JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

HUMAN VOICE CONTROLLED ROBOT EMBEDDED WITH REAL TIME OBSTACLE DETECTION AND AVOIDANCE

DR. Puja Singh, Ram Rajput, Mohit Prajapati, Raman Nagar, Kshitij Tomar

Professor, Student, Student, Student, Student,
Electronic and Communication,
Medicaps University, Indore, India

Abstract

The use of robotic vehicles has been gaining momentum in recent years due to their ability to perform tasks without the need for human intervention. This research focuses on developing a robotic vehicle that can perform user-given tasks via voice commands, utilizing speech recognition technology for controlling machinery via speech. The vehicle uses an Android app along with a Bluetooth HC-05 module for communication, and an Ultrasonic sensor module for obstacle detection. Customized Arduino hardware controls the motors that propel the vehicle, with Ultrasonic sensors assisting in automatic braking on sudden obstacle detection. The device is equipped with various features such as GPS module, OLED, Latitude, and Longitude, which enhances its functionality.

The use of sensors adds an auto-braking system and slow-down feature for greater safety, making it extremely useful in areas that are inaccessible to humans, such as dangerous or hazardous areas. Additionally, this technology is particularly useful for individuals with physical disabilities who are unable to operate a vehicle on their own. The Bluetooth HC-05 module establishes a communication link between the car and human voice commands via an Android application. The RF transmitter of the Bluetooth module can take human voice commands up to a range of 100 meters, which are then converted into encoded digital data and decoded by the receiver before being fed to the microcontroller to drive DC motors via motor driver L298D.

I. INTRODUCTION

The advancements in the field of robotics have made it possible for robots to become ubiquitous in our daily lives, providing assistance and increasing efficiency. However, physically impaired individuals often face challenges when it comes to driving vehicles due to their natural limitations. This research proposal aims to address these challenges by developing a solution that leverages voice commands to control a robot with automatic braking, speed control, and obstacle avoidance.

The proposed system will utilize an Android app to communicate voice commands via Bluetooth to an Arduino microcontroller. The system will be equipped with ultrasonic sensors that will detect obstacles and respond accordingly through automatic braking or speed control. The use of a smartphone as a control interface provides a user-friendly and intuitive means of controlling the robot. Additionally, the incorporation of speech recognition technology will allow the system to identify the person speaking and differentiate between speech and voice recognition.

The use of voice commands to control robots is gaining momentum due to its natural and intuitive interface, particularly for individuals with physical disabilities. The proposed system aims to provide a practical and effective solution to the challenges faced by physically impaired individuals who wish to drive a vehicle.

Overall, the proposed solution combines various technologies such as speech recognition, ultrasonic sensors, and Bluetooth communication to develop a system that is user-friendly and intuitive. This research has the potential to significantly improve the quality of life for physically impaired individuals, providing them with a means of transportation that is safe, efficient, and accessible.

II. LITERATURE SURVEY

The literature review briefly discusses the increasing demand for robots in various sectors, followed by an overview of research studies on controlling robots using smartphone. Robot have been gaining popularity in various sectors due to their ability to perform tasks autonomously. One area that has seen significant growth is the development of robots that can be controlled using smartphones. This literature review aims to provide an overview of research studies on controlling robots using smartphones, highlighting the various methods and technologies used. Increasing demand for robots the demand for robots has been increasing in recent years due to their ability to perform tasks accurately and efficiently. In industries such as manufacturing, robots have become an essential part of the production process. Additionally, the use of robots in healthcare, agriculture, and military applications has increased, indicating the versatility of these machines. Controlling robots using smartphones. The use of smartphones to control robots has been gaining traction due to the convenience and portability of these devices. The first paper discussed in this literature review presents a method for controlling robots using mobile phones through Bluetooth communication. The study discusses the components of the mobile and

robot involved in the process, such as the Bluetooth module and microcontroller. The paper concludes that the use of smartphones to control robots is a viable and cost-effective solution. The second paper focuses on controlling a robotic vehicle using Wi-Fi module through an android application. The study highlights the ability to control the vehicle by sending regular messages, which can be interpreted by the microcontroller on the robot. The paper concludes that the use of Wi-Fi technology offers greater range and reliability compared to Bluetooth communication.

