

# **FIRE SENSING VOICE CONTROLLED ROBOT**

Submitted in partial fulfillment of the Requirements  
for the degree of

**BACHELOR OF ENGINEERING**

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## CERTIFICATE

This project report entitled “**Fire Sensing Voice Controlled Robot**” by **Vanita Israni, Eeshita Sai and Himabindu Reddy B.** is approved for the degree of **BACHELOR OF ENGINEERING in ELECTRONICS AND TELECOMMUNICATION.**

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## ACKNOWLEDGMENT

We take this opportunity in representing the report on our project “**FIRE SENSING VOICE CONTROLLED ROBOT**”. The completion of any project brings with it a sense of satisfaction, but it is never complete without the appreciating those people who made it possible and whose constant support crowned each effort with success. One cannot even imagine the power of the force that guides us and neither can we succeed without acknowledging it.

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## **ABSTRACT**

The main purpose of this project is to control a robot using voice and to monitor environmental conditions in case of fire emergencies and gas leaks. Voice controlled robot system is a movable robot which is supervised or controlled using voice commands given by the user. The robot performs tasks based on the voice commands given. The voice controlled robot uses a built-in speech recognition application in a Smartphone to convert voice commands to text. Using Bluetooth technology these text commands are sent to robot. A Bluetooth device placed on the robot receives commands. The commands are analyzed by a Microcontroller (in this project Arduino Uno Board) and control the robot using motor driver circuits. A Voice controlled robot system is also used for monitoring the gas present in the surrounding places such as nuclear power plants and industrial areas where there is a high risk of fire accidents and it is hazardous and risky for humans. These parameters are monitored using sensors which are connected to the Arduino. The data collected by the sensors are sent to the smart phone via serial communication. The sensed data is then used to activate the pump connected to the robot and thereby extinguishes the fire.

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# **1. INTRODUCTION**

## **1.1 Importance of Robots**

In today's world the use of robots has increased in all fields of life. Robots are being used in applications such as space exploration, industrial manufacturing automation, medical applications, military purposes and logistics etc. The robots becomes essential in applications involving monitoring of environmental conditions and surveillance in places like chemical plants, nuclear plants, war zones, very hot or sub zero temperature environments, disaster affected areas, places which are highly hazardous and dangerous for human intervention and also in farms etc.

## **1.2 What is a Robot?**

A robot is a machine particularly one programmable by a computer for completing a perplexing arrangement of activities automatically. Robots can be guided by an outside control gadget or the control might be inserted inside. Robots might be developed on the lines of human structure, however most robots are machines intended to play out an undertaking with no respect to their style.

## **1.3 Voice Controlled Robot**

Robots can be remote controlled, voice controlled or fully automated. In this project we are going to control a robot using voice. A voice controlled robot is a semi autonomous robot. The Voice controlled robot system makes use of speech recognition.

## **1.4 Speech Algorithm used in Voice Controlled Robot**

Speech recognition involves recording voice commands and converting them to electrical signals using microphone. The speech recognition algorithm used in voice controlled robot is Forward or Viterbi Algorithm. The forward algorithm calculates the likelihood of the data given the model over all possible state sequences. The Viterbi algorithm calculates the likelihood of the data given the model over the single most likely state sequence .The benefits of voice controlled robots are hands-free and quick data input operations. These signals are then converted into text format. Advantages of using speech recognition is that the speech recognition circuit independently from the robot's central processing unit (CPU) thus eliminating the need to use CPU's power. In this project an android speech recognition application is being created and used.<sup>[13]</sup>

## **1.4 Wireless Technology used for Voice Controlled Robot**

By using Bluetooth technology the Arduino Uno receives commands from the user. Bluetooth technology exchanges data over a short range but is very proficient way of communicating between two devices such as Arduino Uno and an Android phone. Data packages are sent and received through shortwave radio signals. It is essential for robots to take commands without any delay so we have used Bluetooth as the main communication method. In daily life such robots can be used for navigation and for control guidance to a certain position.

## **1.5 Need for Sensors**

Due to technological advancements Robots can be used in places where humans cannot enter. This is possible due to the use of sensors which have been placed on the robot, which continuously monitor the conditions of the place where the robot has been sent to or deployed.

## **1.6 What are Sensors?**

A sensor is a gadget that can recognize changes in a domain. Independent from anyone else, a sensor is pointless, yet when we use it in an electronic framework, it assumes a key job. A sensor can gauge a physical wonder (like temperature, pressure, etc) and change it into an electric signal. These three highlights ought to be at the base of a decent sensor:

- i. It should be delicate to the wonder that it gauges.
- ii. It should not be touchy to other physical marvels
- iii. It should not alter the deliberate marvel during the estimation procedure.

There is a wide scope of sensors we can endeavour to quantify practically all the physical properties around us. A couple of regular sensors that are broadly embraced in regular daily existence incorporate thermometers, pressure sensors, light sensors, accelerometers, gyrotors, movement sensors, gas sensors and some more. A sensor can be portrayed utilizing a few properties, the most significant being:

Range: The most extreme and least estimations of the wonder that the sensor can quantify.

Affectability: The base difference in the deliberate parameter that causes a distinguishable change in yield signal.

Goals: The base change in the wonder that the sensor can recognize.

By using sensors such as gas sensor, it would be helpful to check whether there has been any fire. Robotic sensors are used to estimate the robot's condition and environment. These signals are passed to the controller to enable the appropriate behaviour, The sensors in the robots are based on the functions of the human sensory organs. The robots require the extensive information about their environment in order to function effectively.

Interfacing a water pump to the robot helps to douse the fire.

## 2. LITERATURE REVIEW

Throughout the years, people have advanced in developing new advancements for decreasing human efforts and easing

human life. In compound and explosives fabricating ventures, individuals frequently get harmed while taking care of risky synthetic substances because of absence of due care or protection taken. Physically tested and older individuals face troubles while dealing with objects and consequently they need help for the equivalent. Along these lines, if a mechanical aide is built up that can be worked utilizing discourse directions would be of monstrous use.<sup>[1]</sup>

The first digitally operating robot was created in the year 1954. The new trends in robotics research have been denominated service robotics because of their general goal of getting robots closer to human social needs, and this article surveys research on service robotics such as medical robotics, rehabilitation robotics, underwater robotics, field robotics, construction robotics and humanoid robotics. It is mainly the year 1961 when the robots were being used to lift pieces of hot metal from die casting machines.<sup>[2]</sup>

Aide robots can be utilized for wide range of purposes. These mechanical aides can be utilized for moulding, fabricating and tooling purposes in different segments, for example, fabricating, guard and so on. In emergency clinics, these robots can be utilized to perform medical procedures and activities with high exactness. This execution of Bluetooth innovation was in the early 1990s by Dr. Jaap Haartse which was then later used in portable robots, to give robots the ability to move around progressively. The robot act dependent on calculation put away in the server<sup>[3]</sup>. All the sensor readings from the robot will be transmitted to the server and handled. It will mainly concentrate on the convention in utilizing Bluetooth for controlling a versatile robot utilizing the Handy miniaturized controller. The task is intended to create android application based a mechanical vehicle for remote activity. This is a sort of robot can be useful for versatility help for old and crippled individuals. Also, pictures transmission and gathering. Favourable circumstances of Bluetooth has low expenses and low power and nature can be indicated portions of Bluetooth has been included into different sorts of cell phones, for example, cell phones, PDAs and different remote sets.<sup>[4]</sup>

The human voice directions are usually taken by the robot by its own inbuilt mouthpiece. The robot takes the directions and executes them, yet additionally gives an affirmation through communicating. These robots can perform various developments, turns, wakeup/shutdown tasks, move an item starting with one spot then onto the next and can likewise build up a discussion with human.<sup>[5]</sup> The voice directions are prepared progressively, utilizing a disconnected server. The discourse signal directions are straightforwardly imparted to the server utilizing a USB link or a wireless link depending upon the application purpose. The individual collaborator robots are created on a microcontroller based stage. Execution assessment is done with empowering after-effects of the underlying trials. Potential enhancements are additionally talked about towards potential applications in home, emergency clinics, vehicle frameworks and ventures.

<sup>[6]</sup> As innovative advances are proceeding with consistently, huge numbers of the gadgets can be constrained by methods for remote sensors or self-governing with the assistance of controller. A vehicle, which can be constrained by voice directions by means of advanced mobile phone utilizing Arduino Uno processor and Bluetooth sensor, can be made as a prototype model. The Google Voice and VoiceBot application can be utilized for voice directions. The structure and acknowledgment of the versatile application for the Android

working framework which is concentrated on manual control of versatile robot utilizing remote Bluetooth innovation <sup>[7]</sup>.

The application permits the robot control association with the voice. At the point to utilize a graphical interface, screening the present separation of the robot from obstacles. The estimation of separation is completed by ultrasonic sensor set before the robot. It was important to fabricate a model of a portable robot for the advancement of the application. The model of the versatile robot depends on the differential gear.

Voice controlled automated robot is controlled through voice directions gotten by means of android gadget. The combination of control unit with Bluetooth gadget is accomplished utilizing a Bluetooth module to catch and use the voice directions. The automated vehicle works according to the direction got through android gadget, for this Arduino is coordinated in the framework. The controlling gadget might be any advanced mobile phone having an Android OS. The transmitter utilizes an android application required for transmitting the information. The beneficiary end peruses these directions and more, deciphers them into controlling the mechanical vehicle. The android gadget sends directions to move the vehicle in forward, in reverse, both ways headings. In the wake of accepting the directions, Arduino works the engines so as to move the vehicle in four ways. The correspondence between android gadget and beneficiary is sent as sequential correspondence information. Arduino program is intended to move the engine through a engine driver circuit according to the directions sent by android gadget. <sup>[8]</sup>

The requirement for a gadget that can recognize and smother a fire all alone is long past due. Many house fires originate when somebody is either resting or not at home. With the innovation of such a gadget, individuals and property can be spared at an a lot higher rate with moderately insignificant harm brought about by the fire. The primary target was to structure and manufacture a model framework that could automatically distinguish and quench fire. <sup>[9]</sup> The controlling gadget of the model is PIC microcontrollers. Discourse acknowledgment module, remote handset modules, fan, DC engines and bell are interfaced to Microcontroller. At the point when the client took care of the voice orders to the discourse acknowledgment module, the microcontroller interfaced to it peruses the order and sends important information of that order remotely utilizing handset module. This information is gotten by the handset module on the automated vehicle and feds it to microcontroller which acts as needs be on engines and fan.

