

Robot Controlled Car Using Voice and Wi-Fi Module

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Abstract – The aim of the project is to develop a real time voice control system which is implemented and tested on a mobile robot. The microcontroller ESP32 is programmed using Arduino IDE. Making use of Google speech recognition technology, Android software is developed that can access voice command information and it will later convert that to text. This is done by speech to text technique of Google for the conversion from voice to text, text is then transmitted to ESP32. To receive this information which is in text, ESP32 will be programmed through Bluetooth. Programming is done giving the commands for the movement in all four directions like left, right, forward and backward as well it is programmed for stop. Programming for independence is also done through robot will incorporate fully independent

Operation making use of IR sensor. This facility makes the detection of obstacle if any easier and in turn will avoid collision.

Key Words: Arduino, Bluetooth, Robot, Sensor, Wi-Fi, BLYNK

1. INTRODUCTION

Robotics is an emerging technology and there exists many methodologies for the construction of robots. Each method has both advantages and disadvantages. Robotics includes design, build, working, and usage of robots. Using Robotics, humans can be substituted for machines and machines perform human actions of the fittest.

The A robot is a machine designed to perform one or more jobs repeatedly considering both speed and accuracy. A robot is an electro-mechanical machine working under the guidance of software or electronic circuit. Robots can be independent or non-independent. Robots can perform repetitive tasks as well as dangerous one also which cannot be done by the humans easily.

In this Project, Arduino microcontroller is used in our design of the robot. The reason for the usage of the Arduino microcontroller is due to its features which are multifaceted with many advantages on the basis of ESP32. Physical computation is incorporated with the platform of open source. The SPI which is the general communication platform together with Bluetooth are been used in designing the system. The radio waves are used by Bluetooth and safely, consuming very less power and doing the connection of device, enabling exchange of data between the devices

and without the usage of physical wires and cables. SPI interface, used for interaction with one or greater than one peripheral components rapidly in the limited region is the synchronous serial data process communicator used by microcontrollers. The two basic applications of robot are performing voice controlled action and manually controlling the robot using an application called BLYNK it is an android application where we can develop the interface according to the user requirements.

The control of the working of the robot is through the user voice command. The smart phone operating in android will be used by user for voice command. This command can be accessed using the app converting the voice command into text. Bluetooth will be used to connect phone with the microcontroller having inbuilt Bluetooth module. The data conversion once it's made from voice to text will be communicated from the smartphone to the microcontroller using Bluetooth. The commands are given for the robot to operate forward, backward as well left and right and independent mode. DC motor driver will be used for the operation of two DC motors which are geared and have gripped tyre and in turn the robot will be driven. During independent mode, to detect the obstacle, IR sensor will be used. The reading of the IR sensor will be used by ESP32 to send signals and give information about the obstacle which may be present before robot and considering the fixed range. At any instant, the command can be sent and robot operation can be stopped.

2. LITERATURE REVIEW

Many researchers have worked in the development of robots and have come up with new approaches. These researches serve as the basis for the new innovations.

An attempt has been made to list out some papers mentioning the technology used and advantages of each.

1. "Robot Control Design Using Android Smartphone" by Mrumal.K.Pathak, Javed Khan, Aarushi Koul, Reshma Kalane, Raunak Varshney

This paper explains the controlling of robot through phone adopting Bluetooth technology and some of its features, mobile component and robot. The solutions derived are very much comfortable and they act as platform for robot building. The cost is very less, computation speed and sensing of the control device, smartphone are good. The paper aims to provide simple robot hardware architecture

with sophisticated android domain which is powerful enough.

2. "Smart Phone Controlled Robot Using ATMEGA328 Microcontroller " by Aniket R. Yeole, Sapana M. Bramhankar, Monali D. Wani, Mukesh P. Mahajan

The paper is about robot designing making use of the application of android phone. In this paper, the direction of the robot and what is the distance of the robot from the obstacle will be communicated. This information shared through phone through Bluetooth. The control commands are sent incorporating features like motor speed control and sensing the data .

3. "Android Mobile Phone Controlled Bluetooth Robot Using 8051 Microcontroller " by Ritika Pahuja, Naren

A robot can be defined as electro-mechanical machine governed by programming computer and electronic hardware. Robots are been used in factories all over the world in the Manufacturing units. In this paper, motion of the robot is controlled by the buttons of the android application. Bluetooth module is used for interfacing of smartphone and the controller. This is done through the help of UART protocol.