III. WORKING OF THE ROBOT

The system starts by establishing a Bluetooth connection between the Android application and the robot. Once connected, the user can give predefined voice commands through the mobile handset. The voice commands are processed by the voice recognition module, which converts them into digital signals that can be understood by the microcontroller. The microcontroller, which is the brain of the system, uses this information to control the robot's DC motors and sensors. The robot can move in different directions and speeds based on the user's voice commands, and it can detect obstacles in its path using ultrasonic and infrared sensors. When an obstacle is detected, the microcontroller sends a signal to the motor driver, causing the robot to slow down and stop. The robot then waits for the next command while the sensors continue to monitor the environment for obstacles. The system also includes a Real-Time Operating System (RTOS), which manages the system's resources and ensures that the robot can respond quickly to voice commands and obstacle detection in summary, the Human Voice Controlled Robot Embedded with Real Time Obstacle Detection and Avoidance is a complex robotics system that integrates voice control technology with obstacle detection and avoidance capabilities. It utilizes a range of components, including a microcontroller, voice recognition module, motor driver, ultrasonic and infrared sensors, RTOS, and battery to operate autonomously. The system allows users to control the robot's movements using their voice, while the sensors detect obstacles and take evasive action to avoid collisions.

algorithm

1 Start.
2 Establish the Bluetooth connection between the robot and the Android application.
3 Receive predefined voice commands from the user through the mobile application.
4 Convert the voice commands into digital signals using a voice recognition module.
5 Transmit the digital signals wirelessly from the Bluetooth module (HC-05) to the Arduino UNO microcontroller.
6 Process the digital signals on the Arduino UNO and control the DC motors of the robot according to the commands received.
7 While moving, detect obstacles using ultrasonic sensors mounted on the robot.
8 If an obstacle is detected, slow down and stop the motors of the robot to avoid collision.
9 Allow the user to provide the next command while the robot is stationary.
10 Repeat steps 3-9 until the user stops the robot.
11 Stop.

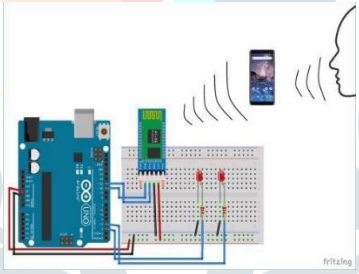

Fig.1: Work flow. [1]

IV. THE HARDWARE

ARDUINO UNO: The Arduino Uno is a microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. It is programmable with the Arduino IDE through a USB cable and is equipped with digital and analog input/output (I/O) pins that can be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (6 capable of PWM output), 6 analog I/O pins, and can accept voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo.

L293D MOTOR DRIVER: The L293D IC is a motor driver that provides continuous bidirectional direct current to the motor. It has an internal H-bridge installed for two motors and is controlled by external low voltage signals. Its power output capacity is higher than expected and it can control any DC motor speed and direction with a voltage range of 4.5 – 36 Volts. It also has internal diodes that save the controlling device and IC from back EMF. It has an internal “Darlington transistor sink” that could be used to control a large amount of current by providing a small amount of current. It has an internal “pseudo-Darlington source” which amplifies the input signal to control the high voltage DC motor without any interception.

12V BATTERY: The main power source to drive the entire vehicle, including DC motors, is designed to operate at 12V DC. A heavy-duty rechargeable battery of 12V and 3 AH (Ampere Hour) is used as a backup source, which drives the entire system. The DC motors used in this project consume 150 milliamps each, and other circuitry including electronic circuit & microcontroller will consume around 200 milliamps. Always two motors remain in an energized condition, thereby the total consumption of the system is approximately 500 milliamps. Since a huge rating rechargeable battery is used whereas the machine consumes less power, the battery can take care of the machine for a long time.

Fig.2 The working HCVR [2]

Fig.3: Arduino Pin Diagram. [3]

ULTRASONIC SENSOR: Ultrasonic Sensors, also known as transceivers when used for object detection, are electronic sensors that emit ultrasound waves to detect the distance to a target object. They work by sending out a high frequency sound wave and then measuring the time it takes for the sound wave to bounce back off the target and return to the sensor. They are commonly used in robotics and automation applications for obstacle avoidance, distance measurement, and other similar tasks. In this project, the ultrasonic sensor is used to detect obstacles in front of the vehicle and avoid collisions.

HC-SR04 distance sensor is commonly used with both microcontroller platforms like Arduino, Raspberry Pie etc. The sensor used for detecting the distance to an object using sonar. It uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. A high frequency ultrasonic sound is emitted by the transmitters which reflects back from any nearby obstacle, and the receiver listens for any return echo. To calculate the time difference between the signal being transmitted and received echo is processed by the control circuit this time can subsequently be used, to calculate the distance between the sensor and the reflecting object.

DC MOTORS: DC Motors are electric motors that run on direct current (DC) power. They are commonly used in robotics and automation applications for driving wheels, propellers, and other mechanical components. In this project, two DC motors are used to drive the vehicle. They are connected to the L293D motor driver, which provides the necessary current and voltage to control their speed and direction.

CHASSIS: The chassis is the base structure of the vehicle that supports all the other components. It is made of a sturdy material like metal or plastic and provides a platform for mounting the motors, wheels, and other components.

