Voice Controlled Robotic Car Using Mobile Application

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***Abstract*— Human Robotic Interface (HRI) is used by or with humans and is a field of research dedicated to understanding, evaluating and designing robotic system.There are different forms of human-robot communication and these forms are greatly influenced by the closeness of humans and robots. The robot car prototype is designed using Human Robot Interaction (HRI), which is controlled by user-specific commands provided by the robot user. The designed prototype uses voice recognition using Android phones. Convert them to a collection of digitally stored words. Human voice commands are performed by a robot with its own built-in microphone. The Bluetooth transceiver module also take decrees and ahead them to the robot's Arduino, as it controls his gesture according to the orders he receives. Pause the robots "go forward", "go back", "go left", "go right" and "stop" and stop back and forth and left and right according to the voice command. This prototype is designed to overcome the problems of manual wheelchairs and provide a quality life individually for the physically handicapped.**

Keywords—Human Robot Interaction (HRI), Voice Recognition, Arduino Microcontroller

I. INTRODUCTION

According to the Paralysis population survey, every 1 in 50 Americans is paralysed or approximately 5.4 million person is paralysed. And over 4.9 lakh persons in India are suffering from paralysis between 2000 to 2017. Spontaneous muscle damage works in one or more parts of our body causing damage to the nervous system known as paralysis. According to the 2013 US Paralysis Prevalence and Health Inequality Survey, it can be caused by a variety of factors (spinal cord injury, cerebral palsy, multiple sclerosis, etc.) but the main cause is stroke[1]. In this regards voice command is a helpful option for assigning task to the machine or robot like wheelchair movement, opening or closing door, operating daily or regular task like opening tap water, switching on lights or other electric equipment's etc. But here we will focus on moving a simple car. Successful implementation of this technique will help to move the automatic wheelchair for disabled person's which is the main novelty of this work [2].

A wheelchair is wheel mobility device used by people who are having difficulty in walking due to an illness or any accident. The device operated either manually(rotating wheels by their hand) or through any automated system. We often have the ability to move here and there but there is a smallest step for the individuals with the mobility disabilities that can prevent them for accessing all parts of their life . It can enhance individuals to interact with other, earn a living and can participate in the community. But there rise many problem during the use of manual wheelchair such as the individual requires assistance to get around as a result the assistance may suffer from repetitive stain issues, especially in the shoulders [3]. This manual wheelchairs are not suitable for going long distances or in up inclines. Therefore by monitoring the discommodities, we have design a prototype of wheelchair which is controlled by voice command. The prototype that we have design is mainly based on Human Robot Interaction (HCI) [4]. It is a field that deals with the modalities of interaction between human and the robot. In this interface, the robot may be constrained by a certain set of command, or a sequence of gestures performed by an operator. The most important part to operate a robot is perception and that's the reason we are using speech recognition technique so that the device could perceive the word narrate by the speaker [5]. The speech recognition technique converts speech into digital data and voice recognition is for identifying the person who is speaking. A voice user interface makes interaction between human and the system by using speech recognition to understand spoken command. It is then received by the robotic system via bluetooth module. DC motors are mounted to turn the wheel and where as L298N-H bridge (motor driver) controls speed of wheels. Ultrasonic sensor (HR-SR04) detects obstacles on the path to avoid collision. In order to sense the surroundings object IR sensor is used in the robotic system. Each and every component is connected in an open-source microcontroller board, Arduino Mega 2560, which is based on ATmega2560 AVR microcontroller. The whole circuit is powered using 9V battery mounted on a system [7].

The main difference from the other designed robotic car is that it can be operated through mobile all which will give a precise and much accurate voice recognition with minimum error. Beside that we have implemented different obstruction abounding mechanism by implementing the proximity sensors attached with the designed device [8, 9].

This device is developed in the Biomedical Instrumentation and Signal Processing Laboratory (BISP) in Biomedical Engineering Department, North-Eastern Hill University in the stipulated one year time.

II. Technical Specification of Component

A. Hardware requirement

1) Car Chassis: The chassis is the basic structure of our car. The chassis can be just a frame, or it can include a wheel, a transition and even a front seat. The chassis is one of the most important components of a car, and there is no structure without it. This is the canvas on which the final structure of the car will be made. [10].

2) DC Motor: It is a type of electrical machine where electrical energy is converted into mechanical energy. When there is an interaction between a magnetic field and an electric field, an energy that mechanically control the motor is generated.[11].

