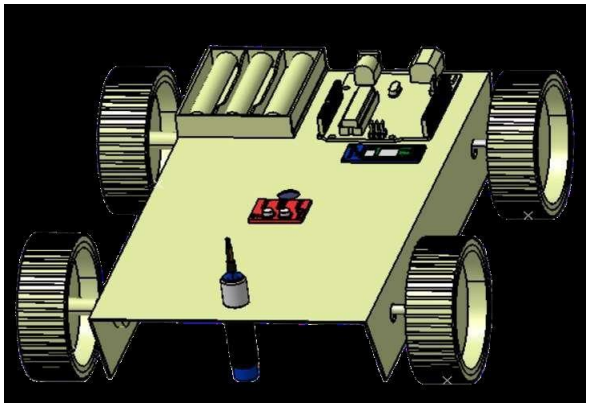

FIG 7: Isometric view of the robot design Results

The results of the analysis of robot control Bluetooth with a Smartphone Android-based on Arduino Uno, this robot uses the Arduino Uno as a robot control system Bluetooth Hc- 05, where the command sent by the smartphone to be able to move the Dc motorsthat it can move the Arduino-based robot thatis made.

Testing the system input on the sensor connected to the micro controller without putbuzzer and LCD. The use of the buzzer isintended to determine the presence of detected metal, and the use of LCD as a display of the resulting voltage on each detected metal.

In this stage, testing the robot control. The robot runs when it is on a level place, withoutobstacles or obstacles, and on the ground withobstacles or without obstacles. This robot uses a DC motor as a driving wheel. This motor has a specification V supply 6V, 100rpm, current 60mA.

This robot is given an incline to find out howstrong the robot can climb. The robot climbs on a flat plane of about 30 degrees with a PWM 75-100. In this condition, the robot canrise. Below is the provision of PWM values for DC motors to determine which robot PWM values can pass a 30-degree incline.

CONCLUSION

Android is a mobile phone system that can build a strong remote-control system.While developing such a system we need to communicate with the robot, this softwarerequires a Bluetooth link. The Multi-PurposeMilitary Service Robot is built to facilitate secure two-way communication between the Android phone and the robot in such a way that it needs can be fulfilled by the military, police, and armed forces. It has numerousimplementations which can be found in diverse situations and environments. It can, for instance, be used for military purposes bythe armed forces in one region, while it can beused for surveillance purposes in another. Themines can also be disposed of once detected by the robot.
Metaldetectors can detect the presence of metal with a variety of metal types, aluminum, low carbon steel, and copper witha maximum detection distance of 0.5mm. Thereliability of the robot can move with a terrainslope of 30 degree, using a 7.4 VDCmotor,75-100rpmrotation.

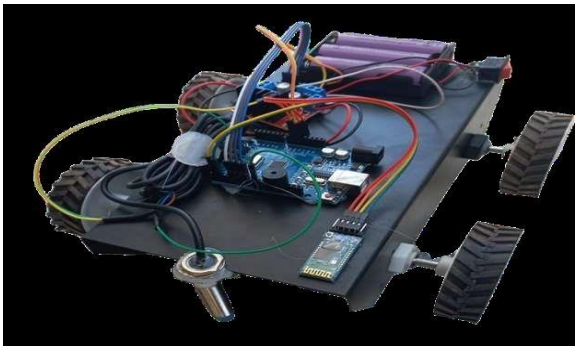

FIG 8: Final development of the robot

REFERENCES

[1]. The Working Principle of an Arduino byYusuf Abdullahi Badamasi (2014).
[2]SmartPhone Based Robotic Control forSurveillance Application by MSelvam (Mar2014).
[3] Arduino controlled war field spy robot using night vision wireless camera andAndroid application by Hitesh Patel (Nov2015).
[4] Bluetooth-controlled spy robot by ManishKorde (2017).
[5] Multi-purpose Military Service Robot by EAmareswar (2017).
[6] Bluetooth Controlled Metal Detector Robot by Ananya Bhattacharya (May2017).
[7] SMART SPY ROBOT by Ankit Yadav,AnshulTiwari,Divya Sharma,Ratnesh Srivastava,SachinKumar (April2016).
[8] Military Spying and Bomb Disposal Robot Using IOT by1.CHAITRALIJADHAV, 2.SHAMLIGIBILE, 3.SNEHALGAIKWAD,4.NEELUMDAVE (April2018)
[9] Bluetooth controlled Metal detectingrobot with message alert by M.Sirisha1,P.Nagalakshmi2,Y.LeelaBrahme swari3(May2018).