### 3. FLOW CHART

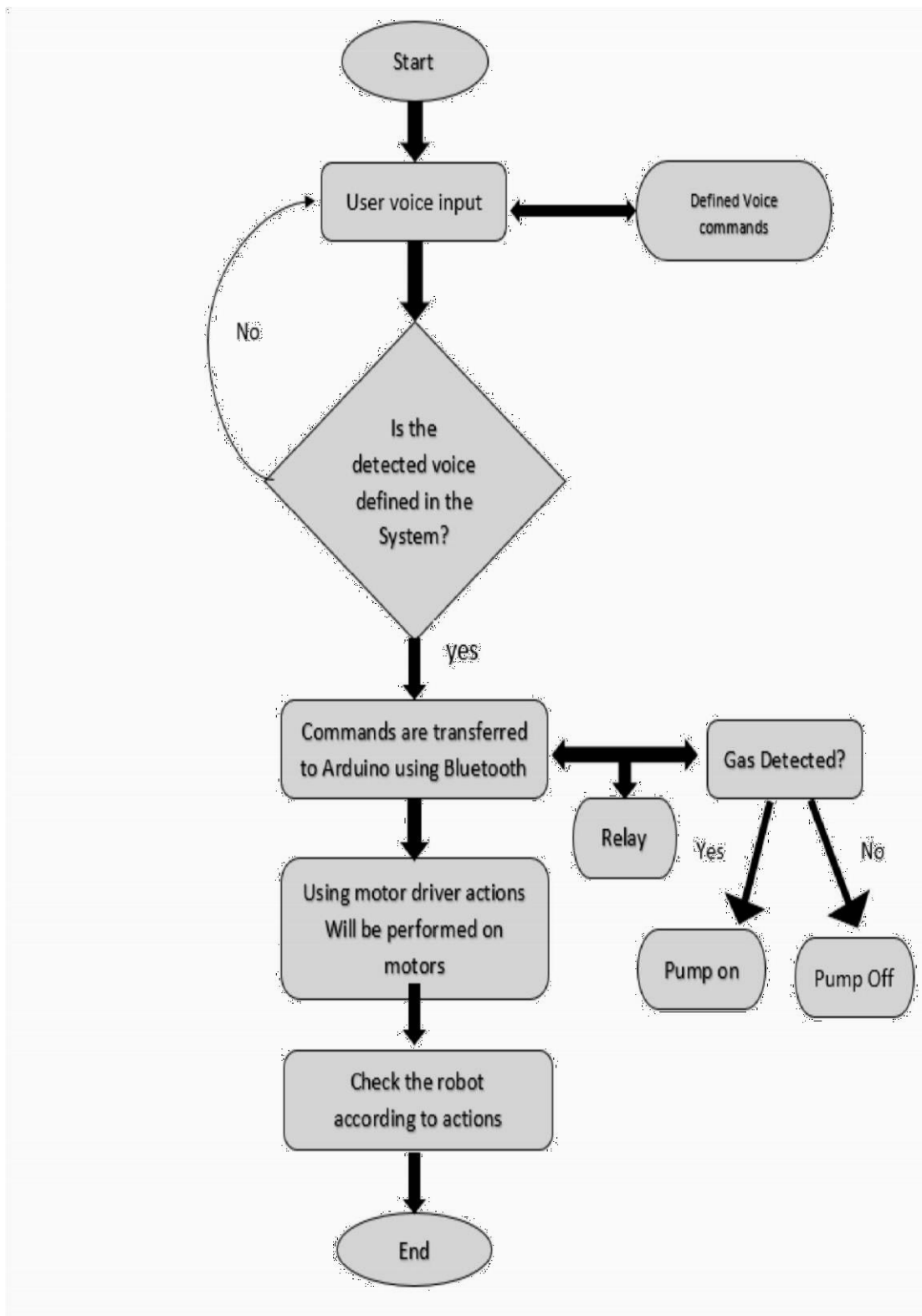


Fig 1: Flow chart of Fire Sensing Voice Controlled Robot



#### **4. PROBLEM STATEMENT**

Fire Sensing Voice Controlled Robot is based on easing the problem for humans of performing repetitive task. Some tasks are deemed to be dangerous or laborious to carry out and so the robots can perform these tasks instead. These tasks are performed more precisely and consistently than human workers. Robots also allow to increase production and profit margin because they can complete task faster. Instead of operating the robot manually using voice controlled it can support people with disability, executing preset commands etc. where human intervention is not possible in the highly dangerous areas. Voice commands are transmitted and received using wireless serial communication.

Fire Sensing Voice Controlled Robot will act as an application for real time fire accident situation's. It increases capability of sensing accurately with increased flexibility. The gas sensor is not sensitive to weather conditions and hence is temperature independent. In Industries these Robots can complete tasks faster and more efficiently than humans as they are designed and are built to perform them with higher accuracy. Working conditions therefore, can be vastly improved as well as the safety within factories and production plants.

## **5. PROPOSED SOLUTION**

The designed Solution is based on the analysis of the above problem statement in which Human voice is taken as an input and converted to text using Speech Recognition App which is an android based application. The robot will perform action on the commands based on the user Input. In this project we have used Bluetooth module (HC-05) which is wireless module and is used to transfer commands to Arduino. It has range up to 100 meters which depends on transmitter and receiver, Atmosphere geographic conditions. It uses serial Communication to communicate with devices.

The Arduino the analysis the Commands that are received by Bluetooth. Arduino AT mega 328 is used in which programs can be directly loaded to the device without the need of hardware programmer to burn the program. This is done using the presence of 0.5KB boot loader, that allows programs to be dumped into the circuit.

Motor driver L293D allows DC to drive in any direction. It controls two motors simultaneously. The advantage of using DC motor is that, we can reverse the polarity of applied voltage across the load without modifying the circuit. The L293D is a quad held HBridge chip which has two complete H bridges out of it.

This robot also consists of gas sensor which detects the amount of gas and displays the amount of gas in the Mobile App. This sensor displays the amount of smoke in ppm units. The relay is connected Arduino which is nothing but an electrically operated switch. It consists of set of input terminals for a single of multimode signal.

The pump is connected to relay the signal of the gas sensor is send to the App and then based on the value of smoke the pump is functioned ON and OFF. Therefore, this robot can be used in places where human intervention is not possible an using voice controlled it can be used by handicapped persons also.

## 6. BLOCK DIAGRAM

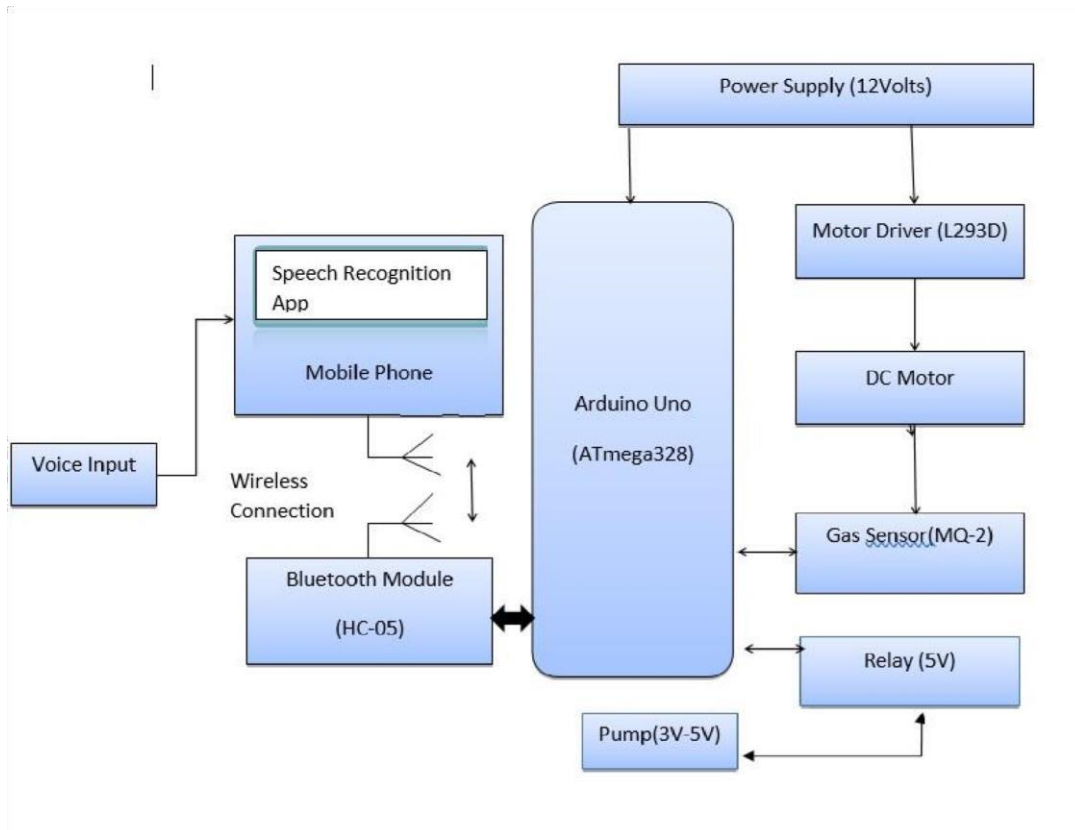


Fig2: Descriptive Block Diagram

### Block Diagram Explanation:

1. Voice Input: Voice input consists of voice commands for the robot which are given using an Android phone. These commands will act as an input to the robot and the robot will perform task accordingly. Various commands are listed below,
  - move forward
  - move backward
  - turn right
  - turn left
  - stop (stops doing the current job)
2. Speech Recognition App: This app is made using a software MIT app Inventor 2 tool. This tool consists of designer section and Block section. In Designer section there is Component List to change its properties (color, size, behaviour). It also consists of

Palette in which we can find components and drag them to the Viewer. It consists of Built in Drawers in which component specified drawers are there in which we can code according to the requirement.

Designer Section: This section consists of front end page of the app in which there are:

Image Label: In this slot there is an image which represents the symbol front view as the app opens up.

Button (Press to Speak): This button is used as a button to input voice commands from the user to the robot. The voice commands are converted into text format by speech recognition application present in the Android phone.

Button (pump Switch): This button is ON whenever the smoke value is generated.

Text Label (Value): The text label value shows the value of smoke in ppm units as the user finds the value of smoke the pump is on.

Bluetooth Button: This button checks the Bluetooth connection if not on pops the message in the App if on then connects it to Arduino.

Text Field (Word Spoken): This field shows the text which is converted from the user input/voice.

3. Bluetooth Module: HC-05 is a Bluetooth serial Bluetooth Protocol used for wireless communication with Bluetooth enabled devices (like smartphone). The Android phone is connected to the Arduino using this Bluetooth module. The commands are sent to the Arduino via Bluetooth. The module consists of red LED light which indicates connection, whether the Bluetooth is connected or not if the Bluetooth is connected the button on the app will start working. When it gets connected to any other Bluetooth device, its blinking slows down after two seconds. The connection can be point-to-point or multi-point where the maximum range is 10 meters. The transfer rate is data is 1Mbps. In order to increase the range of the Bluetooth we can use Bluetooth range Extenders which can increase the range up to 150ft in open air, and between 15-17 ft indoors.
4. Arduino Uno (ATmega328): The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family (late microchip technology acquired Atmel in 2016). The Arduino is connected to mobile phone through Bluetooth module.

