



INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact Factor: 6.078

(Volume 7, Issue 3 - V7I3-1473)

Available online at: <https://www.ijariit.com>

Hardware Implementation of Obstacle Detection for Autonomous Vehicle

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ABSTRACT

This paper proposes a design variant of obstacle avoidance and voice control for the automobile's car unit. The future advancement in this technology will help us in for the handicapped ones who cannot drive the vehicle on their own, transportation purposes, hazardous environment places where human interaction might be impossible and so on. Also, the use of sensors will provide greater safety from sudden hits. A Bluetooth module is used to create a communication link between the car and human voice commands via Android Application. The RF transmitter of the module can take human voice commands through the application which will then be converted into encoded digital data up to an adequate range of 100 meters from the robot. The receiver of the module decodes the input data before feeding it to the microcontroller to drive DC motors via motor driver L298D for necessary movements. An Arduino UNO which is the brain of our system is programmed to read voice commands and respond accordingly. Obstacle detection can be done by ultrasonic sensors interfaced with the Arduino UNO. Considering this feature, in the future it might prove a milestone in vehicle automation. Further the project can be developed using the Internet of Things, Artificial Intelligence technology where a user can control the car from any corner of the world.

Keywords— Obstacle detection, Voice command, Ultrasonic Sensors, Bluetooth module, Motor Driver, Infrared sensor, Arduino UNO

1. INTRODUCTION

The combination of major fields such as mechanical, electrical and electronics provides automation systems which are known as Robots. The growths in these industries are a major reason for the efficiencies in every sector by reducing the human effort

and interaction [1]. By doing such, this promises us a safer environment in dangerous and insightful grounds. Due to its precision and absolute accuracy it has made a major presence in all the essential fields whether it is education, bio-medicals, engineering and so on.

1.1 Obstacle avoidance

To achieve the obstacle avoidance in the system we are using an Ultrasonic distance sensor which is connected to the L298D motor shield followed by Arduino UNO. This sensor is used to detect any object at some certain distance using sonar. This non-contact ultrasound sonar is used to measure the distance between the object and the sensor. It consists of two transmitters, a control circuit and a receiver for emitting and receiving pulse data respectively. A high ultrasonic sound is emitted by transmitters which will get reflected by any nearby object and the sensor will see toward to get any return echo. The distance for object detection can be subsequently changed by our own means in the coding algorithm. The distance will get calculated of the transmitted signal and receive echo in the control system.

1.2 Speech recognition

The ability of the machine to receive and interpret the human voice or to understand and carry out spoken commands can be concluded as speech recognition. It works on the basis of algorithms codes that match the sound of the detected speech or voice with word sequences and interpret it as a command in Arduino IDE which is a coding platform for Arduino UNO. With the help of these we can command around our system as per the desired needs.

2. LITERATURE SURVEY

The essential focus of this research is speech recognition technology by converting speech into the text message.

Controlling hardware utilizing speech was impractical before. This examination will help us in actualizing this innovation for the debilitated ones who can't drive the vehicle all alone [2]. The utilization of sensors will give more noteworthy wellbeing from abrupt hits because of the auto stopping mechanism and hinder include. A Bluetooth module (HC-05) is utilized to set up a correspondence connection between the vehicle and human voice orders using the Android Application.

The RF transmitter of the Bluetooth can take human voice orders which are changed over to encoded advanced information for the benefit of a satisfactory range (up to 100 meters) from the car. The recipient unravels the information before taking care of it to the microcontroller to drive DC engines through engine driver L293D for vital work [3]. An Arduino UNO is modified to peruse voice orders and react appropriately. Ultrasonic sensors interfaced with the Arduino can help in snag identification. Considering this component for the future degree may demonstrate achievement in vehicle robotization.

3. PROBLEM STATEMENT

- (a) The present automobiles are not suitable for handicapped and old age people.
- (b) This technique of our project will help them to drive their vehicle on their own.
- (c) This use of sensors will provide greater safety from sudden hits due to auto braking and slow down feature.
- (d) Prevention from hazardous and fatal situations.
- (e) Automatic braking and Bluetooth module controller will make the process handy and easy to detect and to provide judgments for the vehicle.

4. PROPOSED SYSTEM

Speech Recognition is a technology which permits the procedure of a speech input to text and is speaker independent. This permits it to be used in numerous applications differing from digital assistants to controlling machinery. This paper put forward strategies which can be used in managing a robotic vehicle through connected speech input. The speech recognizer platform are going to be an Android smartphone which communicates with the car using Bluetooth Connectivity. This method permits for systematic recognition and effortless data transfer. Additionally, the car will also have the potential to detect obstacles and notify the user to use a different command. Our proposed technique will be functional for applications such as assistive robots for people with disabilities or in industrial applications such as work robots. Initially the command is given using android app. The command is within the sort of voice using Google voice search method. The given voice input transmits to Arduino UNO via Bluetooth module HC-05. Then Ultrasonic sensor starts to figure with the knowledge provided by the Arduino UNO from android app. Then, the Ultrasonic sensor transmits sound waves and if the sound waves hits any object, it then returns back and therefore the Ultrasonic sensor receives the sound waves and detect where the obstacle within the given limit with the assistance of servo motor. After identifying the obstacle, the robot stops immediately and await the command from the user to maneuver further.

