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Wireless Voice Controlled Robotic Car

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Abstract: *The Wireless Voice Control Robotic Car project is a system used for security purposes. Although many wireless-controlled robots use RF modules, this project utilizes an Android smartphone for robotic control, with more control commands available compared to RF modules. To use this project, the user must install an application on their mobile device and turn on Bluetooth. Various commands, such as "go ahead," "get back," "turn left," "turn right," "stop," "break," and "show me your dance" are available. While the Robotic Car is in action, the user can watch a live video feed from the camera installed on it. In order to successfully connect to the live feed, users must configure their system with a username and password. Successful authentication is necessary to ensure that the data remains confidential. Once authentication and configuration are complete, the user has several options for camera settings.*

Keywords: Bluetooth, Voice, Speech to Text, Robot, Navigation, Servo Motors, ESP 32 CAM

I. INTRODUCTION

The project aims to design a robotic car that can be operated using an Android smartphone. The robotic car is wirelessly controlled through Bluetooth, which is a feature present in the Android smartphone. In this project, an Android smartphone acts as a remote control for operating the robotic car.

Android is a software stack designed for mobile devices, which comprises an operating system, middleware, and key applications.

The platform offers several connectivity options, including Wi-Fi, Bluetooth, and wireless data over cellular connection such as GPRS, EDGE (Enhanced Data Rates for GSM Evolution), and 3G.

Android provides developers with access to numerous libraries and useful tools that can be used to build rich applications.

Moreover, Android includes a full set of built-from-the-ground-up tools alongside the platform that provides developers with high productivity and deep insight into their applications.

Bluetooth is an open standard specification for a radio frequency (RF)-based, shortrange connectivity technology that promises to change the face of computing and wireless communication.

It is designed to be an inexpensive, wireless networking system for all classes of portable devices, such as laptops, PDAs (Personal Digital Assistants), and mobile phones.

This type of technology is valuable because it eliminates the need for wire connections between devices like monitors, printers, CPU keyboards, and desktop hardware.

To control the robotic car in this project, an Arduino Uno serves as the central controller for the entire system, which includes the Bluetooth module and DC motors.

An Android smartphone sends input data to the Bluetooth module, which is then received by the Arduino Uno and used to control the motion of the DC motors.

The robotic car can be maneuvered in all the four direction based on voice commands received via the smartphone.

To facilitate these functions, a simple program is loaded onto the Arduino Uno, which processes preset commands received from user input to achieve the desired robot behavior.

Additionally, users can access live video feed through the ESP32 CAM device but must first authenticate and properly configure it to do so. ESP32 CAM will provide the live video feed directly onto user's device.

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II. PROBLEM STATEMENT

The methodology for controlling a robotic vehicle must be user-friendly and simple to use. The manual wired control procedures are inefficient and require cables to be present between the robot and the controller in order to operate the vehicle. In contrast, an RF-based control system includes a transmitter and receiver which eliminates the use of wire. Our proposed solution involves developing a voice-controlled robotic car that utilizes an Android application built specifically for this project, thus enabling users to control the robot vehicle via their voice commands and Bluetooth technology. This project is aimed at creating a robotic car that can be managed using an Android mobile phone, and the plan is to wirelessly control the robot by using the Bluetooth feature available on the mobile device.

III. OBJECTIVES

The system is very simple in design and to implement. The system can be controlled remotely with multiple user-friendly commands. Live streaming of video data has been made possible. It has got following features.

- Ensure data privacy.
- Proper control of the Robotic Car(robot).
- Minimized manual task.
- Optimized user-friendly commands to control the Robotic Car(robot).
- Minimized time needed for the various processing.
- Greater efficiency.
- Better service.
- Live video footage, multiple advanced camera settings and interactive.
- Easy to pair and connect securely.
- Faster recharging

IV. 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:

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

Phase 2: The hardware design, fabrication and assembly:

The microcontroller unit is the heart of this project and is responsible for controlling the robotic vehicle. During this phase, the project's hardware is designed by interfacing various components with the microcontroller, such as the Bluetooth module, motor drivers, power supply unit, ESP32 Cam, etc. A PCB for the same is then fabricated. Once the PCB is ready, the different components will be mounted to complete the hardware assembly of the project.