Bluetooth module communicates with microcontrollers using serial communication (USART). ATmega 328 has 1KB Electrically Erasable Programmable Read Only Memory (EEPROM).

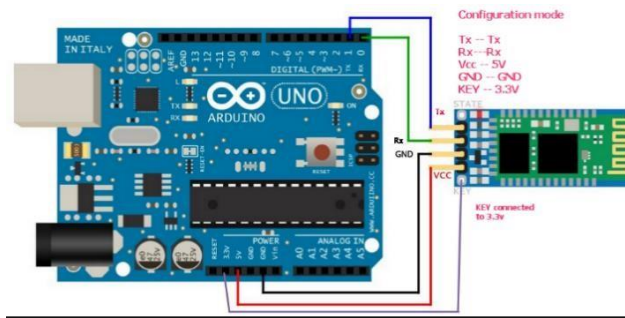


Fig.3: Arduino Uno and HC-05 Bluetooth module Interface

5. **Driver Circuit:** The commands are analyzed by the Arduino, which then controls the motor drivers. These motor drivers are controlled by driver circuits. The DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets (permanent or electromagnets), and rotating electromagnets. If you want to rotate your motor in only one direction, then this is the easiest way to do so. Here power transistor is used as a switch to turn a motor on or off depending upon the applied voltage at base.
6. **DC motor:** A DC motor is of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. Two DC motors are interfaced in Arduino.

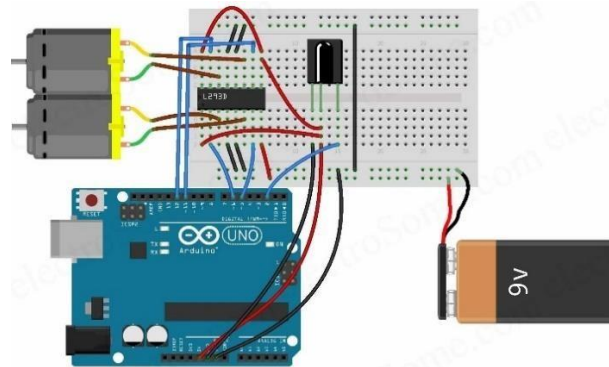


Fig.4: Two DC motors Connected to Arduino

7. **Gas Sensor:** The Gas sensor detects the smoke when the robot is send in the remote areas. The smoke is detected in ppm units and then transferred using Arduino to mobile app through Bluetooth.
8. **Relay:** The relay used acts as a switch for the gas sensor. It consists of set of input terminals for a single or multimode signal.
9. **Pump:** As the On button is pressed in App the pump will start working.

## 7. COMPONENTS

### 7.1 ARDUINO UNO

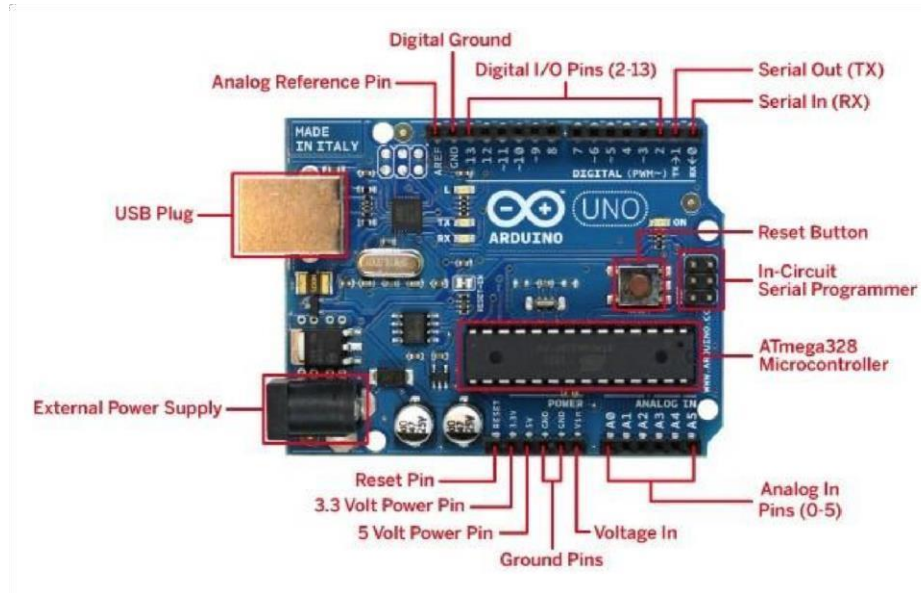


Fig 5: Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. The recommended input voltage for an Arduino Uno is 7-12V. The limits for input voltage are 6-20V. The DC current per I/O pin is 40mA. The DC Current for 3.3V Pin is 50 mA. The Flash Memory of Arduino Uno is 32 KB of which 0.5 KB used by boot loader. The SRAM is of 2 KB (ATmega328). The EEPROM is 1 KB (ATmega328). The microcontroller is programmed with the help of the Embedded C programming. Arduino has its own programming burnt in its Read Only Memory (ROM). C program is very easy to implement for programming the Arduino UNO. In this project Arduino acts as the brain of the project which controls the action of the robot through signals sent from it. A bluetooth module is a medium that enables Arduino to connect to the android device or smart-phone. The L293D motor driver is interfaced to the arduino uno. The commands received by the Arduino from the android phone are analysed by it. After this the Arduino accordingly controls the motor drivers to perform the tasks the user wants. Five basic commands are used to steer the robot that are forward, right, left, reverse and stop to guide the robot. Building on these, a few more commands allow the robot to change speed or perform a particular movement. The L293D motor driver is interfaced to the arduino uno.

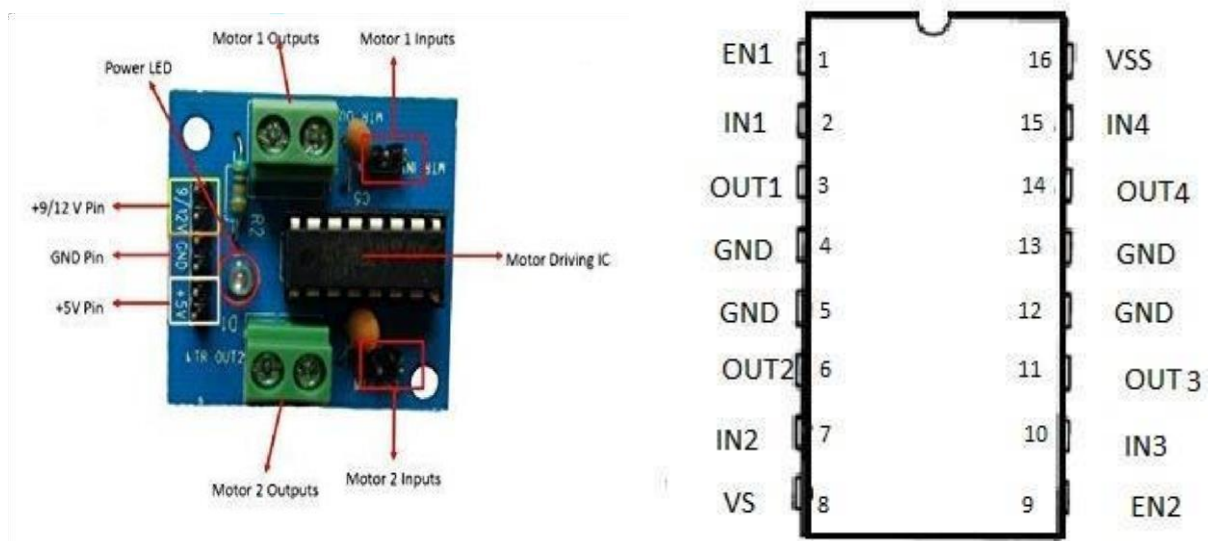


Fig 6: Motor Drive and Pin Diagram

## 7.2 L293D MOTOR DRIVER

The L293D device is quadruple high current half H-Drivers. The L293 is designed to provide bidirectional drive currents of up to 1A at voltage from 4.5V to 36V. The L293D is designed to provide bidirectional drive currents of up to 600mA at voltages from 4.5V to 36V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high current/ high voltage loads in positive supply applications. The L293D motor driver can be used to run two DC motors with the same IC. The motor driver can be used control speed and direction. The L293D IC receives signals from the Arduino and transmits the relative signal to the motors. It has two voltage pins, one of which is used to draw current for the working of the L293D and the other is used to apply voltage to the motors. The L293D switches its output signal according to the input received from the microprocessor. The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor. L293D consists of two H-bridges. H-bridge is the simplest circuit for controlling a low current rated motor.<sup>[16]</sup>

## 7.3 BLUETOOTH MODULE (HC-05)

HC-05 is a serial Bluetooth protocol of Bluetooth serial interface module and Bluetooth adapter. Bluetooth serial module is used for converting serial port to Bluetooth. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with Adaptive Frequency Hopping Feature. This device is capable of establishing connection with any bluetooth device and can connect to any microcontroller for the exchange of serial data.

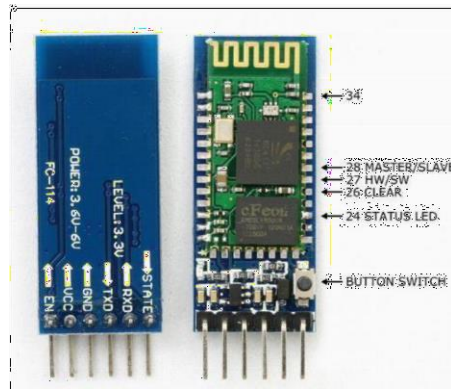


Fig 7: Bluetooth Module (HC-05)

The bluetooth protocol of HC-05 is V2.0. The range of the module is 10 meters. The frequency is 2.4GHz ISM. The modulation used is GFSK. The transmit power of the Bluetooth module is 4dBm. The sensitivity of HC-05 module is 8dBm. The power supply required for the module is +3.3V. The bitrate of the Bluetooth module is 2.1Mbps(Max.). This module is based on the silicon radio BC417 2.4 GHz Bluetooth chip with CMOS technology and it uses an external 8 Mbit flash memory. Working temperature of the module is -20 ~ +75Centigrade. Dimension of the module are 26.9mm x 13mm x 2.2 mm. The HC-05 Bluetooth Module has 6 pins Vcc, GND, TX, RX, Key and LED. It comes pre-programmed as a slave, so there is no need to connect the key pin, unless there is a need it change it to master mode the major difference between master and slave modes is that, slave mode the Bluetooth module cannot initiate a connection, it can however accept incoming connections. After the connection is established the Bluetooth module can transmit and receive data regardless of the mode it is running in. The default data transmission rate is 9600kbps. The range for Bluetooth communication is usually 30m or less. The module has a factory set pinoff "1234" which is used while pairing the module to a phone.<sup>[21]</sup>

## 7.4 DC MOTORS



Fig 8 :DC Motor

DC Motor runs on DC power or AC line voltage with a rectifier. The operating speeds of dc motor are of 1,000 to 5,000 rpm. The efficiency rate of the DC Motor is 60-75%. DC Motor has a high starting torque. It has low no-load speed. The dc motors are connected to the wheels of the car through the dc motors only possible to change the directions of the car. 9V batteries provide charge to motors. In order to have a complete control over DC motors, control over its speed and rotation direction is required. This can be achieved by combining these two techniques. PWM (Pulse Width Modulation) is for controlling speed. H-Bridge is used for controlling direction of rotation.<sup>[20][22]</sup>



## 7.5 GAS SENSOR (MQ-2)



Fig 9: MQ-2 Gas Sensor

MQ2 is one of the commonly used gas sensors in MQ sensor series[1]. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected. MQ2 Gas sensor works on 5V DC and draws around 800mW. MQ2 can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide. The operating voltage is 5V[2].

