WIRELESS VOICE CONTROLLED ROBOT

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Abstract - *Robot control systems have been a topic of greater research. The control systems have different implemented in near present yet the topic of the control of the robotic vehicle remains of greater research. This project deals with the development of voice controlled robotic vehicle. The Robotic vehicle is designed which can move forward, backward, left and right using the voice commands given by the user using android application. The android application developed uses speech to text to determine the voice commands and then Bluetooth socket to send it to the robotic vehicle. The robotic vehicle structure then parses the incoming Bluetooth data to move or navigate the robotic vehicle in different directions. The robotic vehicle can move in different directions as well as turn at degree as we have included the precision turning system using servo motors.*

*Key Words***:** Bluetooth, Voice, Speech To Text, Robot, Navigation, Servo Motors Etc

1. INTRODUCTION

Robotics is the currently being used in any field right from industrial automation to medical sciences and home automation. The ongoing techniques on the robot control methodology and analysis of the same has delivered few impressive results and innovative methodologies in the control of the robotic vehicle. A lot of research work is being carried out to enhance the control methodology and improve the easy interaction between the human and the robots. The robot control techniques vary from completely autonomous which can take their decisions on own using SLAM and manual control techniques or semi autonomous techniques. The Autonomous robots fail and fall short in results where more human intelligence is required and decisions are to be made in real time. The autonomous control techniques of the robot involves various techniques including the pre-programmed path on which robot vehicle can move, GPS guided navigation, SLAM and Lidar based real time path mapping systems and RF based indoor positioning techniques.

The manual control techniques involve teach pendant based approach to control the robot, wired joystick which can track the motion of the 5 d joystick and generate the control signal as well as RF based robot control system to establish wireless communication. Voice control robotic control is another innovative method to control the robotic vehicle. Voice control system are slowly capturing the virtual assistant market and can the same can be used to control the

robotic vehicle due to ease of the ability to control the robotic vehicle.

Voice control robot is highly advantageous in fields where there is the risk for humans to enter. The Voice controlled robotic system can be developed which will parse the voice commands of the person and then generate the control signal to control the robot. Different voice command s will be used to control the robot movement in different directions .The voice control system can be implemented to use speech recognition system to determine the speech commands of the user using the speech recognition hardware or the PC with the software running on it. However this is not user friendly and accurate.

2. PROBLEM STATEMENT

The control command methodology to control he robotic vehicle needs to be user friendly and easy to operate. The Manual control methods using wired controller are inefficient and require wires to be available between the robot and the controller to control the vehicle. The RF based control system required transmitter and receiver which is an additional piece of hardware. Our approach is to develop and voice controlled robot which can use android application developed as a part of this project to control the robotic vehicle by using just voice commands and Bluetooth technology.

3. OBJECTIVES

The main objectives of the paper are:

➢ To develop a robotic vehicle which can navigate in forward, backward, left and right direction using microcontroller based control system

➢ To make the robotic vehicle wireless by interfacing and controlling it using the Bluetooth commands received from the Bluetooth module interfaced to the controller

➢ To develop a voice control system which can take user voice commands and perform speech recognition and speech to text conversion to generate the control signal for controlling the robotic vehicle

➢ To design and develop an android application which can be installed in users smart phone to recognize

the voice commands form the user to control the robot using voice and Bluetooth wireless connectivity.

➢ To implement degree turning system this can force the robotic vehicle to turn at precise degree.

4. METHODOLOGY

➢ The implementation of this project involves designing and fabrication of smart system and also a prototype of vehicle on which the concept can be demonstrated.

➢ **Phase 1:** The Android application development for voice command recognition:

  o To bring about of concept of voice controlled robot using microcontroller the first step proposed is the development of android application for detection of voice commands given by user and converting speech to text. The android application is developed using android studio which consist of Bluetooth adapter and speech recognition activity to detect the voice command from the user, convert it to text and transmit it to the Bluetooth socket.

➢ **Phase 2:** The hardware design, fabrication and assembly:

  o The microcontroller unit is the heart of this project and is responsible for controlling the robotic vehicle . In this phase the hardware of the project is designed by interfacing the different components to the microcontroller such as Bluetooth module, motor drivers, power supply unit etc and PCB for the same is fabricated. After the pcb is fabricated the different components will be mounted to complete the hardware assembly of the project.

➢ **Phase 3:** The Robotic vehicle Development:

  o To demonstrate this concept, robotic vehicle is fabricated. This can be operated using the voice commands received form the android application developed

➢ **Phase 4:** Programming and Testing:

  o In this phase the programming of the project is done. The microcontroller program is developed and uploaded on the arduino microcontroller.