4. "Robot Controlled Car Using Wi-Fi Module" by S R Madkar, Vipul Mehta, Nitin Bhuwania, Maitri Parida

In this paper, robot controlled car designed in android application making use of Wi-Fi in the smartphone. The devices can be controlled even though android phone is not physically present through the SMS. In this project, inclusion of spy camera using which live videos can be streamed to the user making use of Wi-Fi. Instead of using normal lithium ion battery, this project makes use of solar cells leading to energy efficiency.

5. "Lab VIEW Model of Voice Commands for Mobile Robot Motion Control using Internet of Things Module" by Snezhana Georgieva Pleshkova, Aleksander Bogdanov Bekyarski and Zahari Todorov Zahariev.

The interaction of the people with the robots are been satisfied through many mobile robot methodologies done by many of the researchers. In all the methodologies, commonly the voice commands are the interaction domain. This is required for operating the motion of the mobile robot. This is accomplished in this article by proposing a creation of LabVIEW model for the reception and recognition of voice commands which is transmitted from the person to the mobile robot. The experimentation and testing of LabVIEW model is carried out in the Internet of Things which is sophisticatedly adopted on the mobile robot domain.

6. "Implementation and Testing of Voice Control in a Mobile Robot for Navigation" by Sudeep Sharan, Trung Quoc Nguyen, Peter Nauth¹ and Rui Araújo

This paper is about integration of a voice control software system done for the robot mobile system named as

ROSWITHA. The integration is with the SLAM algorithm of Robotic Operating Systems. The robot is also been controlled in numerous ways through the development of Graphical User Interface (GUI). There are many tabs for controlling like to start the navigation on the map which may be created or available , for the detection of voice, in order to enter the location to which we are intended to go and for the immediate stopping of the system in emergency. In real time and in numerous environments, and with differentiation in the speaker, the experimentation and testing is carried out. This is done to improve the accuracy of the designed system.

7. "A Voice Command Detection system for controlling Movement of SCOUT Robot" by S. Azargoshab, A. H. Korayem, Sh. Tabibian.

The robot termed as SCOUT robot is controlled through the detection system using voice commands. Hidden Markov model is used for the implementation of the detection system for the transmission of voice commands. A database for speech is created incorporating needed commands. The database is non-native and it has different commands like ready, left, right, stop, forward, backward, fast, slow and go. Twenty Persian language speakers have uttered each of the command. Among them ten are male and ten are female. On the basis of HMM, the detection of voice commands done. The Bluetooth is used for the transmission of detected command to the robot. The evaluation results of the designed system shows the performance improvement in the interaction of human and robot.

8. "Design and Implementation of a Voice Controlled Robot with Human Interaction Ability" by Humayun Rashid, Iftekhar Uddin Ahmed, Sayed Bin Osman, Qader Newaz, Md. Rasheduzzaman and S M Taslim Reza.

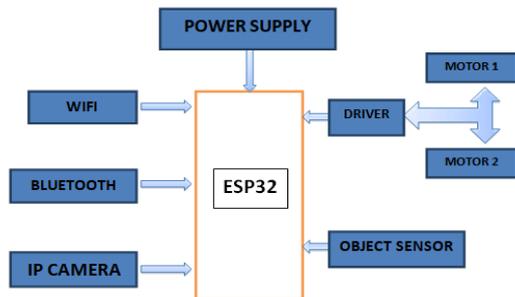
The system of design involves microcontroller connected to the smart phone through Bluetooth module for the transmission and reception of the commands in voice mode. The movement of the robot can be controlled through the transmission of the voice command which is converted to text using the app of the smartphone and for transmission of data to the microcontroller. The data reception is followed by the responses of the robot which are given corresponding to the voice commands. Voice commands are used to make specified movement in the specified direction. The talking system of the robot is developed with the SD card consisting of pre-recorded human voice. This audio file is then made use in talking system of the robot. The robot will speak the sentences , will operate based on the instruction after receiving each of the commands from the device.

9. "Voice Control Robot Using Android Application" , by Soniya Zope, Preeti Muluk, Rupali Mohite, Aishwarya Lanke, Megha Bamankar.