The load resistance is 20K $\Omega$ . Heater resistance of MQ2 is 33 $\Omega \pm 5\%$ . The heating consumption is less than 800mw. Sensing resistance of MQ2 is 10 K $\Omega$ -60 K $\Omega$ . The concentration scope is 200-10000ppm. The preheat time is over 24 hour. The MQ2 sensor has 4 pins. The Vcc supplies power to the module. It is connected 5V output of the Arduino. The GND is the ground pin it has to be connected to the ground pin of Arduino Uno. The D0 pin is the digital out pin. D0 provides a digital representation of the presence of combustible gases. The digital value is obtained by setting a threshold value using potentiometer. A0 pin is the analog out pin. This pin outputs 0-5V analog voltage based on the intensity of the gas.<sup>[23][24]</sup>

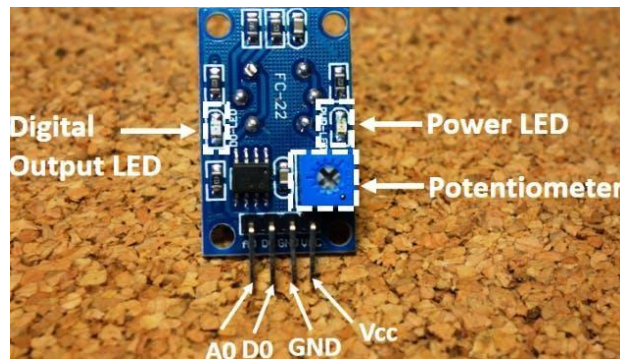


Fig 10 : Pin structure of Gas Sensor Working of Gas Sensor:

The voltage that the sensor outputs changes accordingly to the smoke/gas level that exists in the atmosphere. The sensor outputs a voltage that is proportional to the concentration of smoke/gas. The relationship between voltage and gas concentration is the following:

- The greater the gas concentration, the greater the output voltage
- The lower the gas concentration, the lower the output voltage



Fig 11: Behaviour of Gas Sensor in presence of smoke

## 7.6 Mini Submersible Pump 3-5V



Fig 12: Pump

The DC Voltage required for the pump is 3-5V. The pump generates low noise. It has a maximum lift of 40-110cm / 15.75"-43.4". Flow rate of pump is 80-120L/H. Outer diameter of water outlet is 7.5mm or 0.3". The inner diameter is 4.7mm or 0.18". Diameter is approximately 24mm or 0.95 inches and length is 45mm or 1.8 inches. The pump is made of plastic and has a continuous working life of 500 hours. The driving mode for the pump is brushless dc design and magnetic driving.<sup>[25][26]</sup>

## 7.7 5V RELAY

### 5V Relay Terminals and Pins



Fig 13: Relay

The SRD-05VDC-SL-C relay has three high voltage terminals (NC, C, and NO) which has to be connected to the device to be controlled. The other side has three low voltage pins (Ground, Vcc, and Signal) which connect to the Arduino. NC is Normally closed 120-240V terminal. NO is Normally open 120-240V terminal and C is Common terminal. Ground is to be connected to the ground pin on the Arduino. The 5V Vcc is to be connected to the Arduino's 5V pin. Signal pin carries the trigger signal from the Arduino that activates the relay. [27][28]

## 8. SOFTWARE

### 8.1 ANDROID SPEECH RECOGNITION APPLICATION

The voice directions to the robot are handled by means of android application and afterward transmitted by means of Bluetooth. A choice to utilize an Android OS interface as the discourse handling stage was made, because of its adaptability and various highlights. Likewise it permits a simple and solid association with the Google Speech preparing libraries for smooth and precise discourse acknowledgment. For controlling of robot BT voice control application is utilized. It includes a few stages for getting to the robot. To achieve the above purpose an application utilizing MIT Application Inventor 2 is developed.<sup>[11]</sup>

### 8.2 ARDUINO IDE

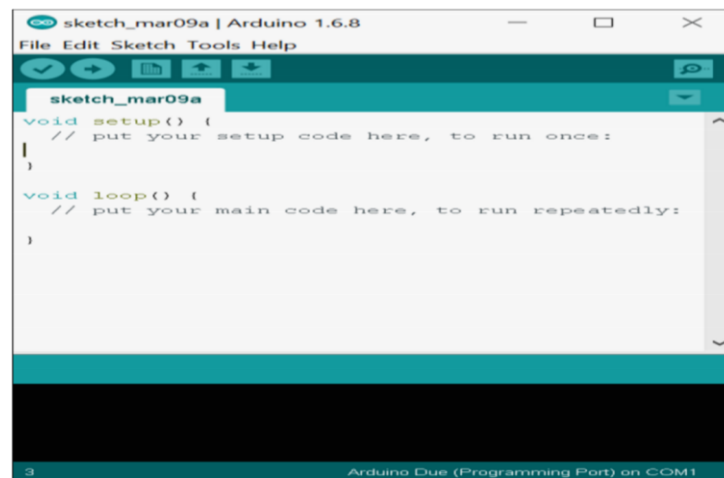


Fig 14: Screenshot of Arduini IDE

The Arduino Integrated Development Environment is a cross-platform application that is written in the programming language Java. It is used to write and upload programs to Arduino. Arduino environment's built-in serial monitor is used to communicate with an Arduino board. For serial communication click the serial monitor button in the toolbar and select the same baud rate used in the call to begin(). Serial communication on pins TX/RX uses TTL logic levels (5V or 3.3V depending on the board). These pins should not be directly connected to an RS232 serial port; they operate at +/- 12V and can damage the Arduino board.<sup>[18][19]</sup>

### 8.3 MIT APP INVENTOR 2

Working of MIT APP Inventor App Inventor involves three aspects: (i) App inventor designer, (ii) App Inventor Blocks editor, and (iii) An emulator or Android Phone. The set-up process for the software is very easy and system requirements are very basic. It is compatible with Mac OSX, Windows and Linux Operating systems. Browsers required for the software are Mozilla Firefox 3.6 or higher, Apple Safari 5.0 or higher, Google Chrome 4.0 or higher and Microsoft Internet Explorer 7.0 or higher.<sup>[29]</sup>

## 9. CONNECTIONS OF BLUETOOTH MODULE AND ARDUINO

Bluetooth module HC-05	Arduino
Vcc	5V
GND	GND
Tx	Digital pin 12
Rx	Digital pin 13

Table 1: Pin connections of bluetooth with Arduino

The physical connection of Bluetooth includes the following connections. In order to provide the power supply to the Bluetooth module the Vcc pin of the module has to be connected to the 5V supply of the Arduino and the GND Pin of the Bluetooth module to any of the GND pin of the Arduino. The Rx pin of the Bluetooth module is connected directly to any of the digital pin of arduino, we connected it to digital pin no. 12. It broadcasts all the serial data received via this pin. The Tx pin that is the transmitter pin of the module of the Bluetooth module is connected to the digital input pin of the arduino, here we connected it to digital input pin number 13. It transmits all the data received by the Bluetooth module in the form of serial data.

## 10. PROGRAMMING LOGIC FOR HC-05

- Communication of bluetooth to with arduino
  - 1) SoftwareSerial- Creates an instance of an object for serial communication.  
Use Case- Serial Communication with Bluetooth  
Create “Bluetooth” as the object  
Using Pin 12 and 13  
SYNTAX: `SoftwareSerialBluetooth(rxPIN,txPIN)`
- Reading data from Bluetooth
  - 2) `Bluetooth.Available`-gets the number of characters available for reading from the software serial port  
Use Case- Check if the data is available on Serial Buffer  
SYNTAX: `if(Bluetooth.Available())`  
{  
}  
    - 3) `Bluetooth.Read`-Returns the character received on the Rx pin Use Case-Read the character from the serial port.  
SYNTAX: `charbt = Bluetooth.Read();`
- Printing data

- 4) Serial.Println-To print data on serial monitor  
Use Case-Prints characters, String or variables on serial monitor

SYNTAX: Serial.Println (“ characters”)