➢ The system consists of android application developed which is installed on the users smart phone.

➢ The android application developed will take the user speech input, perform speech recognition, convert detected speech to text and send the detected voice command in the form of text string to the Bluetooth paired device which is paired with the users smart phone.

➢ The Robotic vehicle on the other hand consists of the microcontroller interfaced with the Bluetooth module and the motor drivers for controlling the motor.

➢ The Bluetooth module is paired wirelessly with the android smart phone and waits for the command form the voice control application developed.

➢ When the control command is received from the Bluetooth, the command string is compared with the valid command strings and the robot is controlled accordingly with the voice command given by the user.

➢ After checking the voice command the microcontroller signals the motor driver to drive the motors to move the robotic vehicle in accordance with the control command received from the voice control application.
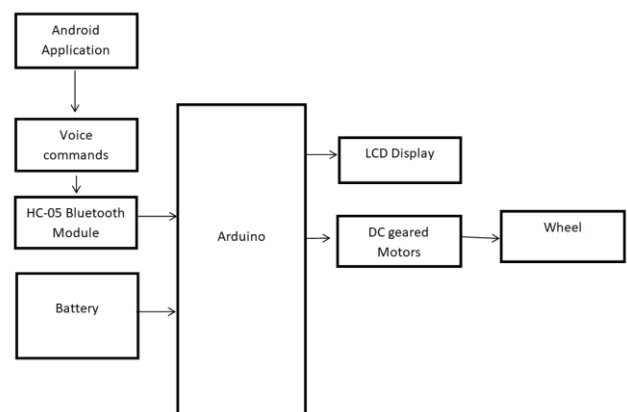
5. BLOCK DIAGRAM

Fig.1 Block Diagram

6. HARDWARE AND SOFTWARE USED
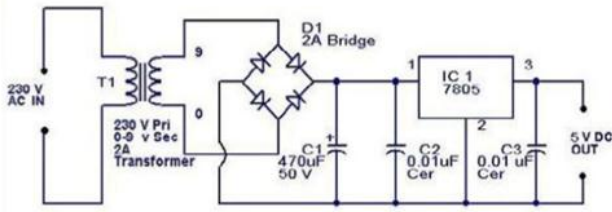
i. Regulated Power Supply

Fig 2: Power supply circuit diagram

Power supplies are essential for the testing and implementation of any useful electronic circuit. If power supplies are not available then the only way to provide power to a circuit is the battery. For long-term use and frequent manipulation, batteries are not feasible. More over these are not flexible as modern day power supplies. They do not provide for over load protection and thermal protection.

ii. DC Geared Motors

Fig 3 DC motor

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

iii. The microcontroller

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip. Sometimes referred to as an embedded controller or microcontroller unit (MCU), microcontrollers are found in vehicles, robots, office machines, medical devices, mobile

radio transceivers, vending machines and home appliances among other devices.
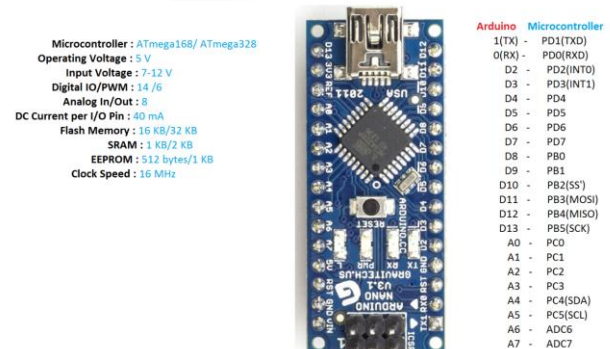

Fig 4. microcontroller

iv. HC-05 Bluetooth Module

The HC05 Bluetooth Module is used for communication and processing the voice commands received by the system. HC-05 is a Bluetooth module which is designed for wireless comunication. This module can be used in a master or slave configuration.
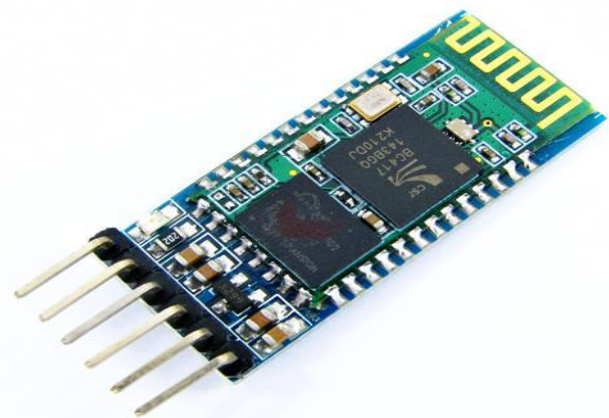