Phase 3: The Robotic Vehicle Development:

To demonstrate this concept, robotic vehicle is fabricated. This can be operated using the voice commands received from the developed Android application and live feed can be viewed directly from the mounted device.

Phase 4: Programming and Testing:

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

The system consists of developed android application which is installed on the user's smartphone.

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 user's smart phone.

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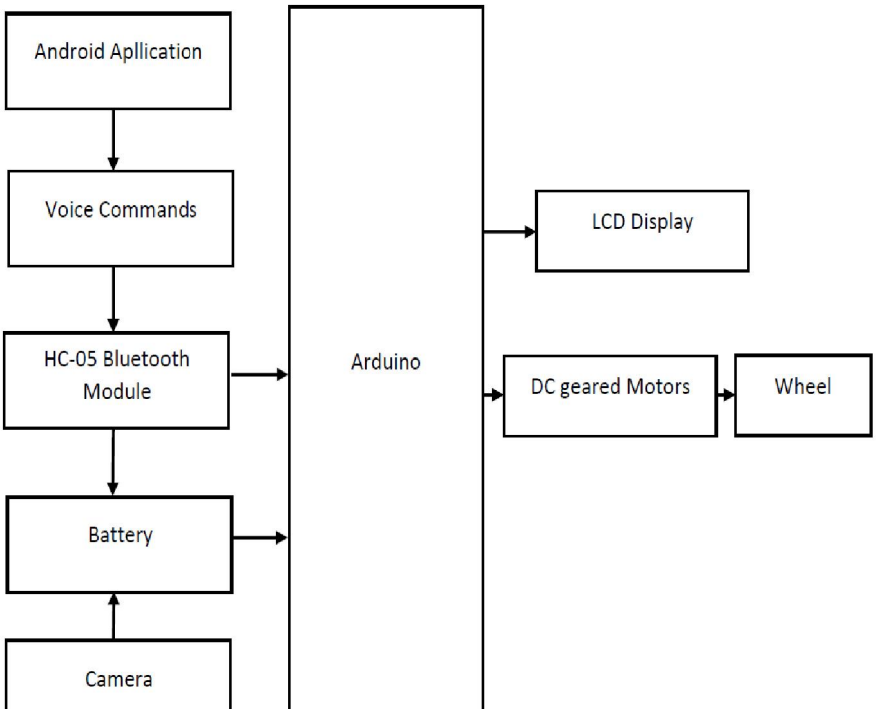
The Robotic vehicle on the other hand consists of the microcontroller interfaced with the Bluetooth module, the motor drivers for controlling the motor and ESP 32 camera module to obtain live video feed and direct the vehicle accordingly.

The Bluetooth module is paired wirelessly with the android smartphone and waits for the command from 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.

V. BLOCK DIAGRAM



VI. HARDWARE AND SOFTWARE USED

6.1 Regulated Power Supply

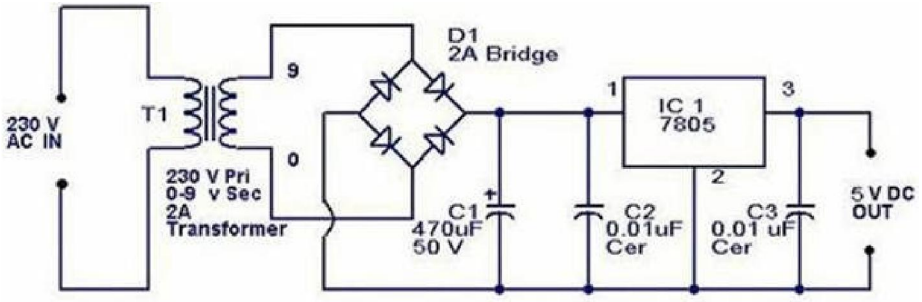


Fig. 2. Power supply circuit diagram

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.

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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.

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 device.