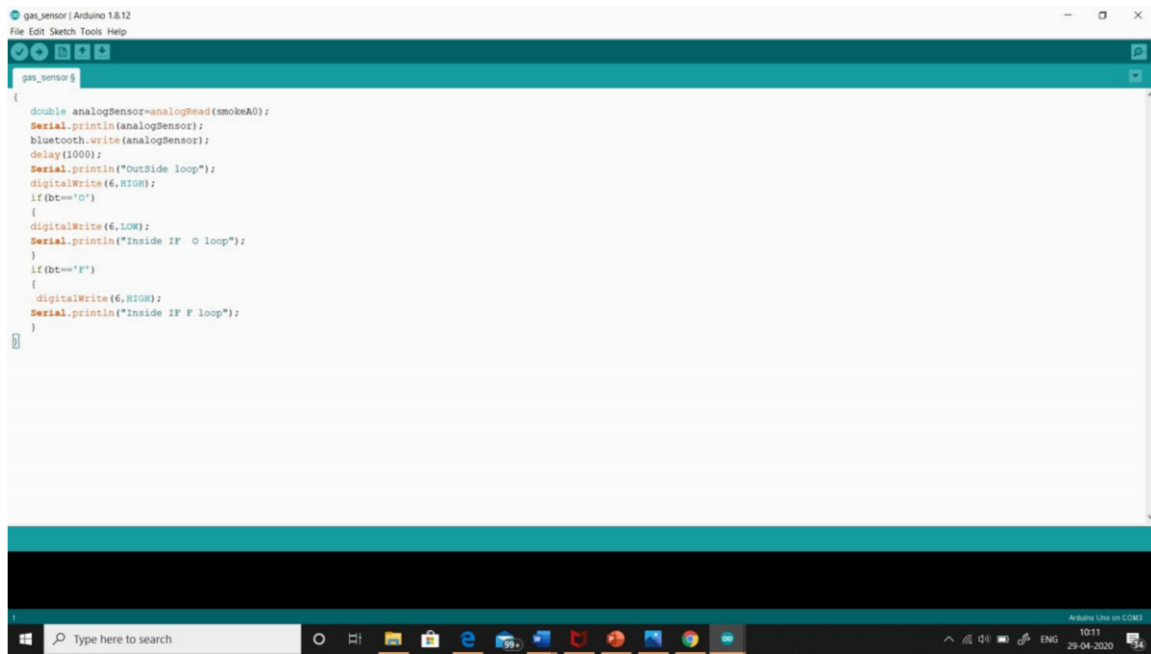


Fig 15: Screenshot of bluetooth communication with Arduino

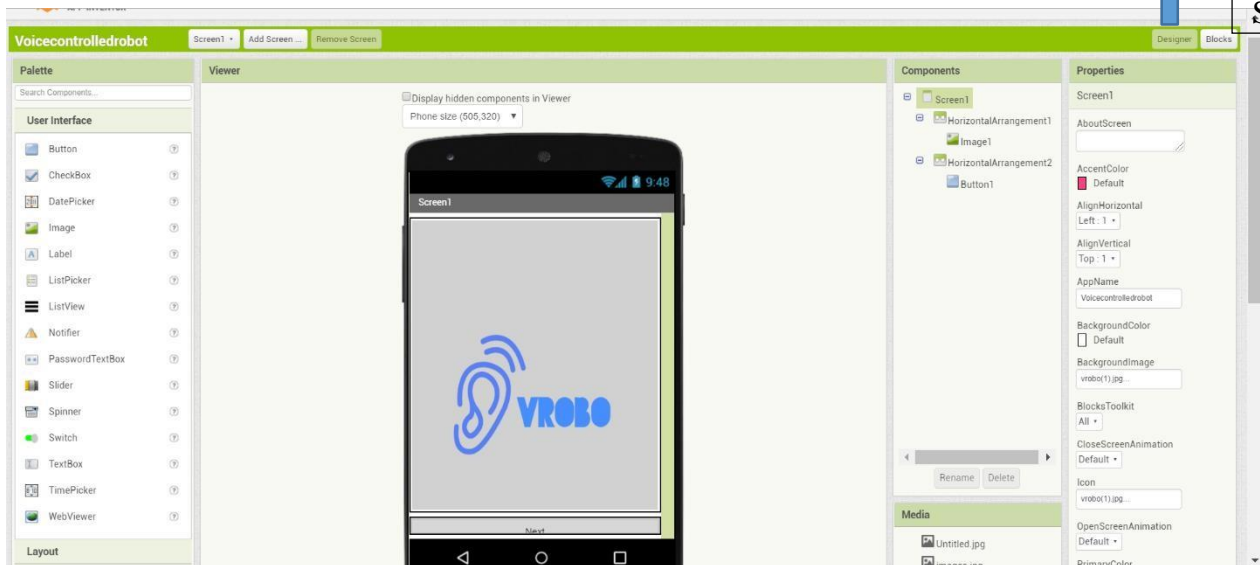
## 11. MOBILE APPLICATION

The Android application has been designed using MIT App Inventor 2. MIT App Inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). App Inventor is a blocks programming language. Blocks are the pieces when connected together to tell the app what to do. Blockly is the name of the visual programming editor that App Inventor uses to make the blocks in the browser. MIT App Inventor uses Graphical User Interface (GUI). This feature helps users to drag and drop visual objects to create an application that can run on mobile devices. Working of MIT APP Inventor App Inventor involves three aspects: (i) App inventor designer, (ii) App Inventor Blocks editor, and (iii) An emulator or Android Phone. The design editor, or designer is a drag and drop interface to lay out the elements of the application's user interface (UI). The blocks editor is an environment in which app inventors can visually lay out the logic of their apps using color-coded blocks that snap together like puzzle pieces to describe the program. To aid in development and testing, App Inventor provides a mobile app called the App Inventor Companion (or just "the Companion") that developers can use to test and adjust the behaviour of their apps in real time.<sup>[30][31]</sup>

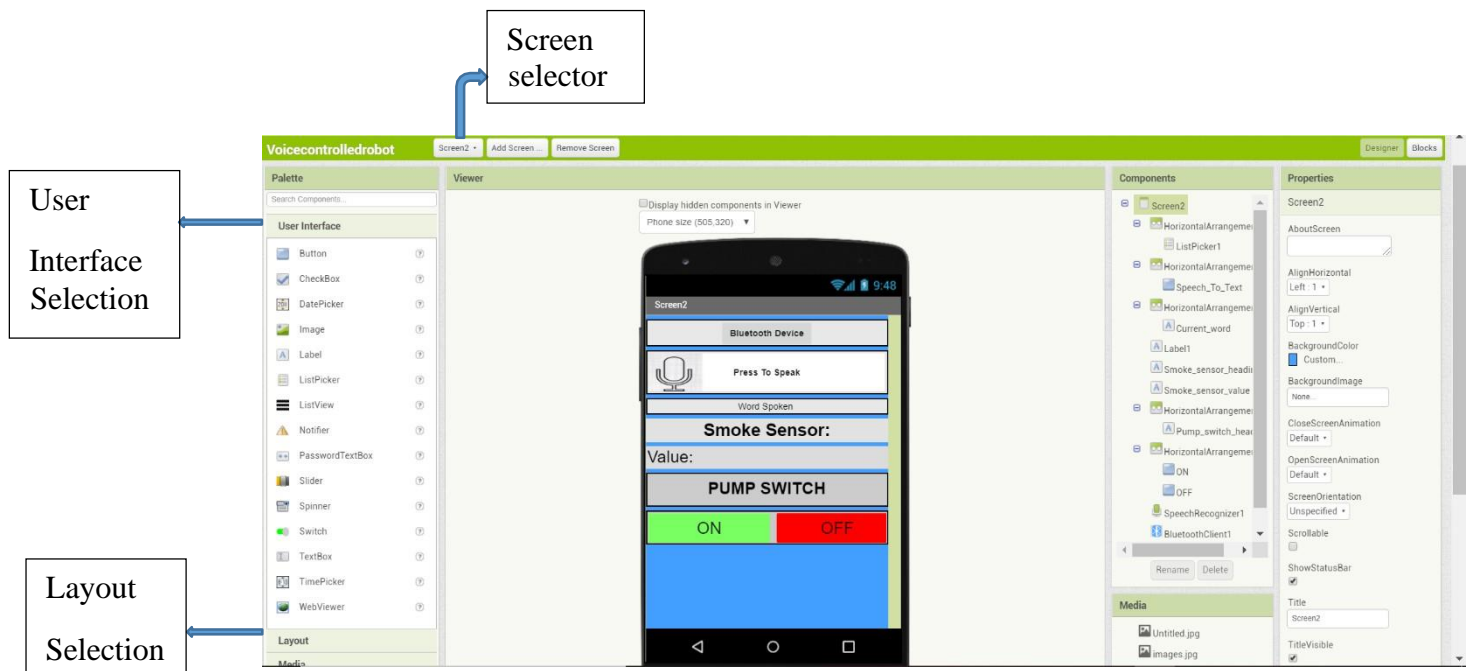
### i. App inventor designer

The App inventor designer block is used to design the user interface of the mobile application. Using the Layout tools and User Interface tools the User Interface has been designed. In this project it has 2 user interface screens.<sup>[31]</sup>

#### 1. The first screen-



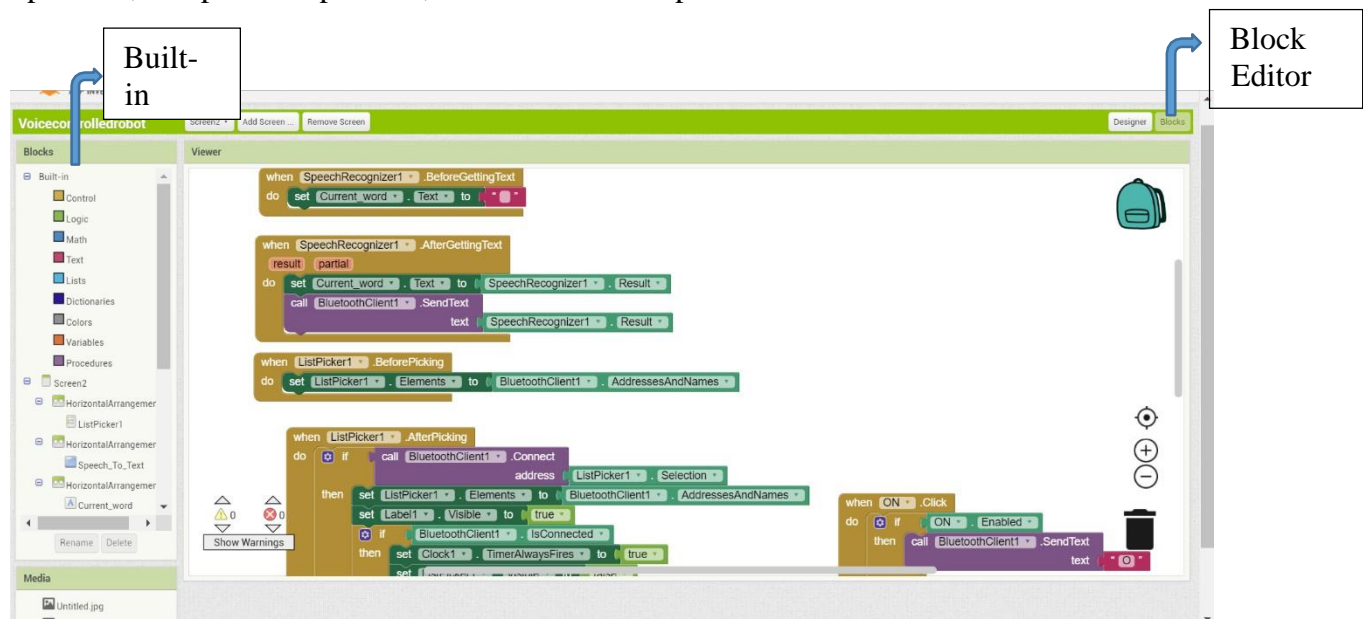
#### 2. The second screen



The second screen has a button called Bluetooth device for selecting a Bluetooth device to be connected to. The Press to speak button is a speech to text converter which records the command and converts it to text. Words spoken row is used for displaying the command that has been given. The reading of the Smoke Sensor is displayed in the Value textbox. If the output of the sensor is high this indicates the presence of fire in the environment in which the robot has been deployed in. The fire can be doused using a spraying water. The water pump is controlled using the ON/OFF switch present on the application.

## ii. App Inventor Blocks Editor

The Blocks Editor in MIT App Inventor is used for providing functionality to the application. Block editor is where program blocks are assembled, so that they specify how the components should behave. There are two types of blocks in App Inventor: built-in blocks and component blocks. The built-in blocks library provides the basic atoms and operations generally available in other programming languages, such as Booleans, strings, numbers, lists, mathematical operators, comparison operators, and control flow operators.<sup>[31]</sup>





## 12. GAS SENSOR AND PUMP CONNECTIONS

Gas Sensor (MQ2)	Arduino
VCC	5V
GND	GND
A0	Analog pin(A6)

Table 2: Connections of Gas sensor with Arduino

Pump	Arduino
Vcc	5V
Gnd	Common GND

Table 3: Connection of Pump with Arduino

The Gas Sensor (MQ2) is connected to analog pin of Arduino along with VCC and gnd pin. The data type double with data variable name as analog sensor reads the value from specified analog pin. In Atmega based boards it takes 100 microseconds (0.0001s) to read an analog input. The print command the prints data to the serial port as human-readable ASCII text.

