

# ARDUINO BASED VOICE CONTROLLED WHEELCHAIR FOR PHYSICALLY CHALLENGED PERSONS

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**Abstract—** As the time being, Technology is growing at a faster rate. Improvement in Technology makes the lives simple. everyone wants to live individually using the technology. However, this is deceptive for physically challenged persons. Majority of people with disabilities having trouble moving various body parts. The only solution is to depend on their family and friends to complete their day to day works. Even for moving from one place to other place the persons must use a wheelchair. For moving the wheelchair, the person should have enough strength in hands or requires other person to assist the wheelchair. The persons having disability are less communicating with the outside world which make them weak and reluctant. The proposed machine is a wheelchair-manipulated gadget to help disabled human beings to turn out to be unbiased. The device uses a voice recognition unit which will take human voice as command and control the wheelchair movement based on the command. The device integrates Arduino, HC-05 Bluetooth module, speech-to-text voice recognition android utility, and motor driver through which the customers can perform the wheelchair with the aid of absolutely speaking to the wheelchair microphone. The wheelchair is designed at low cost in such a way that needy users will benefit from the machine.

**Key Words-** voice recognition, HC-05 Bluetooth module, physically challenged persons.

## 1. INTRODUCTION

Speech recognition is a popular topic in now-a-days lifestyle. The packages of Speech recognition may be discovered everywhere, which makes our lifestyles greater effective. An example, the software in the cellular cellphone, as opposed to typing the name of the person that humans need to call, human beings can simply without delay speak the name of the person to the mobile smartphone, and the cellular cellphone will robotically call that man or woman. Speech recognition is a generation that humans can manage the gadget with their speech. In

preference to typing at the keyboard or working the buttons for the device, the usage of speech to govern gadgets is greater convenient. Robotic wheelchairs are stronger than manual wheelchairs via introducing locomotion controls. These gadgets can ease the lives of many disabled human beings, especially people with severe impairments by increasing their variety of mobility.

Robotic wheelchairs can even be helpful for aged people who are susceptible and unable to move their body parts. The advancements in the wheelchair generation like joystick control, touch screen management, and gesture control are futile for the persons having disability in moving arms.

The assignment voice-controlled wheelchair goals to counter the above troubles. The wheelchair can be managed using voice instructions like “FORWARD”, “BACK”, “LEFT”, “RIGHT”, “STOP”, “UP” and “DOWN”. The man or woman simply needs to say the path and the wheelchair actions in the favored path. In hardware development, we are using HC-05 Bluetooth module, Arduino, motors, and AMR voice app (android software), which correlates commands to do speech processing and give the result to Arduino that's related to Bluetooth similarly programmed with respective locomotion instructions.

### 1.1 SYSTEM DESCRIPTION

The aim of the project is to design a wheelchair that will circulate according to the consumer's voice instructions. The system will be helpful for the disabled persons to lead their lives happily and make them individualistic because the customer do not require others help to progress the wheelchair as the wheelchair will circulate automatically with electricity. In the working process firstly, the command given by the disabled person who is using the wheelchair is identified by using voice recognition module i.e., HC05.

The system will get the voice command from the user using a mobile application called AMR voice which is connected to Bluetooth module HC05 of the wheelchair wirelessly. As the disabled person is unable to move the hands, to give the command the person can use a microphone. The microphone can be placed at the vicinity of the persons mouth such that it will take the voice commands clearly without any disturbances. The command is converted into text by the mobile application and is fed to HC05 Bluetooth module using air as a medium. As Arduino is connected to voice recognition module, the module will send the appropriate signal to Arduino. The Arduino ATmega328p then transform the signal into binary code. As Arduino is programmable it traces the code for that particular command. When a command gets matched with the command given in the code it will send the signal to L298N driver board to make the motor terminals as low or high as to control the motors rotation that can be clockwise or anticlockwise based on the instructions given by the person.