5. HARDWARE IMPLEMENTATION

5.1 Arduino UNO

The Arduino Uno is an open-source microcontroller board and developed by Arduino.cc. The board is given sets of digital and analog I/O pins which may be interfaced to varied expansion shield and other circuit's boards. The board has 14 digital

input/output pins during which six capable of PWM output and programmable with the Arduino IDE (Integrated Development Environment), via USB type B cable. This microcontroller are often powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. The motor driver board is mounted on the Arduino UNO. Then, the program is uploaded to Arduino UNO via data cable needed. Arduino UNO is basically cheap, easy to use and acquire less space so as that each one the components are often placed on the chassis of car.



Fig. 1 Arduino Uno

5.2 L293D Motor Driver

The Motor driver is a module that permits you to use Arduino to regulate the working speed and direction of the motor. The Motor driver are often powered by Arduino directly or by an external 6V~15V power supply via the

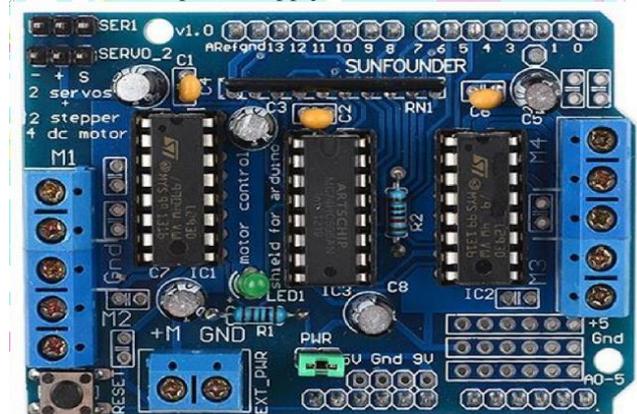


Fig. 2 Motor Driver

Terminal input. The DC motor drives in both forward and reverse direction with the assistance of L293D. Two H-bridges are located in L293D circuit. In L293D, pin 2, 7 are input pins which is found within the left side of the L293D and pin 15, 10 also are input pins which are located in the right side of L293D. It designed to drive inductive loads like relays, solenoids, DC motors and stepping motors. It allows you to drive two DC motors alongside your Arduino board, controlling the speed and direction of each one independently. You can also measure the motor current absorption of every motor, among other features.

5.3 Ultrasonic Sensor

The purpose of this part is to save the driver and vehicle from different type of hurdles. To achieve this, ultrasonic sensor is employed within the front side of the vehicle. Ultrasonic sensor which emits ultrasonic waves having a frequency over 20KHZ which is beyond the human hearing. Ultrasonic sensor has transmitter and receiver part. Distance from which the location of the obstacle is additionally detected. The piezoelectric material convert's electrical energy into sound waves (mechanical energy).

The piezoelectric material will generate Ultrasonic waves for detecting the obstacle.

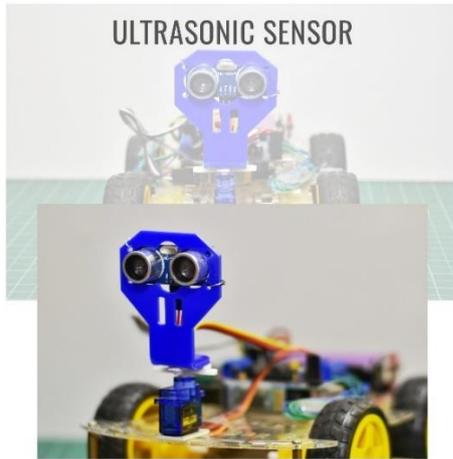


Fig. 3 Ultrasonic Sensor

5.4 Infrared sensor

An infrared sensor is an electronic instrument that's accustomed sense certain characteristics of its surroundings by either emitting or detecting infrared rays. Infrared sensors also are capable of measuring the warmth being emitted by an object and detecting motion. A proximity sensor often emits a beam of electromagnetic radiation (infrared, for instance), and appears for changes within the sector or return signal. The object being sensed is usually stated because the proximity sensor's target. Different proximity sensor targets demand different sensors.

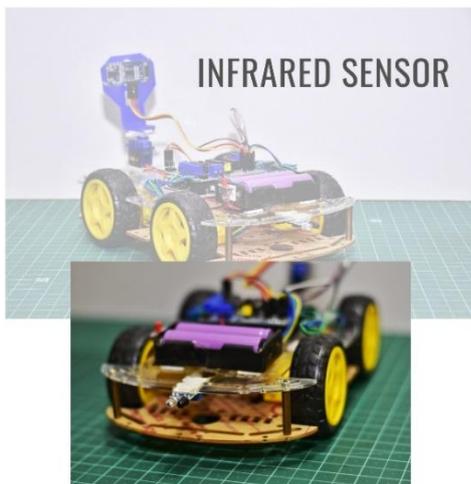


Fig. 4 Infrared Sensor

The distance is calculated using diserver method of the beam of light. The sensor consists of an IR LED and a light-weight detector or PSD (Position Sensing Device). Infrared radiation extends from the nominal red fringe of the color spectrum at 700 nanometers (nm) to 1 millimeter (mm). This range of wavelengths corresponds to a frequency range of roughly 430 THz right down to 300 GHz. Below infrared is that the microwave portion of the spectrum. Proximity sensors can have an extended functional life thanks to the absence of mechanical parts and lack of physical contact between the sensor and thus the sensed object.