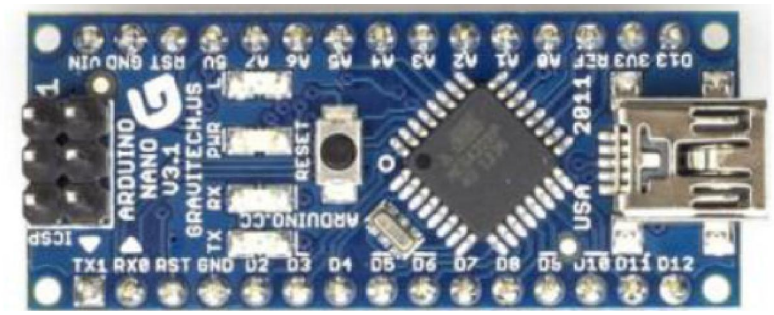

Fig. 4. Microcontroller

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 communication. This module can be used in a master or slave configuration.

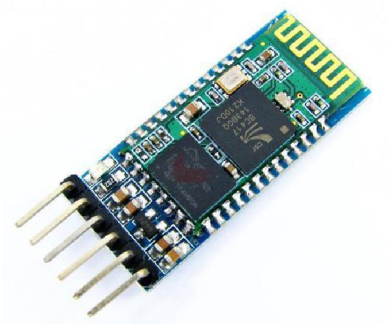

Fig. 5. Bluetooth module

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ESP32 Camera Module

The ESP32 CAM will provide the live video feed directly to the user's device. In order to access the live feed and additional camera settings, the user needs to properly configure and authenticate with the ESP32 CAM.

Fig. 6. Esp32 Cam Module

VII. 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 run background 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.

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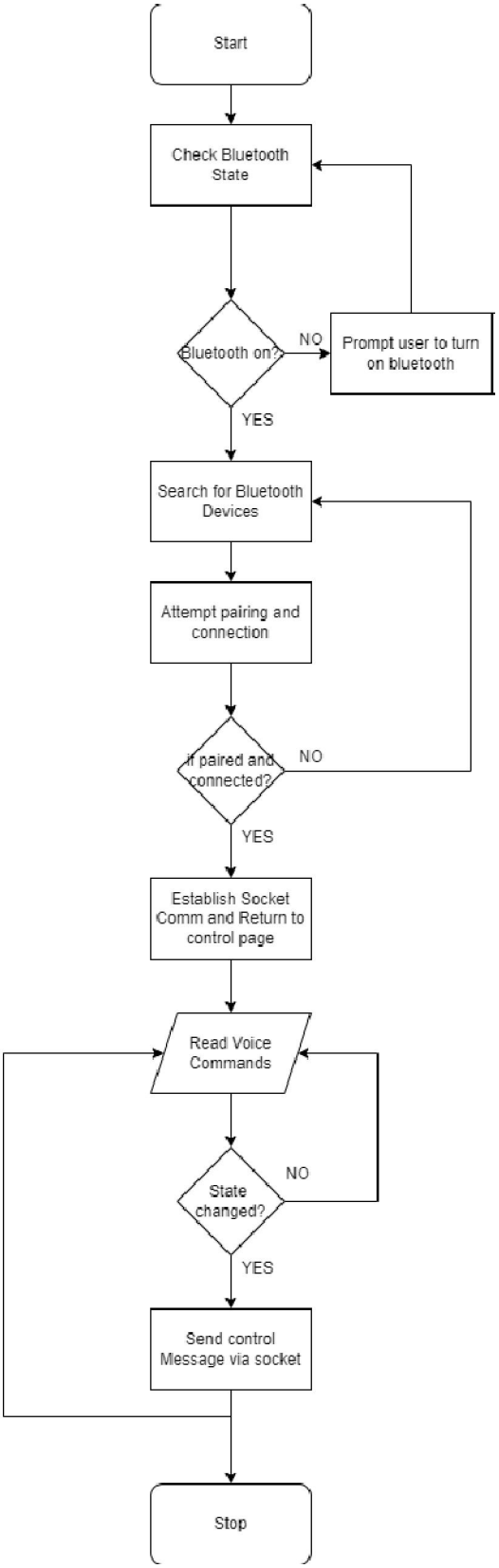
VIII. FLOW CHART OF THE APP PART



