**IOT BASED GESTURE CONTROL CAR FOR LANDMINE DETECTION**

## A PROJECT WORK

*Submitted in the partial fulfillment for the award of the degree of*

# BACHELOR OF ENGINEERING IN

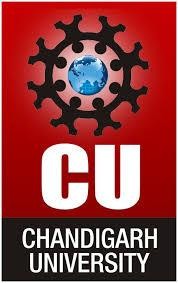
**COMPUTER SCIENCE *(Internet of Things)***

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**DECLARATION**

**I ‘Shagun’** student of **‘Bachelor of Engineering in COMPUTER SCIENCE (Internet of Things)’, session: 2018 - 2019**, Apex Institute of Technology, Chandigarh University, Punjab, hereby declare that the work presented in this Project Work entitled **‘IOT BASED GESTURE CONTROL CAR FOR LANDMINE DETECTION’**

is the outcome of our own bona fide work and is correct to the best of our knowledge and this work has been undertaken taking care of Engineering Ethics. It contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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**CERTIFICATE**

This is to certify that the work embodies in this dissertation entitled ***‘Blind’s Mate’ being*** submitted by **17BCS4538** for partial fulfillment of the requirement for the award of **Bachelor of Engineering** in **Computer Science *(Internet of Things)*** discipline to Apex Institute of Technology, Chandigarh University, Punjab during the academic year 2018 - 2019 is a record of bona fide piece of work, undertaken by him/her the supervision of the undersigned.

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**EXTERNAL EXAMINER**

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# TABLE OF CONTENTS

1. INTRODUCTION
2. OBJECTIVES
3. COMPONENTS
4. METHODOLOGY
5. WORKING
6. CIRCUITORY
7. CONCLUSION

**IOT BASED GESTURE CONTROL CAR FOR LANDMINE DETECTION**

INTRODUCTION

Humans opts . However, gestures have been an important means of communication in the physical world from ancient times, even before the invention of any language. In this era of machines taking control of every complex works, interactions with machines have become more important than ever.

A Robot is an electro-mechanical system that is operated by a computer program. Robots can be autonomous or semi-autonomous. An autonomous robot is not controlled by human and acts on its own decision by sensing its environment. Majority of the industrial robots are autonomous as they are required to operate at high speed and with great accuracy. But some applications require semi- autonomous or human controlled robots. Some of the most commonly used control systems are voice recognition, tactile or touch controlled and motion controlled.

One of the frequently implemented motion controlled robot is a Hand Gesture Controlled Robot. Undoubtedly, the output and the functioning of machines will be more intuitive if they are communicated using human gestures. A gesture is a form of communication in a non-verbal manner by using visible body movements or actions conveying messages. There are several ways to capture a human gesture that a machine would be able to understand. The gesture can be captured using a camera, or a data glove. Gestures can also be captured via Bluetooth or infrared waves, Acoustic, Tactile, optical or motion technological means.

The embedded systems designed for specific control functions can be optimized to reduce the size and cost of the device, and increase the reliability and performance. With the advent of Smartphone and other modern technologies, operating machines have become more flexible. The Smartphone are equipped with in-built accelerometer which may be used for gesture recognition and such other tasks. Moreover, the Android OS is gaining significant popularity in the world of Smartphone due to its open architecture. Android platform is being used in the development of numerous applications for cell-phones.

Thousands of innocent lives are lost each due to various conflicts between countries leading to war and human led destruction at a large extent. Landmines, one of the most common type of explosive has been used for more than a decade in various war fields. Efficient and effective detection of landmines is very necessary with low false alarm rate detection.

Researchers have shown interest in gesture recognitions and have built several robots and devices that are controlled by human gestures. There is a constant development in the field of gesture controlled devices. The devices can be equipped with some more accurate sensors to detect landmines.

There are various modes of communication between the microcontroller of the robot and the Smartphone. However, the popularly used means of communication is done via Bluetooth module which has intermediate range of distance covered and at low cost.

In this project, an android operated phone is incorporated as an accelerometer and The Arduino microcontroller is incorporated in the robot for the main computation and the main communication between all the modules. Then there is a motor driver that deals with the computation and functioning of the motors to turn the wheels essential for the movement of the robot. Last, but not least, a Bluetooth module is incorporated in the robot that serves as the means of receiving the data from the Smartphone which is processed in the Arduino to detect the direction of movement of the users hand and move the robot accordingly. The prime aim of the design is that as the user moves his hand in some direction, the robot moves in the same direction as well. In other words, the robot is solely controlled by the hand movements and gestures of the user.