Syntax

`Serial.print(val)`

`Serial.print(val,format)`

The command `Bluetooth.write(val)` writes to the specified analog sensor with a delay of 1 sec. The relay used in the circuit is an Active High Relay i.e the function is executed when relay is in HIGH state .The loop which contains If statement is then executed in which if the button from the app is pressed ON then the corresponding variable 'O' connected to analog pin will become LOW and if OFF is pressed the corresponding variable 'F' will get HIGH. In serial monitor it will print the corresponding statements according to code.

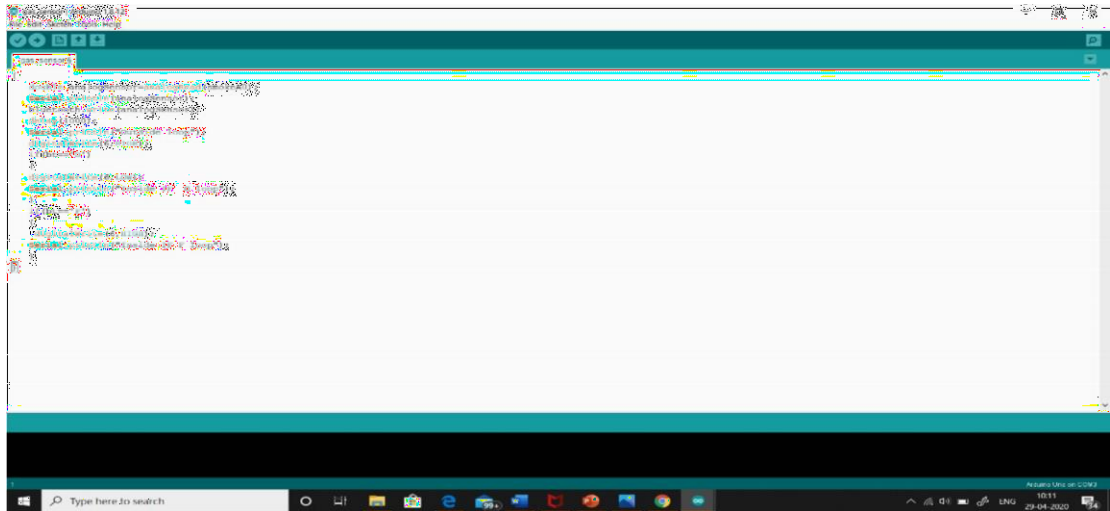
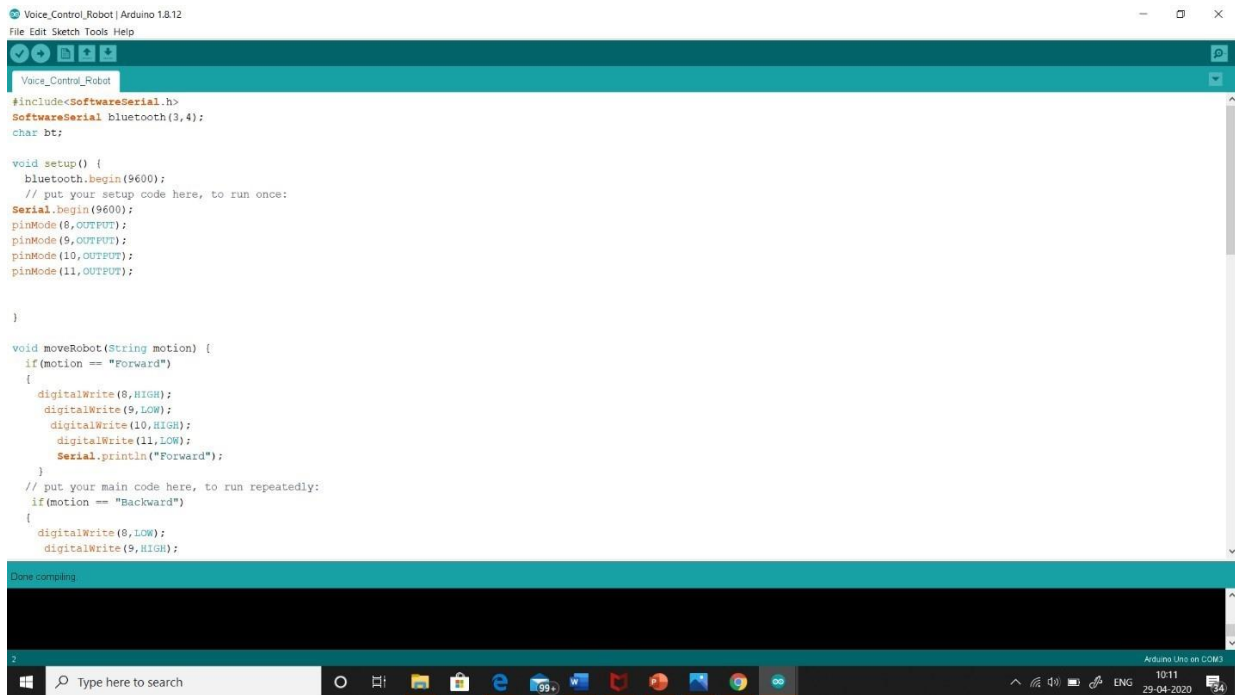


Fig 19: Code of Gas Sensor (MQ2) and Pump

### 13. MOTOR DRIVER CONNECTIONS

<u>L293D</u>	<u>Arduino</u>
1 ( Enable1/2)	PIN 3and 6 motor
2 input 1	Output1
3 Output 3	Terminal of Motor
4 GND	GND
5GND	GND
6. OUTPUT 2	OUTPUT 2 MOTOR
7.INPUT	INPUT 2
8. VCC	VCC (5V)
9.ENABLE(3/4)	PIN 11 AND PIN 14
10.INPUT 4	OUTPUT 4
11 OUTPUT 4	MOTOR TERMINAL
12 GND	GND
13 GND	GND
14OUTPUT3	TERMINAL OF MOTOR
15 INPUT 3	OUTPUT 3
16 VCC	VCC(5V)

Table 4 : connections of motor drivers with Arduino



```

Voice_Control_Robot | Arduino 1.8.12
File Edit Sketch Tools Help

Voice_Control_Robot

#include<SoftwareSerial.h>
SoftwareSerial bluetooth(3,4);
char bt;

void setup() {
  bluetooth.begin(9600);
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(8,OUTPUT);
  pinMode(9,OUTPUT);
  pinMode(10,OUTPUT);
  pinMode(11,OUTPUT);
}

void moveRobot(String motion) {
  if(motion == "Forward") {
    {
      digitalWrite(8,HIGH);
      digitalWrite(9,LOW);
      digitalWrite(10,HIGH);
      digitalWrite(11,LOW);
      Serial.println("Forward");
    }
    // put your main code here, to run repeatedly:
    if(motion == "Backward") {
      {
        digitalWrite(8,LOW);
        digitalWrite(9,HIGH);
      }
    }
  }
}

```

Done compiling.

Arduino Uno en COM3

Type here to search

10:11  
29-04-2020

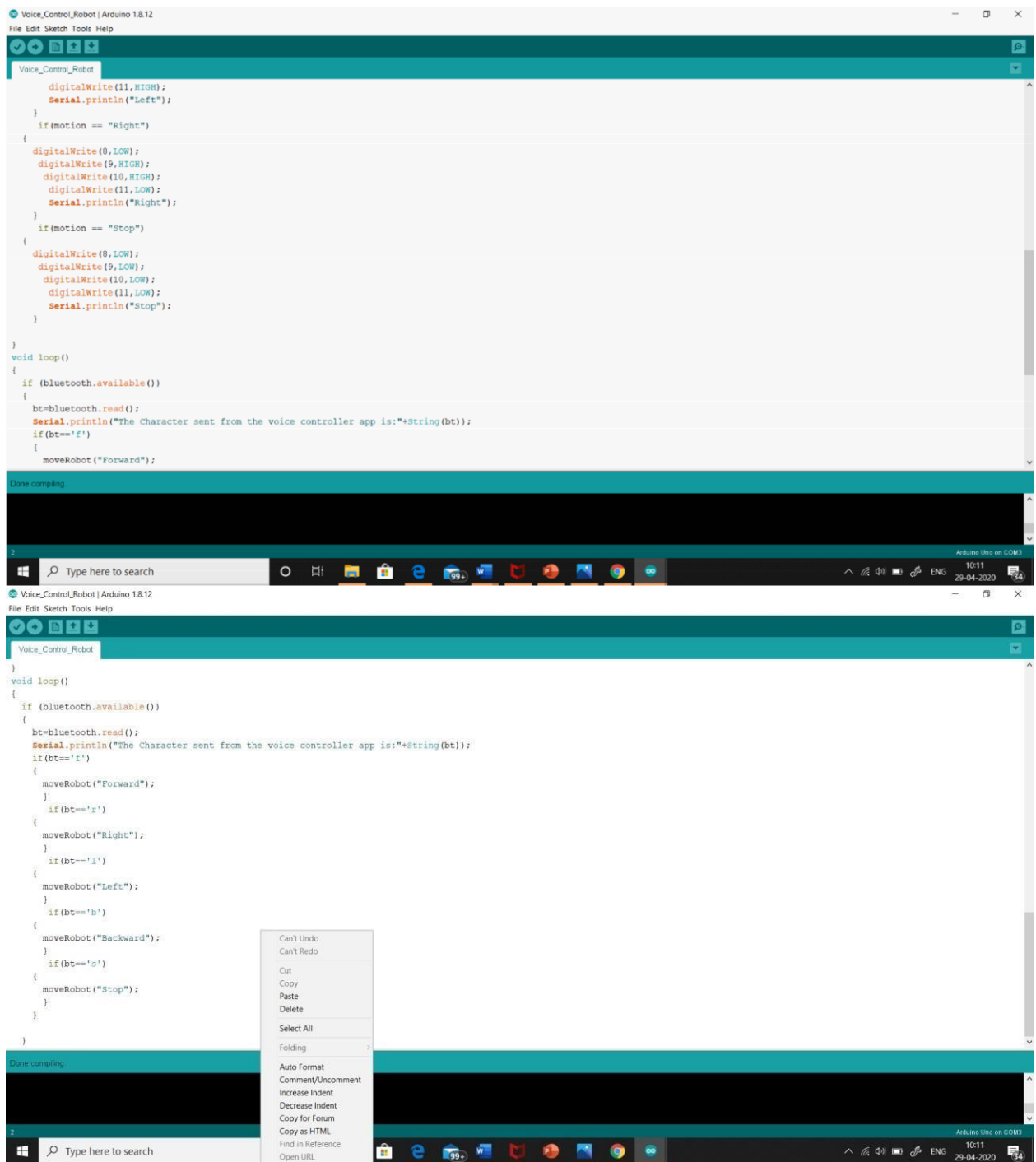


Fig 20: Coding Screenshot of Motordriver with arduino

## 14. RESULT AND ANALYSIS

In this robot we have designed an App using MIT app Inventor the APK file of which is mentioned below:

Mobile Application link: <http://ai2.appinventor.mit.edu/b/3qne>

The mobile app consists of Back End and Front End matter in which there is designer and block section.