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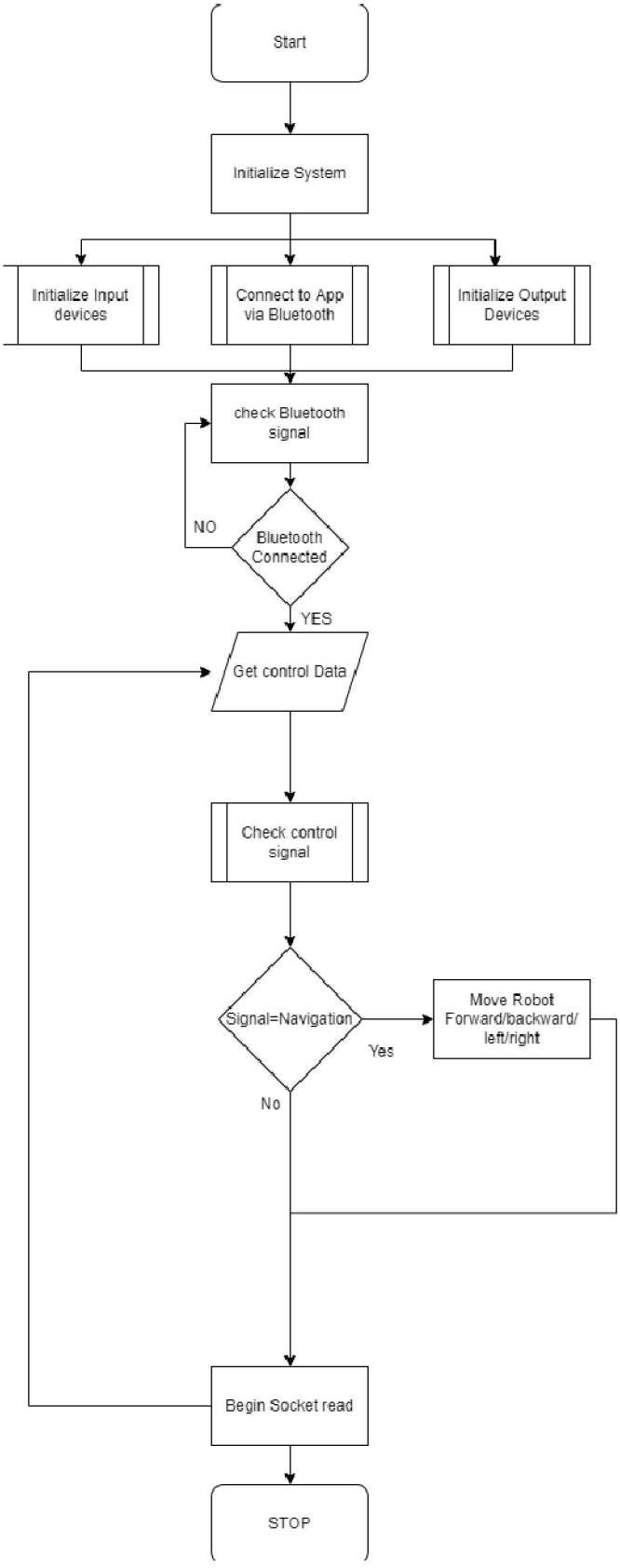
IX. FLOW CHART OF THE ROBOTIC VEHICLE PART



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X. RESULT AND DISCUSSION

Test Case No.	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 themotor.
Case 4	Turn at angle	Turing at expected angle	Control signal forturning with delay and stop

XI. RESULT AND DISCUSSION

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 which are: Module Testing, Integration Testing, System Testing and Acceptance Testing.

Based on the conducted tests, we can conclude that the robotic vehicle executed the above tests successfully with precision and produced accurate results. The system relies on Bluetooth communication and functions only when there is a connected Bluetooth socket connection properly established.

XII. CONCLUSION AND FUTURE SCOPE

The project has been completed successfully with the maximum satisfaction of the organization. The constraints are met and overcome successfully. The system is designed as like it was decided in the design phase. The project gives good idea on developing a full-fledged application satisfying the user requirements.

Wireless control is one of the most important basic needs for all living beings. But unfortunately, due to a huge amount of data and communication overheads the technology is not fully utilized.Many of the wireless-controlled robots use RF modules. But this project makes use of Android mobile phone for robotic control which is very cheap and easily available.

In the future, we can use multiple electronic sensors to achieve the best automation. A distance sensor is one of them, which enables the robotic car to automatically detect obstacles and halt before it to avoid a collision with them. Suspension technology can be added to the tires of the robotic car to ensure that the robot runs smoothly even on tough, rough surfaces without damage.

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