MOTIVATION AND OBJECTIVE

Our motivation for the project to work on came from the various problems faced by the various sectors of the society which needs an interactive innovation for its solution. Gesture controlled car is a prototype developed which can be implemented in various sectors where tasks performed are human incompatible or involves any threat to human life. Robots are basically build to ease human task and so will this prototype do.

Our objective is to make the device simple as well as cheap so that it can be implemented easily and mass produced and can be used numerous purposes. We need constant change, technological innovation capability, and high productivity to survive in the fierce competitive environment.

TECHNICAL REQUIREMENTS

In this work, there are ten fundamental components are required to build up the project:

**Arduino**

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by [Arduino.cc. The board is equipped with sets of digital and analog](https://en.wikipedia.org/wiki/Arduino) input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other [circuits.[1] The board has 14 Digital pins, 6 Analog pins, and programmable with the](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-Makerspace-1) Arduino IDE (Integrated Development Environment) via a type B USB cable.[[4] It can be powered by a USB cable](https://en.wikipedia.org/wiki/Arduino_Uno#cite_note-priceton-4) or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

USB Battery

It is used to supply power to the device. USB batteries are rechargeable and can be efficiently used. It is a good source of power supply to enhanced embedded devices.

USB Cable

It is used to connect arduino to peripheral devices and to connect to the USB battery.

L293D Motor Driver Shield

L293D is a typically motor driver IC which allows DC motor to drive on either direction. L293D motor driver shield consists of two L293D ICs which can control a set of 4DC

motors simultaneously in any direction.

9V Battery

A 9-volt battery, sometimes referred to by its original designation as a PP3 battery, is shaped as a rounded rectangular prism and has a nominal output of nine [volts. Its nominal](https://encyc.org/w/index.php?title=Volt&action=edit&redlink=1) dimensions are 48 mm × 25 mm × 15 mm. It is used to power supply the motor.

**Bread Board**

A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate

**Car Chasis Kit**

It is used as the base where the arduino and all the components will reside. The chasis kit will contain the basic architecture of a car with four wheels including the motor that will drive the wheels.

**Jumper Wires**

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

**HC-05 Bluetooth Module**

HC‐05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04‐External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

**DC 9 V Holder**

It is used to hold the battery. The battery is inserted in the holder through which the power is driven across the device.

**NEO 6M GPS Module**

The NEO 6M GPS module is a well performing complete gps receiver with a built in 25 x 25 x 4 mm ceramic antenna which provides a strong satellite search capability with the power and signal indicator.

**Metal Detector Sensor**

It is a sensor developed to detect any metal which comes in to the radius of the sensor. It is used to first identify the landmine.

**Android Smartphone**

This is the remote components that senses the user’s hand movements and send its determinant value to the Arduino microcontroller via the Bluetooth module. The Android application designed for this work does the calculation of the determinant.

SYSTEM DESCRIPTION

Gesture recognition is the main aim of this work. The user holds an Android operated

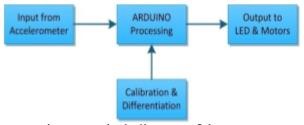
Smartphone, and moves, or rotates his hand in any direction. The accelerometer within the phone is regulated to generate a maximum and minimum value for the movement of the hand in three dimensional co-ordinates depending upon the external environmental conditions. The android application does the work of sensing the accelerometer calibration and generating the maximum

and minimum values from it. Depending upon the values obtained, it sends a determinant value to

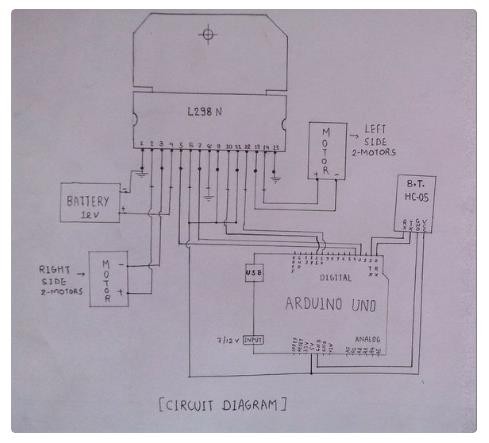
the microcontroller using Bluetooth. The Bluetooth module receives data and transmits it to Arduino where it checks the determinant value and moves the robot accordingly. The whole process is under an infinite loop, so it runs as long as the power is supplied. The output depends on the

accelerometer inputs directly that can be used to control the robot. The accelerometer input depends on the gestures of the user’s hand. The steps stated above are broadly described in this section. The system consists of the following steps to work as mentioned:

**A. Block Diagram of the system**

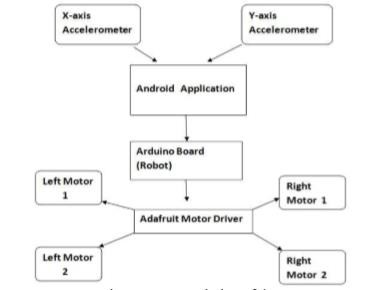


**B. Circuit Diagram**



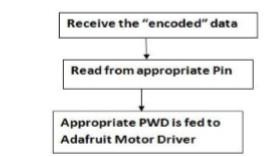
**C. Transmission of data from Android application to Motor driver**

The input to the application is the direction of movement of hand of the user given by the accelerometer. This is analog in nature. It is then digitally coded by the Android application before sending it to Arduino by HC-05 Bluetooth module. The signal goes to the digital pins of the Arduino board, which has an inbuilt AD/DA converter of 8 bit. The Arduino process the received data. Based on the data received, appropriate signal is transmitted to the motor driver to rotate the motor in such a way that the robot moves in the direction of movement of the user’s hand.



**D. Receiving the data**

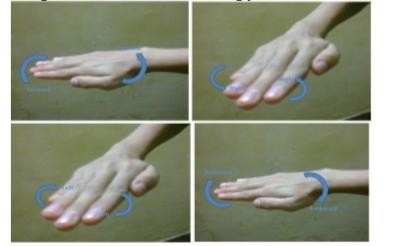
The data is received from the Android Smartphone via HC-05 Bluetooth module on the digital pins of the Arduino microcontroller. It is then processed in Arduino. This processed data is received by the Adafruit motor shield or L293D. Based on the data



**E. Gesture Recognition**

Android Smartphone’s are equipped with inbuilt accelerometers. The application designed in this work retrieves the value of the accelerometer and sends a determinant value to the microcontroller via Bluetooth. As the user moves his hand, the accelerometer reading changes. It is then retrieved by the application. There are two values: One is maximum value and the other is minimum value. The range is specified using these two values for each function of the robot. If the value retrieved by the application lies between these specified values, then the corresponding determinant is generated. This determinant is sent to the microcontroller, which then receives the determinant value, process

it to recognize the corresponding gesture, and sends signals to move the robot accordingly.



The above figure shows the gestures to control the movement of the robot. When the user tilts his hand forward, the gesture is recognized as the forward movement, and the robot moves in the forward direction. The angle of the tilt or the difference between the angle of tilt of user’s hand and the threshold value of forward movement gesture determines the speed of the robot. When the

user tilts his hand on the right direction, the gesture is recognized as the right turn, and the robot

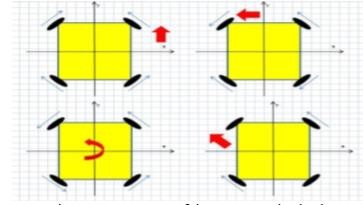
moves in the right direction. When the user tilts his hand in the left direction, the gesture is recognized as the left turn, and the robot moves in the right direction. The angle of the tilt of user’s hand determines whether the left or right turn is a normal turn or a sharp turn. A sharp turn is one in which a car changes direction without slowing down before turning. When the user tilts his hand backwards, the gesture is recognized as the move backward gesture, and the robot moves in the backward direction. If the user’s hand is somewhere between the two gestures, i.e., the accelerometer value is somewhere between the threshold of two directions(forward and left turn, left turn and backwards, backwards and right turn, forward and right turn), then the robot moves in that diagonal direction.

**F. Movement of Motors and Wheels**

There are four DC motors used in the design of this robot: one motor for each wheel. The motors are controlled by the Adafruit motor shield or the L293D. The shield is stacked on top of Arduino. Every shield stacked can run 4 DC motors. The signal is sent to the motor shield that runs the motors.

The wheels are connected to the motors. 4 DC motors are used Two for left wheels, and two for right wheels. When the signal received in the motor shield is to move forward, all the four wheels of motors rotate forward, this turns all the four wheels in the forward direction. The robot moves in the forward direction. When the signal received in the motor shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right diagonal motors are made rotated forwards. This makes the robot turn in the forward left direction. When the signal received in the motor shield is to turn the robot in the forward right direction, the right diagonal motors are rotated backward while the left diagonal motors are rotated forwards. This makes the robot turn in the forward right direction. When the signal in the motor shield is to move backward, both the pairs of the motors are rotated backwards resulting the robot to move backwards. When the signal in the motor shield is to stop the robot, all the motors are made stationary resulting the robot to stop.

Similarly, to rotate the robot in backward directions, similar methodology is used. To turn the robot in the backward left direction, the left diagonal motors are rotated forwards while the right diagonal motors are rotated backwards. This makes the robot turn in the backward left direction. To turn the robot in the backward right direction, the right diagonal motors are rotated forwards while the left diagonal motors are rotated backwards. This makes the robot turn in the backward right direction.