Controlling the robotic device or vehicle through the voice commands and remote operation control in the manual method is designed in the project. The microcontroller ATMEGA32 and Bluetooth device is used incorporating

interfacing of control unit and sense the signals which will be sent by the android app. The Android app sends the serial data received from the Bluetooth module which is interfaced to the ATMEGA32. The paper deliberates the controlling of robot car making use of Wi- Fi module and android application of the smartphone.

3. BLOCK DIAGRAM



The Arduino IDE is used to program microcontroller. Arduino IDE is the official software principled on C programming vendor specified, it's used to program microcontroller ESP32. The Google speech recognition technology is used creating android software getting voice command data and converting into textual data. Speech is converted to text by the android software and the converted text data is transmitted to ESP32. The transmission and reception of commands made possible using Bluetooth ESP32. According to the commands, the robot programmed for the movement in forward, backward, left, right and stop modes. IR sensor is used to check for any obstacles and to avoid the collision resulting in an autonomous programming.

4. HARDWARE AND SOFTWARE REQUIREMENTS

1. Power Supply: The electrical device providing power to the load resistance is the Power supply. In the power supply, the transformers provided with the alternating current steps down the value into the required voltage, sends the reduced voltage to the full wave bridge rectifier which converts ac to dc .The dc component is fed to the capacitor filter, and then the output is fed to the voltage regulator with load. Power supply output is got from the load and fed to the microcontroller.
2. ESP32: The system on chip (SoC) Microcontrollers integration with WiFi and Bluetooth enabled is the cheaper and lesser power consumed microcontroller. The high integration of ESP32 with power amplifier filters, switches of antenna are satisfied in ESP32. With this RF, receiver amplifier and power management modules are also integrated. This microcontroller incurs appreciable functionality as well as versatility to the

applications with reduced PCB design necessity. It works like a full standalone module or it performs the work of slave to the host microcontroller. This reduces the overhead of the communication buffer on the specified application oriented processor. The microcontroller interfacing with the other systems like Wi-Fi and Bluetooth done through the SPI or I2C interfaces.

3. Wi-Fi: Full 802.11 b/g/n/e/i Wireless LAN, Protocol of MAC and TCP/IP implemented by the ESP32. In the station or the client mode, ESP32 communicates with many Wi-Fi Routers. Access point can be created by full 802.11 b/g/n/e/i. The Wi-Fi Direct is also supported by the ESP32. The peer-to-peer communication without access points is provided by Wi-Fi direct. It is the easiest way to transfer data at a very high speed than Bluetooth and setting up is also easier. The configuration of ESP32 projects from the phone supporting Wi-Fi direct can be done potentially by this. In the development, there are many features of the ESP-IDF WiFi which are exploited like softAP mode support or P2P mode , discovery, group owner, group client ,power management, WPA/WPA2-Enterprise and driver, pre-authentication and TSN etc. are supported.
4. BLUETOOTH: Both latest Bluetooth version 4.2 and classic one are supported by the ESP32. This facility enables for the communication with both Bluetooth smartphones and the tablets. There are many features supported by this Bluetooth enabled device like SBC audio CODEC, SMP with 128-bit AE, $\pi/4$ DQPSK and 8 DPSK modulation, Error correction etc.
5. An Internet Protocol camera: The digital video camera which receives the controlling data and transmits the image through internet. This type of camera generally used for surveillance. The closed-circuit television cameras (CCTV cameras) require recording device but Internet protocol cameras don't require recording device, they need only local area network. Most of the Internet protocol cameras are webcams , even though the Internet protocol cameras are directly applied through networking.
6. A DC motor: The electric motor running on the dc power. Electromagnetism is the basis for the operation of the motor. The magnetic field will be generated by the conductor carrying current, when placed in the external field comes across a force which is directly proportional to the current of the conductor as well to the magnetic field strength. In other words, motor is defined as the device doing conversion from electrical to mechanical energy. The principle is that conductor carrying current in

the environment of magnetic field comes in contact with a force which is used to rotate the motor taking reference of its original location. DC Motor used practically comprised of field windings to give the magnetic flux. The armature is the conductor. The two basic parts of DC motor, the rotor which is the rotating part and the stator which is the fixed. There is rotation of rotor corresponding to the stator.