This motor uses the magnetic field produced by the current generated in the output shaft to obtain a fixed rotor speed. The output torque and spades depend on both the electrical input and the design of the motor.[12].

3) IR Sensor: An infrared sensor (IR) is an electrical device that measures and detects infrared rays and the surrounding environment. This sensors can measure the heat of an object, and also detect its movement. It's wavelengths is longer than visible light and are invisible to the human eye[13]. It has non-linear properties and depends on the reflection properties of the surface of the object. Therefore, knowledge of the properties of the surface requires knowing the forehead. [6].

*4) HC-05 Bluetooth Module:*Bluetooth module HC-05 is a master module. Module roles can only be configured with AT COMMANDS. The Bluetooth module is an early set of chips that integrate Bluetooth functionality and can be used in wireless network transmissions. Bluetooth modules are widely used to enable Bluetooth communication.[14].

*5) Arduino Mega 2560 (Arduino board):*Arduino is the brain of a mega robot. The successor to the Arduino Mega, the best microcontroller board of the Arduino Mega 2560 ATMGA 2560 AVR microcontroller. In this project, each block connects to an Ardino board. Whenever a user sends an order from an Android smartphone via a Bluetooth module, the signal is first sent to the Arduino board, then the receiver signal is sent by the user in a specific direction [7].

The Arduino Mega 2560 is a project that requires 44 digital I / O pins, 16 analog inputs, and more I / O lines with more space, more sketch memory, and more RAM.[15].

*6) HC-SR04 Sensor(ultrasonic module):*HC-SR04 is an ultrasonic module that provides 2cm to 4cm non-contact measurement function. It works by transmitting sound waves from the transmitter that hit an object and back to the receiver. You can determine how long it will take for the sound wave to return to the sensor. The frequency of ultrasonic waves is between 20kHz and 500kHz.[16].

7) L298N H-bridge: A member of the L298NH family whose IC name is "L298". The L298N can handle up to 3 Ampere with a 35 volt DC motor which is suitable for most hobby motors. [17].

The L298N actually has two complete H-bridge circuits that can drive a pair of DC motors. This is ideal for robot projects, as most robots have two or four powered wheels. The L298N can be used to drive a single stepper motor[18].

B. Software requirements

1) Mobile Application: This is a software applications and it is designed to run on mobile devices such as phones, tablets and smart-watches. Android devices use an application called AMR Voice to convert audio into data sets and transmit it via Bluetooth.[19].

Fig. 1. Mobile application

2) Arduino IDE: The Arduino Integrated Development Environment (or Arduino Software (IDE) is a text editor, text field for texting messages and code. Toolbar with a set of common button functions and menus. It is an open source software that is primarily used to write and compile code on Arduino modules. It is the official Ardino software, and the code can be compiled so easily that even the average person with technical knowledge can enter the learning process[20].