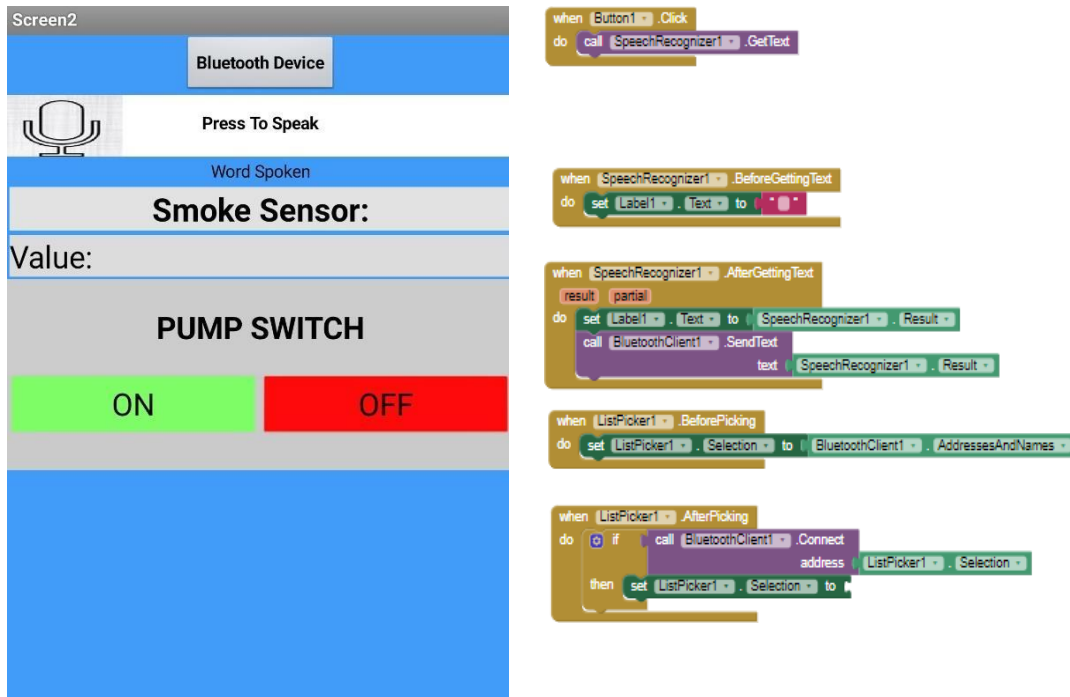


Fig 21: Front End and Back End of Mobile App

This project reduces human efforts at places where human interventions are difficult. Such systems can be brought into use at places such as industries, military and defence.

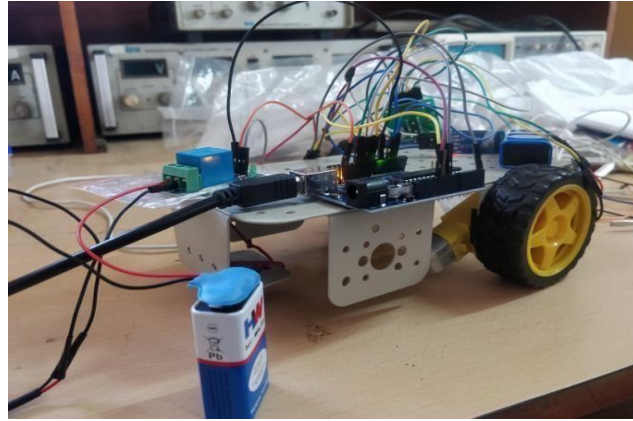


Fig 22 Fire Sensing Voice Controlled Robot

## 15. CONCLUSION

This project designs a robot which is controlled using voice commands. The voice commands of the user are transferred to the robot via Bluetooth communication using Bluetooth module HC-05. These voice commands by the users Control the motion of the robot.

The robot continuously senses the conditions around itself and provides the the recorded data visible to the user via the mobile application installed in the users mobile phone. This mobile application is also a medium for the user to send the voice commands to the robot.

The data sent to user's application is collected by the sensors attached to the robot. The data is a reference by which the user can decide if there is a fire accident or a gas leak and accordingly he can activate the water pump which is connected to the robot via a button provided in the mobile application there by flushing the water and extinguishes the fire.

Therefore the robot can detect any fire and continuously senses the surrounding conditions and notifies the user in cases any fire accident and helps the user extinguish without the user going there remotely.

## 16. FUTURE SCOPE

- **THE PRESENTATION OF THE ROBOT:** Automated sensors are utilized to evaluate a robot's condition. These sign are passed to a controller to empower suitable conduct. Sensors in robots depend on the elements of human tangible organs. Robots require broad data about their condition so as to work successfully.
- **RANGE EXTENSION:** Bluetooth range extenders connect to an audio source to improve its range and connectivity. The impact of the separation between the mouth and receiver on the robot (utilizing Bluetooth transmitting at 2.5mW with a scope of 10 meters or 33 feet can be expanded utilizing range extenders). Bluetooth range extenders can also eliminate dead zones. There are a few such range extenders that can go similar to 150 feet in outdoors, and between 50-70 feet inside. On the off chance that you decide to place two territory extenders in arrangement (likewise called a "daisy-chain"), it can broaden the separation significantly further. That will give you a chance to give you run through your whole house, or even into your yard. It maintains a strategic distance from the deferral of 2-3 seconds that is run of the mill of Bluetooth items - and if there is a separation, it gets reconnected rapidly. It can likewise be utilized as a transmitter and receiver.
- **CLARITY OF VOICE COMMANDS:** The effect of emphasize of the speaker on the activity of the robot (utilizing a discourse to content transformation application) Training the robot to understand voice of the user, so the it can perform speech synthesis and speech recognition, to increase the functionality of robot by working and doing tasks. Only for the authenticated users.
- **AUTHENTICITY OF THE ROBOT:** By using proper security algorithms or by introducing Artificial Intelligence into the architecture we can properly authenticate the users so that the robot will only respond to a fixed set of authenticated users with the help of speech recognition. This will make sure that any outside person cannot misuse the robot for his own benefit.
- **USE OF RENEWABLE ENERGY** :Utilizing inexhaustible wellspring of vitality for the working of the robot would likewise demonstrate to be eco-friendly alternative(Sun oriented cells can be a potential wellspring of vitality) The developing advancements, for example, solar cells, solar engineering photovoltaic cells are utilized for this technology. In light of the best approach to catch, change over and convey sun based vitality, these advancements based on solar energy are arranged into two sorts as dynamic sun oriented and detached sunlight based. The electrical vitality produced from the sun powered vitality is called as Solar Power Energy which can replace the batteries used in our project.
- **IMPROVING SENSING OF ROBOT** : To improve the sensing ability of the robot we can also incorporate a wireless camera which will send the video footage of the affected area to the user via Bluetooth communication directly to the mobile application .Therefore it will sense the danger to a greater degree and provide better picture of the fire accident taken place.

- **AVAILABILITY OF ROBOT** : To increase the availability of robot we can introduce it to as many platforms as possible. We can create the mobile application which can work both android as well as on iOS. We can make it available to as many gadgets as possible ranging from personal computers, laptops, mobile phones and smart watches too.
- **IMPROVING PERFORMANCE OF THE ROBOT** : Performance can be improved by introducing more sensors for collecting more data for the user analysis. Accelerometer sensor will improve the functionality by understanding the gestures of the user. GPS tracking system can be added to provide better location identification for the user.



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# FIRE SENSING VOICE CONTROLLED ROBOT

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**Abstract** - The main purpose of this project is to control a robot using voice and to monitor environmental conditions in case of fire emergencies and gas leaks. Voice controlled robot system is a movable robot which is supervised or controlled using voice commands given by the user. The robot performs tasks based on the voice commands given. The voice controlled robot uses a built-in speech recognition application in a Smartphone to convert voice commands to text. Using Bluetooth technology these text commands are sent to robot. A Bluetooth device placed on the robot receives commands. The commands are analyzed by a Microcontroller (in this project Arduino Uno Board) and control the robot using motor driver circuits. A Voice controlled robot system is also used for monitoring the gas present in the surrounding places such as nuclear power plants and industrial areas where there is a high risk of fire accidents and it is hazardous and risky for humans. These parameters are monitored using sensors which are connected to the Arduino. The data collected by the sensors are sent to the smart phone via serial communication. The sensed data is then used to activate the pump connected to the robot and thereby extinguishes the fire.

**Key Words:** Arduino Uno, Sensors, Android Application, Speech Recognition, Bluetooth.

## 1. INTRODUCTION

In today's world the use of robots has increased in all fields of life. The robots becomes essential in applications involving monitoring of environmental conditions and surveillance in places like chemical plants, nuclear plants, war zones, very hot or sub- zero temperature environments, disaster affected areas, places which are highly hazardous and dangerous for human intervention and also in farms etc.

In this project we are going to control a robot using voice. A voice controlled robot is a semi-autonomous robot. The

Voice controlled robot system makes use of speech recognition. The speech recognition algorithm used in voice controlled robot is Forward or Viterbi Algorithm [7]. In this project an android speech recognition application is being created and used.

The wireless technology used in this project is Bluetooth. By using Bluetooth technology, the Arduino Uno receives commands from the user.

Due to technological advancements Robots can be used in places where humans cannot enter. This is possible due to the use of sensors which have been placed on the robot, which continuously monitor the conditions of the place where the robot has been sent to or deployed. By using sensors such as gas sensor, it would be helpful to check whether there has been any fire. And by interfacing a water pump to the robot it helps to douse the detected fire.