Fig. 5. Bluetooth module

v. SOFTWARE USED- Easy EDA

A great web based EDA (Electronic Design Automation) tool for electronics engineers, educators, students, market and enthusiasts. Easy EDA is free online software for creating circuit schematics, designing PCBs as well as simulating electronics circuits.
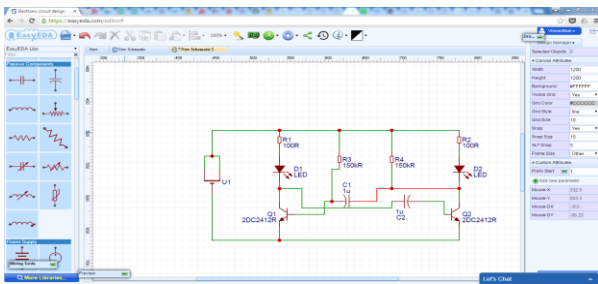
Fig. 6. Software interface

7. Important Functions of the developed Application:

The robot is controlled via voice commands and the voice commands detected are sent to the robotic vehicle using the Bluetooth protocol. The following important functions are implemented in the project while designing the android application for the control of the robotic vehicle.

Important functions in the implementation of app and their description:

onCreate(): used to set layouts, call ui related tasks, and handle ui related interactions and runbackground services.

SetOnTouchListener(): Returns if the button is pressed or released. We call this function on every button to check if the button was clicked

setOnCheckedChangeListener(): Usually used in toggle switches to check if the device state has been changed. We use this in the app to monitor the toggle switch and send the message via Bluetooth.

onResume(): This is the inbuilt function which is called when the app UI is loaded or app returns from the minimization state

Socket.connect(): Connect to the Bluetooth device (voice controlled robot) using the inbuilt phone Bluetooth

onPause(): onPause function is used to pause the state of the services when the app is minimized or goes in background state
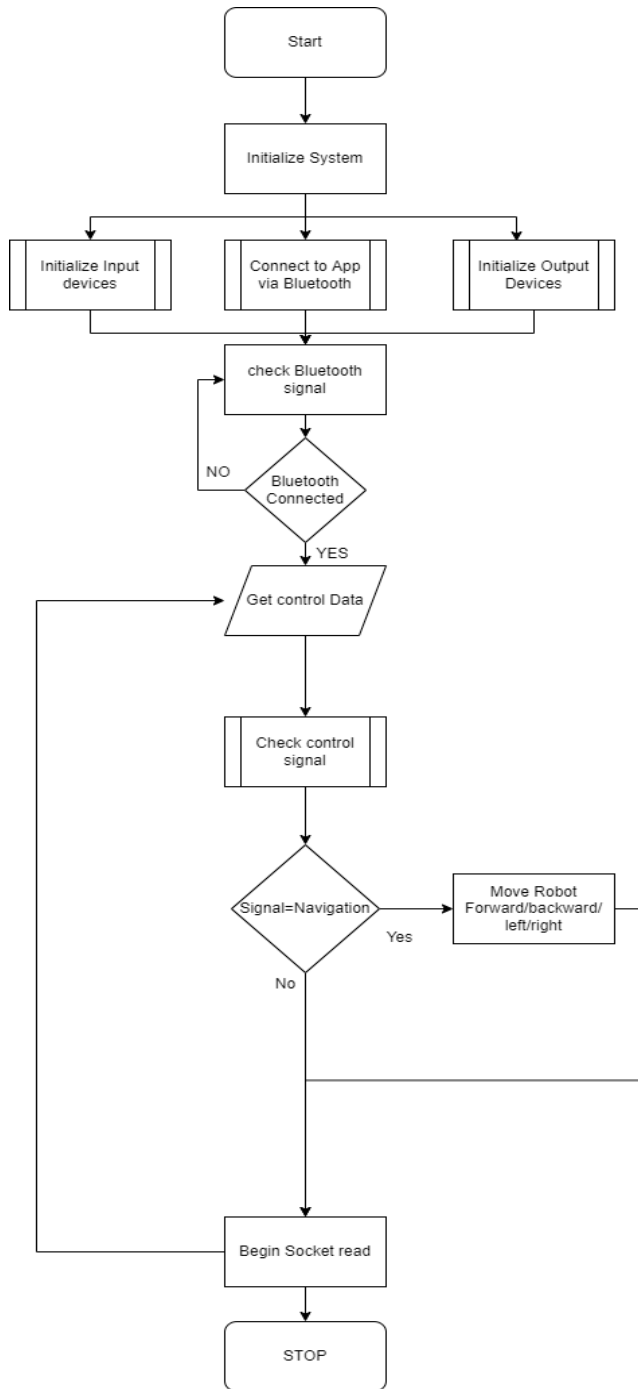
SendSignal(char message): This function is the important function which is used to send the control command from the app to the robot. This function checks if the Bluetooth is connected and if it is connected it will send the message to the Robot using the OS level functions.