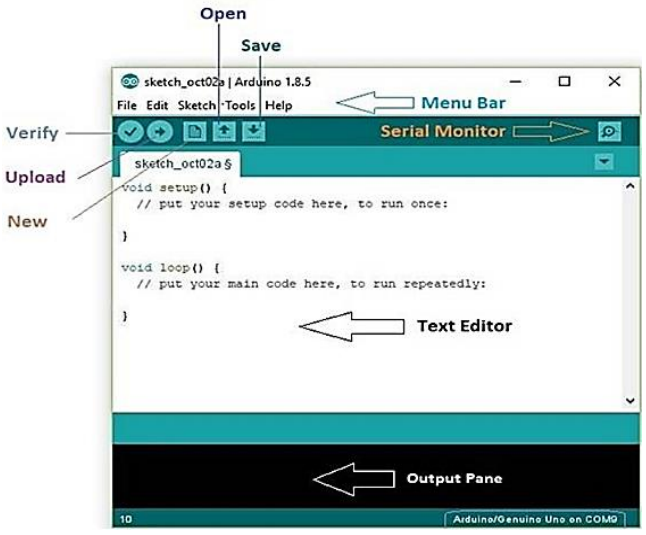

Fig. 2. Arduino IDE

III. Design

A. Block Diagram

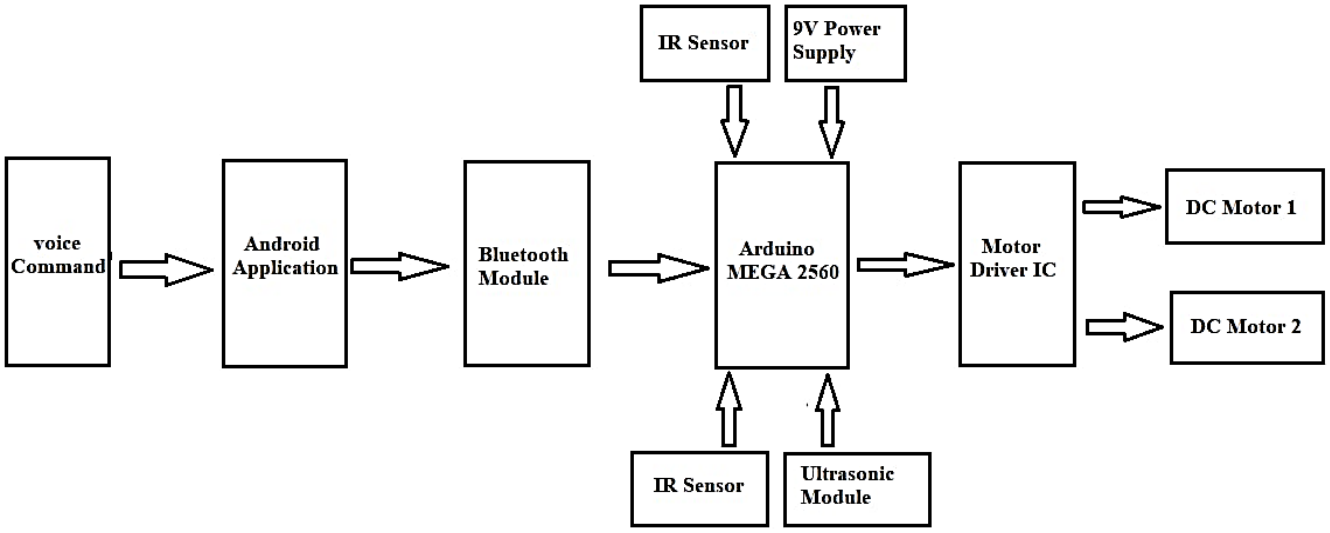

Fig. 3. Block diagram of robotic car.

The block diagram consist of Arduino MEGA-2560, L298N motor driver, sensor, ultrasound sensor, Bluetooth module, stepper motor and power supply[21]. The voice-controlled robot car is installed on a smartphone that recognizes voice commands from the user and is transferred to the Bluetooth module HC-05 of the voice-controlled robot car. [22]. The command converts text from the module and sends the string to Arduino for further processing. The Arduino microcontroller decodes the received string and performs the corresponding additional function. The signal is compared to the transmission of the motor, so it supplies and drives the motor connected to the motor. In the transmitter section, mobile applications are ordered through the microphone of the mobile phone. The mobile phone is connected to a moving vehicle via a Bluetooth module. The mobile application we use is programmed so that when the voice commands given on the mobile application through the handset, are received by the microphone and these analog voice commands are converted into digital word sequences.[23]. These stored sequences are transferred to the transceiver controller via the Bluetooth transceiver module instead of being transmitted to the robot car. The Android application transceiver uses the Bluetooth module to decode the received signal. The controller compares these digital signals to stored program commands and converts them into voice strings.[22].

B. Circuit Diagram

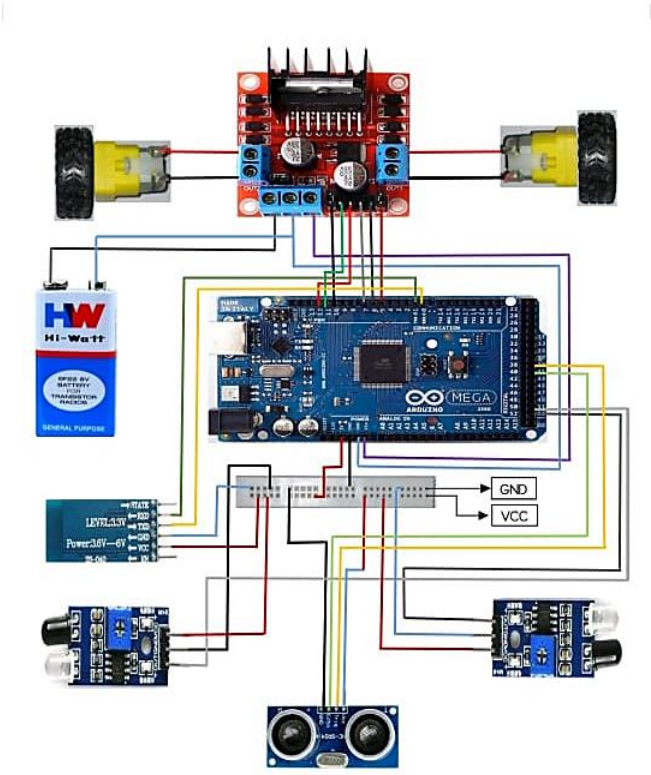

Fig. 4. Circuit Diagram.