## 2. BLOCK DIAGRAM

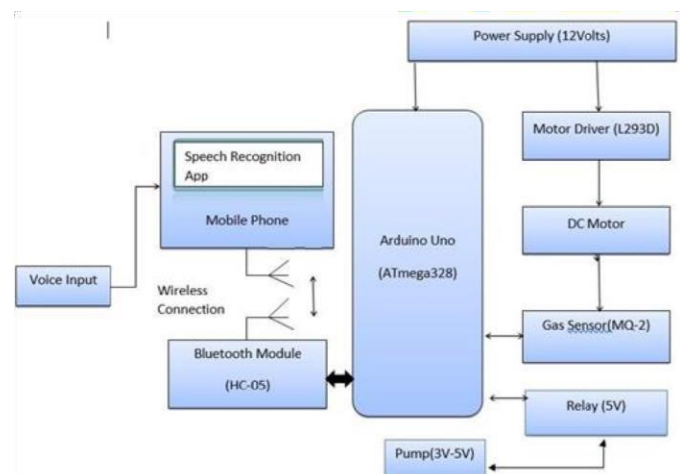
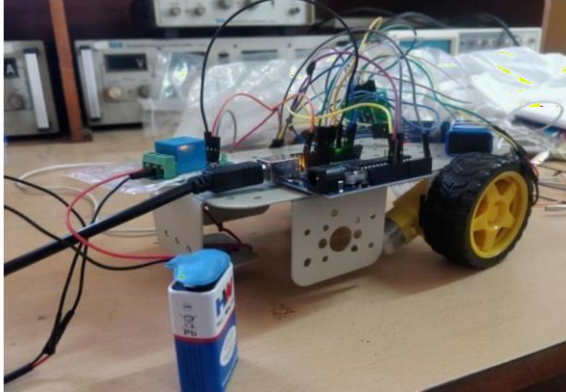


Fig-1: Descriptive Block Diagram

### 3. CONSTRUCTION DETAILS OF ROBOT



**Fig-2:** Construction of Voice Controlled Robot

1. **Voice Input:** Voice input consists of voice commands like move forward, move backward, turn right, turn left for the robot which are given using an Android phone.
2. **Speech Recognition App:** This app is made using a software MIT app Inventor 2 tool. This tool consists of designer section and Block section.
 

**Designer Section:** This section consists of front End page of the app in which there are: Image Label: In this slot there is an image which represents the symbol front view as the app opens up.

**Button (Press to Speak):** This button is used as a button to input voice commands from the user to the robot.

**Button (Pump Switch):** This button is ON whenever the smoke value is generated.

**Text Label (Value):** The text label value shows the value of smoke in ppm units as the user finds the value of smoke the pump is on.

**Bluetooth Button:** This button checks the Bluetooth connection if not on pops the message in the App if on then connects it to Arduino.

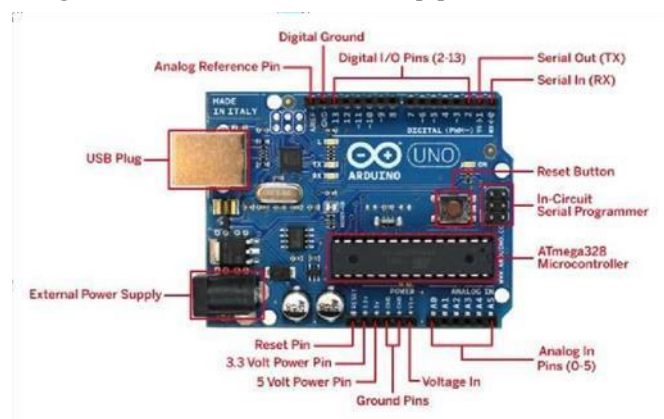
**Text Field (Word Spoken):** This field shows the text which is converted from the user input/voice
3. **Bluetooth module (HC-05):** Bluetooth serial Bluetooth Protocol used for wireless communication with Bluetooth enabled devices (like smartphone) When it gets connected to any other Bluetooth device, its blinking slows down after two seconds. The connection can be point-to-point or multi-point where the maximum range is 10 meters. The transfer rate is data is 1Mbps. In order to increase the range of the Bluetooth we can use Bluetooth range Extenders which can increase

the range up to 150 ft in open air, and between 1517 ft indoors.

4. **Arduino Uno (AT-mega328):** The AT-mega328 is a single-chip microcontroller created by Atmel in the mega AVR family (late microchip technology acquired Atmel in 2016). The Arduino is connected to mobile phone through Bluetooth module. Bluetooth module communicates with microcontrollers using serial communication (USART). AT mega 328 has 1KB Electrically Erasable Programmable Read Only Memory (EEPROM).
5. **Driver Circuit:** The commands are analyzed by the Arduino, which then controls the motor drivers. These motor drivers are controlled by driver circuits.
6. **DC motor:** A DC motor is of a class of rotary electrical machines that converts direct current DC motors are interfaced in Arduino.

### 4. HARDWARE USED

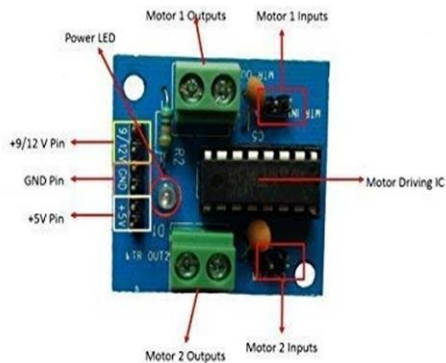
**Arduino:** Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. The recommended input voltage for an Arduino Uno is 7-12V [8].



**Fig -3:** Arduino Uno

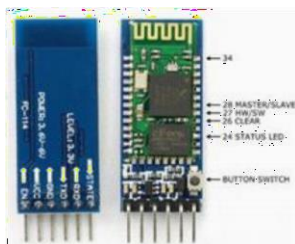
**Motor Driver:** The L293D motor driver can be used to run two DC motors with the same IC. The motor driver can be used control speed and direction. The L293D IC receives signals from the Arduino and transmits the relative signal to

the motors. It has two voltage pins, one of which is used to draw current for the working of the L293D and the other is used to apply voltage to the motors. The L293D switches its output signal according to the input received from the microprocessor. The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor [9].



**Fig -4: L293D Motor Driver**

**Bluetooth Module:** HC-05 is a serial Bluetooth protocol of Bluetooth serial interface module and Bluetooth adapter. Bluetooth serial module is used for converting serial port to Bluetooth. This device is capable of establishing connection with any bluetooth device and can connect to any microcontroller for the exchange of serial data. The HC-05 Bluetooth Module has 6 pins Vcc, GND, TX, RX, Key, and LED [13].



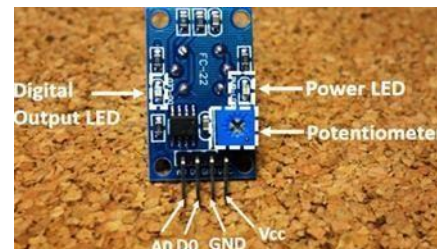
**Fig -5: HC-05 Bluetooth Module**

**DC Motors:** DC Motor runs on DC power or AC line voltage with a rectifier. DC Motor has a high starting torque. It has low no-load speed. The dc motors are connected to the wheels of the car through the dc motors only possible to change the car directions. 9V batteries provide charge to motors [13].



**Fig -6: DC Motor**

**Gas Sensor:** MQ2 is one of the commonly used gas sensors in MQ sensor series. Using a simple voltage divider network, concentrations of gas can be detected. MQ2 Gas sensor works on 5V DC. MQ2 can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide. The operating voltage is 5V [14].



**Fig -7: MQ2 Gas Sensor**

**Mini Submersible water pump:** The DC Voltage required for the pump is 3-5V. The pump generates low noise. The made is made of plastic and has a continuous working life of 500 hours. The driving mode for the pump is brushless dc design and magnetic driving [11] [16].



**Fig -8: Mini Submersible Water pump 3-5V**

**5V Relay:** The SRD-05VDC-SL-C relay has three high voltage terminals (NC, C, and NO) which has to be connected to the device to be controlled. The other side has three low voltage pins (Ground, Vcc and Signal) which connect to the Arduino [15] [17].

5V Relay Terminals and Pins



**Fig -9: 5V Relay**



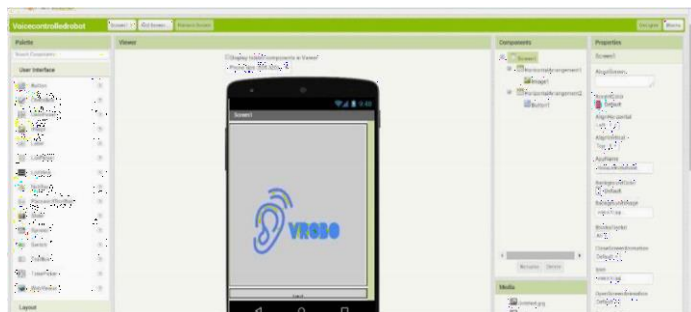
## 5. WORKING

In this Robot Human voice is taken as an input and converted to text using Speech Recognition App which is an android based application. The robot will perform action on the commands based on the user Input. In this we have used Bluetooth module (HC-05) which is wireless module and is used to transfer commands to Arduino. The Arduino the analysis the Commands that are received by Bluetooth. Arduino AT mega 328 is used in which programs can be directly loaded to the device. Motor driver L293D allows DC to drive in any direction. It controls two motors simultaneously. This robot also consists of gas sensor which detects the amount of gas and displays the amount of gas in the Mobile App. This sensor displays the amount of smoke in ppm units. The relay is connected Arduino which is nothing but an electrically operated switch. It consists of set of input terminals for a single of multimode signal. The pump is connected to relay the signal of the gas sensor is send to the App and then based on the value of smoke the pump is functioned ON and OFF.

## 6. APPLICATION

The Android application has been designed using MIT App Inventor 2. MIT App Inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT) [19]. App Inventor is a blocks programming language. MIT App Inventor uses Graphical User Interface (GUI). Working of MIT APP Inventor App Inventor involves three aspects: (i) App inventor designer, (ii) App Inventor Blocks editor, and (iii) An emulator or Android Phone.

(i) App inventor designer: The App inventor designer block is used to design the user interface of the mobile application. Using the Layout tools and User Interface tools the User Interface has been designed. In this project it has 2 user interface screens [18].



**Fig -10: User Interface Screen 1**



**Fig -11: User Interface Screen 2**

The second screen has a button called Bluetooth device for selecting a Bluetooth device to be connected to. The Press to speak button is a speech to text converter which records the command and converts it to text. Words spoken row is used for displaying the command that has been given. The reading of the Smoke Sensor is displayed in the Value textbox. If the output of the sensor is high this indicates the presence of fire in the environment in which the robot has been deployed in. The fire can be doused using a spraying water. The water pump is controlled using the ON/OFF switch present on the application.

## 7. FUTURE SCOPE

We can modify the robot as per our need. In order to improve the sensing capability of the robot we can add additional sensors such as wireless cameras and proximity sensors. To improve the availability of robot an Application can be created which can also be used on iOS platform. Further to make the robot environment friendly we can use solar batteries by implementing solar panels. We can also improve the security of the robot by using security algorithms to train the robot, so that it will only be accessible to authenticated users.

## 8. CONCLUSION

This project designs a robot which is controlled using voice commands. Commands by the users Control the motion of the robot. The robot continuously senses the conditions around it and provides the recorded data visible to the user via the mobile application installed in the user's mobile phone. This mobile application is also a medium for the user to send the voice commands to the robot. The data sent to user's application is collected by the sensors attached to the robot. In case of a fire accident or a gas leak and accordingly he can activate the water, pump which is connected to the robot via a button provided in the mobile application. Therefore, the robot can detect any fire and continuously

senses the surrounding conditions and notifies the user in cases any fire accident and helps the user extinguish without the user going there remotely.

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