7. An Infrared sensor or IR sensor: The electronic device measuring and detecting Infrared radiation in the environment surrounded. The accident discovery of Infrared radiation was done by the astronomer, William Herchel around 1800. He was investigating about the temperature of every colour of light and got to know that red light above temperature is highest. Infrared radiation is not visible for the human eye because it has a wavelength which is larger than the visible light. Anything and everything emitting heat having temperature above 5 degrees kelvin will emit infrared radiation. There are two basic classes of infrared sensors named as active and passive. Both emission and detection of infrared radiation is possible by active infrared sensors. There are two parts in active infrared sensors, one is light emitting diode and another is receiver. The object coming closer to the sensor experiences reflection of the infrared rays from the LED which in turn will be detected by the receiver. Active infrared sensors are like proximity sensors. They are usually used for detection of obstacle like in robots. Passive Infrared sensors are usually used in the detection of motion like security systems used in the home.
8. ARDUINO IDE: The Arduino Integrated Development Environment (IDE) is an open-source software (IDE) which is easy to write as well as to upload to the board. It runs on Windows, Mac OS X, and Linux.
9. BLYNK APP: Blynk can be used to create applications of smartphone making it easier to interact with microcontrollers or full computers like Raspberry Pi. The main objective of the Blynk is to make easier development of smartphone application.
10. MIT APP: It is a web application integrated development environment. This code is designed to run in Google's App Engine. The applications of App inventor can be built by means of MIT, hence is welcomed by all the public. Compiling of code is not required if the usage is in building the applications oriented to MIT app.

6. WORKING

The conversion from 5V to 3.3V as well 9 V to 5 V satisfied with the help of IC 7805 and power supply unit is developed resulting in project implementation. In order to cope up with the slow transition and bypassing of less period spiking, the usage of bypass and polarized capacitors is done. In order to avoid the back current diodes D1 and D2 are used. L293D used in the motor driver controller, it is a quad, half bridge driver, high current, in order to provide bidirectional drive currents up to 600mA and also to provide the voltage range from 4.5 V to 36V. I/P 1 is connected to pin number 23 and I/P 2 is connected to pin number 22 in order to operate motor in left direction, I/P 3 is connected to pin number 20 and input 4 is connected to pin number 18 in order to operate in right direction. The Bluetooth and Wi-Fi are together incorporated in the ESP32 device and external components are not required. Obstacle detection done using the IR sensor and avoidance by the sensitivity that a body emits heat or through the motion produced. The IR sensor has IR transmitter, receiver for checking the obstacle by transmitting and receiving the signal when the body produces heat in it.

The currently available system is a speech recognizing system that records the words spoken using microphone and telephone, after that does the conversion from voice to digital data. The speech recognition quality is analysed by means of two factors: 1) Accuracy 2) Speed

The technology of Speech recognition has numerous applications. This software is applied in many applications like Customer service which is fully automated, the translations, Medical automation, automated robotics, dictation etc. The one who has done bill payment through phone in the automated system, have got to know the advantage of the automation through speech recognition. The prominence of technology of Speech recognition has gained importance from the last few years. But it has its own weaknesses and issues.

The trending technology is recognizing Speech discussions. In spite of its disadvantages, it is rapidly gaining very much importance in the field. Its usage can be expected in the mobile networks in the coming years. The growth is due to the understandability of the fact that voice is the predominant option for the automated service control and current phone will become uncommon.

The programming of microcontroller is done using the Arduino IDE, the open source C programming software. ESP32 programmed by the Audion IDE. Creation of android software gets the voice data, voice data is then converted to text data by means of Speech recognition of Google. The text data is sent to ESP32. The text data is received by means of Bluetooth and commands are used to do the programming for all the cases like left, right, forward, and backward and stop. An autonomous program is made ready for the operation of robot automatically using IR sensor and do the detection of obstacle and collision avoidance.