**Detecting the landmine**

The gesture control car is equipped with a metal sensor having the ability to detect landmines. Whenever, the car rolls over any metal or landminr, it detects it. For further accuracy to reduce false alarm rate of detection, it can also be equipped with a nitrogenous compound detection sensor.

The car will detect the landmine and send the location of the landmine to the user via NEO 6M GPS Module. The user will have a confirmed location of the particular landmine.

**Designing the Android Application**

The Android application is the key to control the robot using hand gestures. The application reads the accelerometer state and X, Y, and Z values are obtained in the application. There are two threshold values assigned for each movement: one is the MAX\_THRESHOLD, and the other is the MIN\_THRESHOLD. If the obtained value lies between these thresholds of a certain movement, then the character assigned to denote that movement, which is called the DET or determinant is sent to the robot via Bluetooth. The application continuously sense this until the application is ON. A graphical user interface has been designed for the comfort of the user. The application abstracts the calculations and accelerometer values, but the user interface shows the direction of movement of the hand so that the user is aware of wrong turns in the bot.

**ALGORITHM FOR GESTURE CONTROLLED ROBOT**

**A. Main Module**

**Step 1:** Initialize the frequencies of the motors.

**Step 2:** Initialize SERIAL 9600

**Step 3:** Set the speed for the motors in rpm.

**Step 4:** While (1) do

**1.** DET check ();

**2.** While DET == F, move the robot forward

Call check (); End While

**3.** While DET == B, move the robot backwards

Call check (); End While

**4.** While DET == L, move the wheels left

Call check (); End While

**5.** While DET == R, move the wheels right

Call check (); End While

**6.** While DET == I, move the wheels right forward

Call check (); End While

**7.** While DET == J, move the wheels right backward

Call check (); End While

**8.** While DET == G, move the wheels left forward

Call check (); End While

**9.** While DET == H, move the wheels left backward

Call check (); End While

End While

**B.** Function check ()

**Step 1:** Initialize DATAIN S

**Step 2:** Initialize VELOCITY 0

If data on the serial lines > 0 then

1. DATAIN Character sent by the phone

2. If DATAIN == F, then DET F

3. If DATAIN == B, then DET B

4. If DATAIN == L, then DET L

5. If DATAIN == R, then DET R

6. If DATAIN == I, then DET I

7. If DATAIN == J, then DET J

8. If DATAIN == G, then DET G

9. If DATAIN == H, then DET H

10. If DATAIN == S, then DET S End If

**Step 3:** Set the velocity based on the data received in the multiples of 25. Set VELOCITY U, if no valid value for velocity is received.

**Step 4:** Return DET

**ALGORITHM FOR THE ANDROID APPLICATION**

**Step 1:** Connect to the Bluetooth Module

**Step 2:** Set THRESHOLD\_MAX and THRESHOLD\_MIN values for each direction forward, backward, Left and Right

**Step 3**: Get the state of the accelerometer: I State of the accelerometer

**Step 4:** VALUE I into X, Y, Z coordinate values

**Step 5:** If VALUE is in between THRESHOLD\_MAX and THRESHOLD\_MIN for a direction, then set

DATAOUT as the direction of VALUE represented by a Character.

**Step 6:** Return DATAOUT

FUTURE SCOPE AND CONCLUSION

The Gesture controlled robot designed in this work has many future scopes. The robot can be used for surveillance purpose. The robot can be applied in a wheelchair where the wheelchair can be driven by the movements of rider’s hand. Wi-Fi can be used for communication instead of Bluetooth to access it from a greater distance. Edge sensors can be incorporated to it to prevent the robot

from falling from any surface. Some camera can be installed which can record and send data to the nearby computer or cell-phone. It can be implemented on a watch, or in any home appliances like Room heater. Modern ARDUINO chips support Intranet as well as Internet connections which can be utilized to a greater extent. This robotic car can be enhanced to work in the military surveillance where it can be sent to some enemy camps and track it’s activities via Internet. With a mind full of creation, the possibilities are endless.

In this project, the design and implementation of Gesture Controlled Robot for landmine detection is presented and developed using Arduino microcontroller and Android Smartphone. An algorithm has been provided and its working is detailed thoroughly. The built device is cheap, and is easy to carry from one place to another. The addition of the some additional sensors or camera will make it more productive. The limitation of the hardware being associated with a system has been reduced to a great extent. As an end thought, the system will allow the user to control it in a way that reduces the gap between the physical world and the digital world with an output more intuitive.

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