8. Flow Chart of the App part:
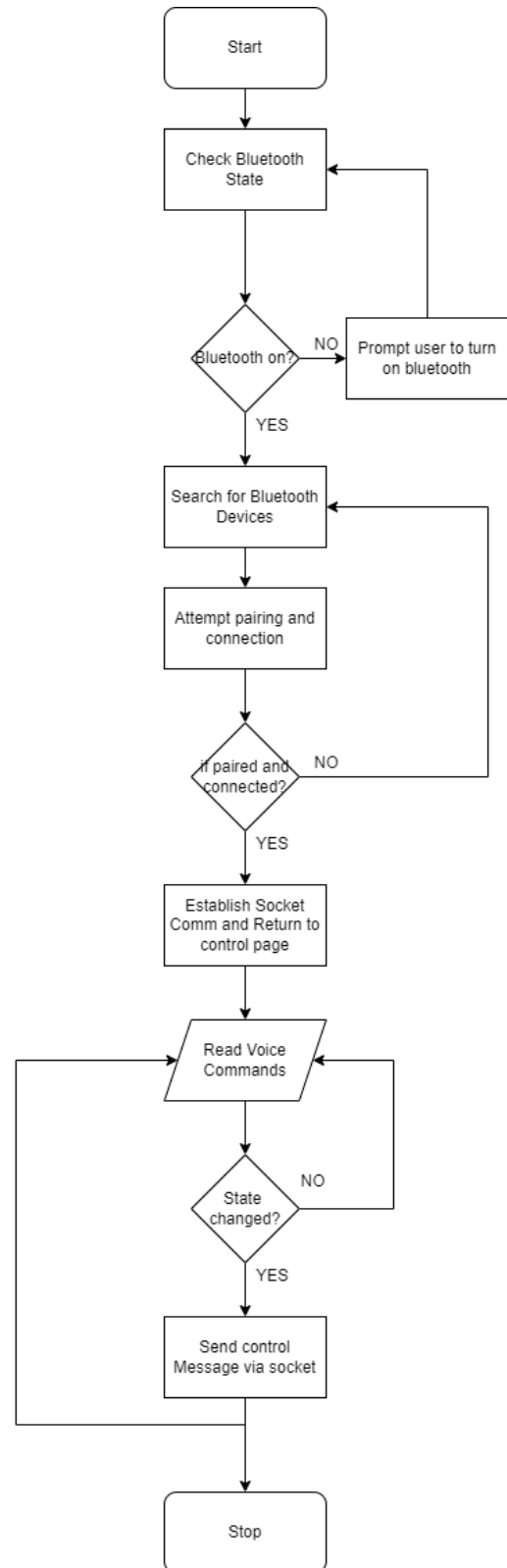
9. Flow Chart of the robotic Vehicle Part:

10. RESULT AND DISCUSSION

The implanted project deals with the development of wireless voice controlled robot. The snap shots below show the completed project. Once the project was completed, the project was tested for the performance. The results of the project are as shown below.
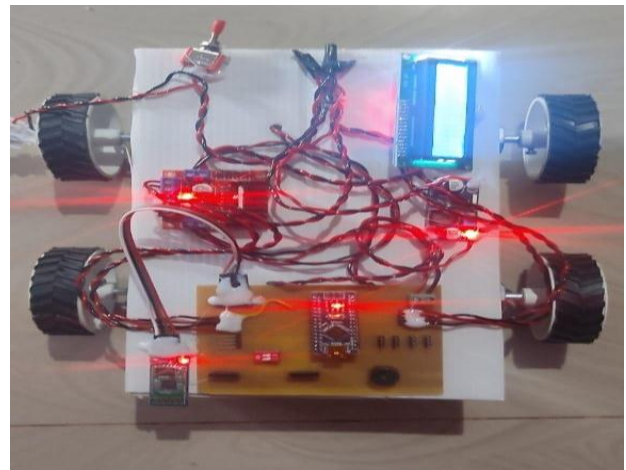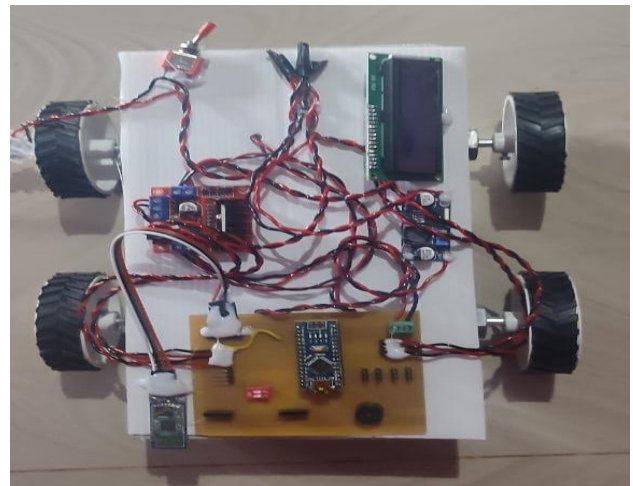

Fig. 6 Assembly of final Robot

Tests are grouped together based on where they are added in SDLC or the by the level of detailing they contain. In general, there are four levels of testing: unit testing, integration testing, system testing, and acceptance are testing. The purpose of Levels of testing is to make software testing systematic and easily identify all possible test cases at a particular level.

There are many different testing levels which help to check behavior and performance for software testing. These testing levels are designed to recognize missing areas and reconciliation between the development lifecycle states. In SDLC models there are characterized phases such as requirement gathering, analysis, design, coding or execution, testing, and deployment.

All these phases go through the process of software testing levels. There are mainly four testing levels are:

i.   Module Testing

ii. Integration Testing

iii. System Testing

Test case number	Test cases	Expected output	Actual output
Case 1	Establish Bluetooth communication	Socket connection	Char message from app to phone
Case 2	Detect Voice command	Speech to text conversion	Voice to text converted and displayed
Case 3	Run robot	Control navigation of the robot	Generated control signals for the motor which control the direction of the motor.
Case 4	Turn at angle	Turing at expected angle	Control signal for turning with delay and stop

iv.   Acceptance Testing

Each of these testing levels has a specific purpose. These testing level provide value to the software development lifecycle.

i.   **Module testing:** A module is a smallest testable portion of system or application which can be compiled, liked, loaded, and executed. This kind of testing helps to test each module separately. The aim is to test each part of the software by separating it. It checks those components are fulfilling functionalities or not. This kind of testing is performed by developers. The individual Module testes are carried out and the following output