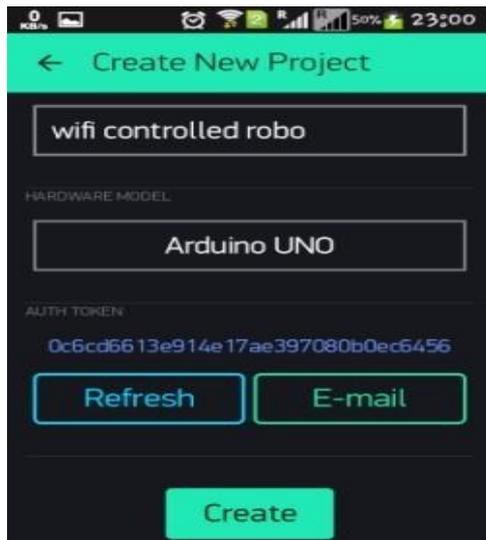
The configuration of ESP8266 in serial mode and controlling of L298N motor drive, possible by the programming of ESP32.

The pin number 2 is configured as receiver and pin number 3 is configured as transmitter by means of serial mode software. Then the pins are connected to the ESP8266 as transmitter and receiver. Later on the I/P's, Input 1, Input 2, Input 3 and Input 4 will be in connection with Pin numbers 22, 23, 19 and 18 .

The robot has four motors which are gear and are connected to 2 motors on the right parallel ,then they are connected to output pins 1 and 2 of motor drive. Then the left motors are also connected in the same way to output pins 3 and 4 respectively.

6.1 STEPS FOR CONFIGURING BLYNK APP

1. In android phone go to the Google Play Store download BLYNK APP and create an account using active gmail account.
2. Selecting the Arduino Board, creating new project.



3. Auth Token Code is to be noted, and to updated in Arduino Program Code.

```
// You should get Auth Token in the Blynk App.

// Go to the Project Settings (nut icon).

charauth[] = "ca17a11e0124d4083d0eaa995f45917";
```

4. Next create button to be clicked in the BLYNK app.
5. Then the Widget of Joystick is to be selected, it has to be clicked, configured and then back button has to be clicked

6. Finally, Play button to be clicked which is on the top right corner in the screen.



6.2 STEPS FOR CONFIGURING MIT APP

The circuit rigging up is very easier. The components are Motors, HC-06, resistors and ESP32. The output pins has connection with H-BRIDGE long motor. Motor shorter oin has connection with H-BRIDGE.

In the HC-06, the VCC and GND is connected 5V and GND terminals respectively, also the receiver of the same joined to Arduino Transmitter, and later on Rx of the same connected to reciver of the arduino. From here the codes divided into two parts, MIT and Arduino. Let us start with the MIT code.

Android Application(Using MIT App Inventor)



Here the app will implement the function for recognizing the speech along with the Bluetooth client and Clock function. A Google Speech recognizer will get activated when the speak button is clicked. Whatever spoken can be seen in the label "What do you speak" and that is sent to Arduino. The arduino will do the remaining processing works.

7. RESULTS

Interfacing of the microcontroller to the robot is done along with the assembly of the hardware components. Motion of the robot is controlled using Bluetooth and BLYNK android app. These two controlling modules of the robot is tested and demonstrated. Although controlling using Bluetooth limits the distance for communication, it is a smart and easy means to guide a robot. Robot motion Controlling via internet is the very easy way as it requires the user to access the designated Bluetooth app to guide it. The system developed can be used in the application for detecting landmines in war field and also for bomb detections by placing a metal detector sensor on it. Further the device size can be minimized based on specific applications.

8. CONCLUSIONS

The mobile robot in real time voice control device is implemented and tested. Project has resulted with good output along with the different experiments carried out the system recognizes the voice command in real time and completes the task assigned. System has been explained in real time situation. The implemented device with GUI showcases applications of voice recognition technology in many field such as Human Robot Interface. Here the implemented project is more effective in recognizing the speaker command in order to navigate towards its destination according to the speaker command. For the movement of the robot BLYNK app is used, when the object is detected at the time of movement it stops the robot and message to user telling object detection. In real time efficient test has been done for both manual movement and voice movement of robot.

9. FUTURE SCOPE

For Internet of things Wi-Fi is the main technology used because of its cost coverage and bandwidth, in comparison with mobile cellular networks. As the technology is growing, imagination can be extended such that our future with only voice control system and Wi-Fi. Where the system is user friendly and less complex and can be readily used to perform assigned task immediately, also Several tedious and repetitive tasks. In the project the robot has been developed mainly for industrial usage. Further can be extended for other purposes such as commercial and research application.

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