WHEELS: The wheels are the circular components that allow the vehicle to move. They are attached to the DC motors and are usually made of rubber or plastic. The size and shape of the wheels can affect the speed, maneuverability, and stability of the vehicle.

CASTERS: Casters are small wheels or rotating balls that are mounted on the underside

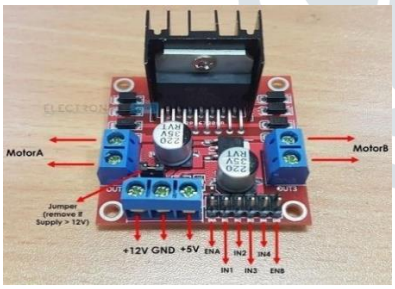

Fig.4: L298D Pin Diagram.[4]

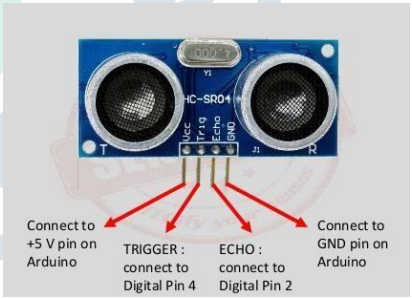

Fig.5: Ultrasonic Sensor HS-SR04. [5]

V. SOFTWARE USED

• Arduino IDE-The software used in the research paper is the Arduino Integrated Development Environment (IDE), which provides a user-friendly interface for programming and uploading code to the Arduino hardware. The IDE includes a text editor for writing sketches, a message area for feedback and error messages, a console for displaying text output, and a toolbar with buttons for common functions. Sketches are saved with the file extension. Arduino and can be edited using features like cut/paste and search/replace. The IDE also displays the configured board and serial port at the bottom right-hand corner of the window. Users can perform various actions like verifying and uploading programs, creating, opening and saving sketches, and opening the serial monitor using the buttons on the toolbar.

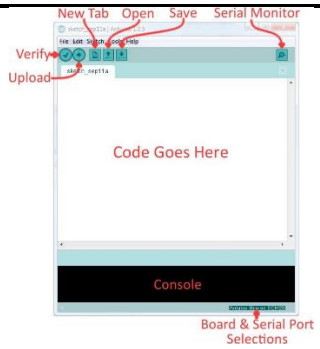

Fig.6: Arduino IDE [6]

VI. CONCLUSION

The proposed system has the potential to significantly reduce accidents and address issues faced by drivers, especially those with disabilities. Drivers will no longer have to constantly change paths, and this technology can be applied to roads with the latest vehicle innovations. These robotic systems not only reduce human effort but can also be used in military, research, and industrial settings.

VII. FUTURE ENHANCEMENT

Voice-controlled robots are the future and can be used for a variety of industrial and domestic purposes to automate daily tasks. While the Bluetooth communication technique is efficient with some time delay after several runs and tests, modifications to the Android application can improve voice recognition clarity. Advancements in this research can include the use of long-range modules to overcome limitations and power optimization algorithms. The robot's ability to detect and slow down for obstacles makes it ideal for handicapped individuals and can also be used for home security and military purposes.

The Bluetooth-controlled robot project has been successfully designed and developed for demonstration purposes. While this is a prototype module constructed with locally available components, it can be used for various applications with some modifications. The robot is controlled through Bluetooth technology with a range of approximately 100m and can be outfitted with a camera for better direction control and monitoring. The full functionality of the robot control system has been tested, and wireless communication between the cell phone and Bluetooth module has been found to be limited to <50m in a concrete building and up to 100m in an open range. The obstacle avoidance robot built on the Arduino platform can detect and avoid obstacles in its path and can be guided by software parameters.

ACKNOWLEDGEMENTS

We express our sincere gratitude to our project guide **DR. PUJA SINGH** for providing us with continuous support and guidance throughout the project. It was his invaluable assistance that enabled us to complete the project successfully. We would also like to extend our heartfelt appreciation to **Medicaps University**, for his unwavering support and encouragement, which motivated us to work harder towards achieving our goals.

VIII. REFERENCES

[1] Ali, Ryther CA, Madsen OB (2009). "Obstacle Detection and Avoidance for Mobile Robots." Technical University of Denmark.
[2] Ahasan MA, Hossain SA, Siddiquee AU, Rahman MM (2012).
"Obstacles Invariant Navigation of an Autonomous Robot Based on GPS." Khulna University. Dhanya KR, JeyanthiR (2012).
[3] Choudhury DR, Jain S. "Linear Integrated Circuits."Carr JJ. "Digital Electronics."
Sheingold A. "Fundamentals of Radio Communication. "Sharma SP. "Basic Radio and Television." Shanmugam KS. "Digital and Analog Communication System. "Sharma MC. "Relays and their Applications." Kamal R. "The Concepts and Features of Microcontrollers. "Ayala KJ.