Before explaining the circuit diagram of the project, it is important to understand how each and every hardware component used in this project, technically works. The circuit comprises of Arduino Mega board, HC-05 Bluetooth module, L298N H-bridge motor Driver, a pair of DC generated motor, HC-Sr04 Ultrasonic module, IR sensor and 9V Battery[21].A DC power supply is required to operate the robot.So the power source of the robot is rechargeable battery or DC battery. When we switch ON the power button the Arduino LED will blink. The power of Arduino is coming from the motor driver which generate the battery[15]. The DC motors are connected to controller using motor driver IC. The Vin of the Arduino is connected to the 5V DC output from the motor driver while ground pin is connected to the common ground

driver. The motor output ENA, ENB are connected to the digital port 10 and 5 of the Arduino board. The input of the motor driver; IN1, IN2, IN3, IN4 are connected to the digital port 11, 12, 7 and 6 of the Arduino board to control the motor direction. A pair of IR sensor is mounted to sense the surrounding objects as it consists of IR transmitter and IR receiver. The Vcc pin and ground pin are connected to the Vcc and common ground of the Arduino board. The output is connected to the digital I/O ports 51 and 53. The ultrasonic sensor trigger pin use an external trigger signal to bring the logical high to at least 10 µs. A sound wave blast is transmitted from the transmitter module and when it hits the surface it returns to its original state and detects the receiver signal [20]. The Vcc and ground are connected to Vcc and GND respectively which is connected by the breadboard. The trig pin and Echo pin is connected to the digital I/O port 39 and 41 of the Arduino board. A Bluetooth module is connected to Vcc, GND, Tx and RX pin of the Arduino board. This module is used to make a connection between user and robot. The breadboard is connected with Arduino board to receive 5V supply and ground connection to give supply voltage to the other components[15].

IV. Method

A. Step to Control Voice Controlled Robotic Car

- Download the "AMR_Voice" application from the Google Play Store and install it.
- Make sure the Bluetooth module is connected to the HC-05 smartphone. The default password for this pair is "1234" or "0000".
- Bluetooth of the Smartphone is automatically enabled once the application gets started by the user.
- In the Options menu, click the Connected Robots option.
- HC-05 appears on the list of device available. Click on it and the system is ready to be used by the user.
- Click the "MIC" icon to talk and give verbal instructions to the Spike robot.
- When the user says "Go Forward", the voice will be recognized and converted to text. The text is transferred to the robot via Bluetooth.
- The robot takes the string of the letter, decodes it, compares it to the instructions written in the program, and moves the robot forward.
- Voice commands “Go backward”, “Go left”, “Go right” and “Stop” are recognised and converted in the same manner and controls the movement of robot in backward, left, right direction and stops the robot in respective manner.

B. Flow Chart

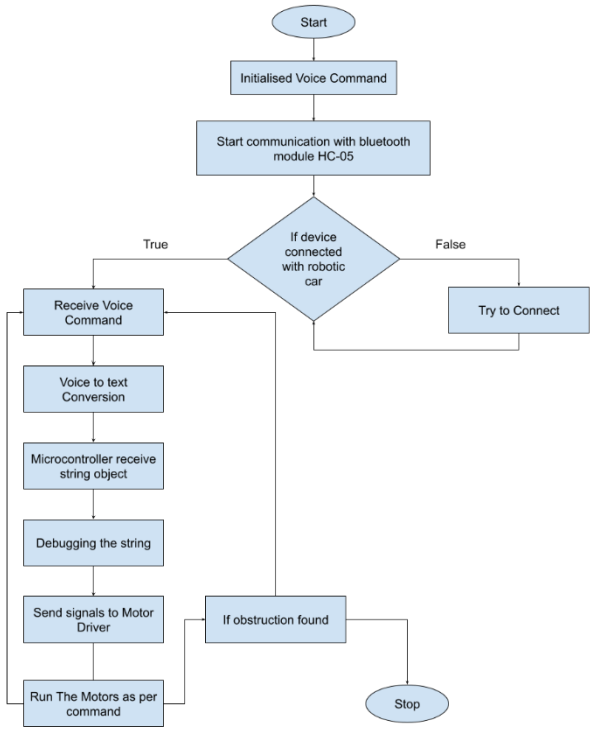

Fig. 5. Flow Chart of the Designed System

V. Results and Discussion

In this robotic car and each component is mounted and connected with Arduino board. A program is constructed for all the individual device and the program is executed program is then merged and uploaded in Arduino board.