5.5 Bluetooth Module

The Bluetooth technology manages the communication of the wireless part. The Bluetooth modules can transmit and receives the info wirelessly by using two devices. The Bluetooth module can receive and transmits the data from a more than two system with the help of the host controller. Here the wireless

connection between the user and therefore the robot is established using the Bluetooth module HC-05. Bluetooth module makes connection with the microcontroller using serial communication method. HC-05 Bluetooth module operates on the premise of master and slave mode because it is Employed for either transmitting or receiving the info. HC-05 Bluetooth Module is very simple to use Bluetooth SPP (Serial Port Protocol) module, created for translucent wireless serial connection setup. Its communication is via serial communication which makes a simple thanks to interface with controller or PC. It is a short-range device of around 10 meters which provides both sound and data transmission. The Bluetooth transmits and receives at a waveband of 2.4 GHz.

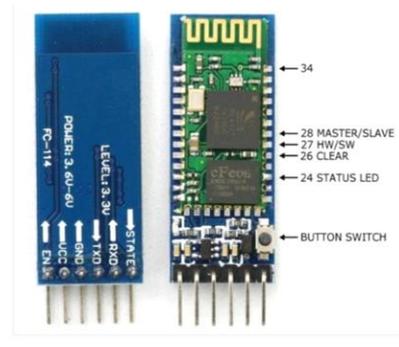


Fig. 5 Bluetooth Module

5.6 Servo motor

A servomotor is a gyrating actuator that permits for accurate control of angular or linear position, velocity and acceleration. It consists of an appropriate motor coupled to a sensor for position feedback. We use servo motor for movement of ultrasonic sensor. It allows the sensor detect obstacles in left and right also.



Fig. 6 Servo Motor

5.7 Gear motor

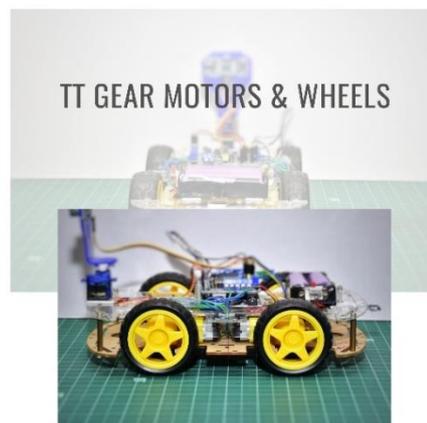


Fig. 7 Gear Motor and Wheels

The TT Micro DC geared motor with encoder. It is a motor with a 120:1 gearbox and an integrated quantization encoder that provides a resolution of 16 pulse single per round giving a maximum output of 1920 within one round. With an Arduino Uno microcontroller and motor driver, applications for this include a closed-loop PID control or PWM motor speed control. We have used 1 motor per wheel for out project.

5.8 18650 LI-ION battery

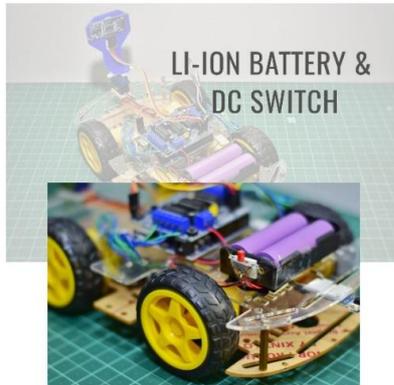


Fig. 8 Li-ion Battery

The 18650 cell has voltage of 3.7v and has between 1800mAh and 3500mAh (milliamp-hours). 18650s may have a voltage range between 2.5 volts and 4.2 volts, or a charging voltage of 4.2 volts, but the nominal voltage of a typical 18650 is 3.7 volts

5.9 Hardware Implementation of the Car



Fig. 9 Final Outcome

6. CONCLUSION

- We are able to say that Voice controlled cars can certainly dominate the longer-term marketplace for many industrial and domestic purposes associated with automating daily tasks.
- It may require several tests but the car works quiet well with very less errors in recognizing voice commands.
- Little modifications within the android application may end up during a far more clarity in voice recognition.
- For advancements during this research work we will use a long-ranged module which can lead to connectivity with the car for long distances and as a result overcome its limitation.
- Power Optimization algorithms can be used.
- Best for handicapped people that can believe this car as there's very less chance of accident. Once the car identifies an obstacle it will stop instantly by slowing down.
- This Internet of Things product gives a totally new direction to automobile.
- As an application it is often used for military purposes where the commands are often given to car with none risk of accelerating the range and that we can install small camera on the robo-car to get enemy view.
- Also, can be used for Home Security purpose with installed cameras.
- Use of AI alongside voice commands will take this research to a replacement dimension.

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