ii.   **shown Integration testing:** Integration means combining. For Example, In this testing phase, different software modules are combined and tested as a group to make sure that integrated system is ready for system testing. Integrating testing checks the data flow from one module to other modules. This kind of testing is performed by testers.

iii.   **System testing:** is performed on a complete, integrated system. It allows checking system's compliance as per the requirements. It tests the overall interaction of components. It involves load, performance, reliability and security testing. System testing most often the final test to verify that the system meets the specification. Evaluates both functional and non-functional need for the testing.

iv.   **Acceptance testing:** Acceptance testing is a test conducted to find if the requirements of a specification or contract are met as per its delivery. Acceptance testing is basically done by the user or customer. However, other stockholders can be involved in this process.

The following test cases were carried out on the project. The results obtained are as shown below.

From the tests conducted we can conclude that the robotic vehicle was able to execute the above tests successfully with precision and accurate output. The system is based on Bluetooth communication and works only when Bluetooth is connected and socked connection is establishes prop

11. CONCLUSION AND FUTURE SCOPE

The proposed project deals with the development of the wireless voice controlled robot. Form the implemented project we can conclude that the proposed system is completely voice controlled and runs using the voice commands given by the user using the android application. The separate android application is developed as a part of this project which will be used to issue the voice commands to the robotic vehicle using speech to text and depending on the voice command detected the Bluetooth socket communication sends the data to the Bluetooth device present in the android application. Thus we can conclude that the developed system can provide voice control interface for robots making it easier to control them.

The project has wide scope for future modifications. In future the project can be modified with the deep learning based system to recognize the voice of a particular person and after performing voice verification will issue the control signal to the robot. This can ensure security.

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