- Mobile application used speech recognition technique to identify the speakers voice.

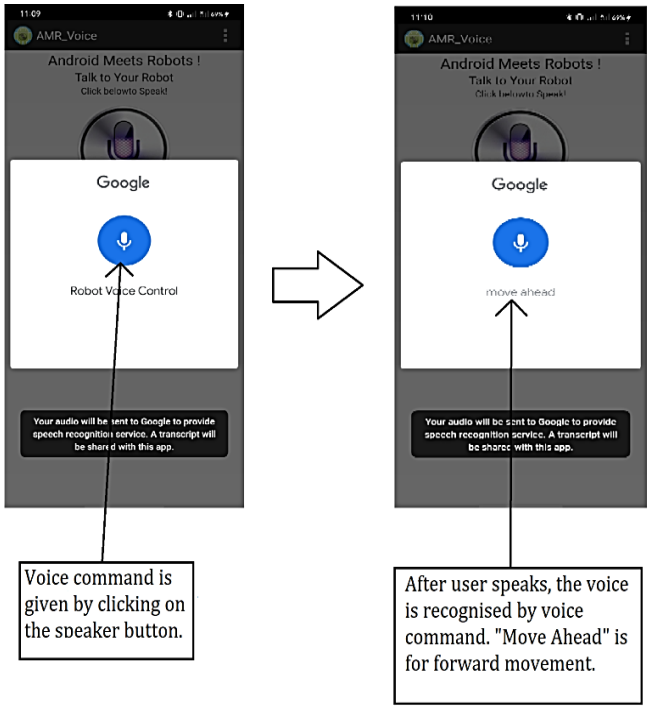

Fig. 6. Mobile application used in the prototype for voice recognition

- A scratch is converted to Arduino-understandable code and during compilation the program is uploaded to Arduino IDE and after the code is compiled it is uploaded to the board's memory.
- The android application which is used in the device is connect with the bluetooth module via bluetooth.
- After uploading codes and connecting Bluetooth with the device, the car is controlled by voice command avoiding obstacles facing it.

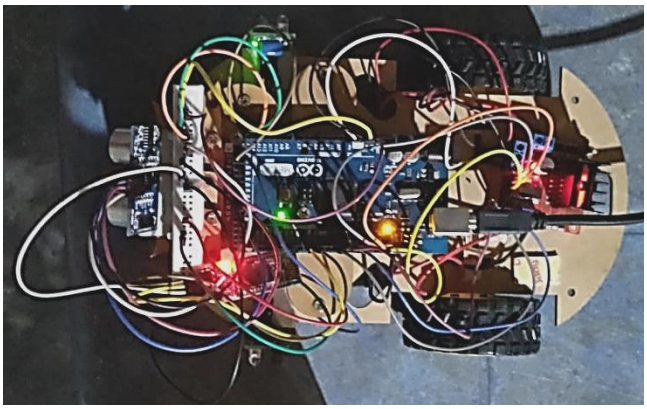

Fig. 7. Picture of functioning robotic car

This design can be further developed by implementing IoT by which the caregiver can view different health parameters over internet and manage the patients as per requirements [9].

VI. Conclusion

Various technologies are now available that can control vehicles in support of self-driving car systems such as GPS and automatic cruise control.We have used the voice command for the movement of robotic car. In this prototype, we design such a way that this robotic car can be moved anywhere by avoiding obstacles, as an ultrasonic sensor is mounted. One can infer from the study that a robotic car can be controlled by voice command using Bluetooth module. The personal assistant robot is placed on a microcontroller based platform. Although the voice command is given from the users handset ,but the voice commands are transmits and receives through Bluetooth technology. The system has very low power consumption. As Bluetooth technology is used, it allows only short range of communication between two device, so we can later on use GPS for better communication.

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