For L298N driver board two DC motors can be connected. These motors are then connected to wheels of the wheelchair and helps the wheelchair to move in desired direction. To make the motor to rotate in clockwise direction, the positive terminal of the motor should be high and the negative terminal should be low. To make the motor to rotate in anti-clockwise direction the positive terminal should be low and negative terminal should be high. Based on the instruction given by the person like forward, back, left, right and stop the motors can rotate in clockwise or anti-clockwise direction.

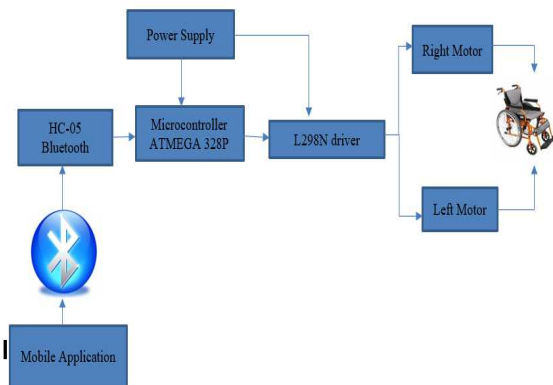


Figure 1: Block diagram of voice-controlled wheelchair

## 1.2 LITERATURE REVIEW

A quadriplegia occurs when sensory and motor receptors in the spinal cord are destroyed, thereby resulting in limb paralysis. The cost of caring for a quadriplegic patient over their lifetime is estimated to be more than a million dollars, making it difficult to pay for it. An automated wheelchair is one of the devices available to support and help a quadriplegic [1].

A battery-powered wheelchair with servo engines is proposed in this framework. The existing joystick-based framework should also be added to the current framework [2].

A digital wheelchair controller is developed in this system. The system depicts an information flow between the driving commands and wheel speed. For the controller, two speed processing data-paths and a command interpreter are proposed as functionally independent blocks. Decoding commands, estimating speed, and serving speed are the steps of the control process [3].

Speech-enabled services can be implemented directly using the AMR codec. The ARM codec operates at the following bit rates: 4.75, 5.15, 5.9, 6.7, 7.4, 7.95, 10.2, and 12.2 kbit/sec [4].

With the use of a Digital Signal Processor (DSP), the system is implemented for parallelized persons by using voice activated wheelchairs. The DSP Starter Kit (DSK) from Texas Instruments TMS320C6711 is connected to the wheelchair to process voice signals. Energy, zero crossing and standard deviation of the spoken word are calculated using DSK [5].

In this proposed motor driver, the usage of bulk of MOSFETs is minimized, which increases the dependability of the machine. It is closely packed and minimally compounded so that the usage of MOSFET in the system can be abolished [6].

Wireless Sensor Network (WSN) used in coal mines provide reliable and flexible communication. Current monitoring system in underground mines are cable based. The system is inconvenient to dispose in exploiting areas. To overcome the problem people proposed Wireless Sensor Networks [7].

A multi-mode embedded control system is implemented in a wheelchair. The system uses a 16-bit single chip and is designed to make the wheelchair more affordable. The multi-mode feature is intended to improve the safety of the wheelchair and enhance the interaction between the user and the machine [8].

To improve the lives of disabled people by using automated tools, many scientists and organizations have designed numerous intelligent products. One such product is the Voice Controlled Wheelchair. In the system, Raspberry Pi is used to control the device, infrared and ultrasonic sensors are used for robust obstacle detection, and a USB microphone is used for voice input [9].

It implements a robotic wheelchair whose controls are voice-activated and computerized in addition to improved trajectory planning and straight-lined movement maintenance; wheel feedback sensors are added to a standard electric wheelchair. A handicapped person can communicate more effectively through voice recognition and voice synthesis, plus vision capabilities, and other sensors are integrated [10].

The wheelchair is controlled by an Arduino microcontroller and voice recognition. An incorrect speech command does not cause the wheelchair to respond. The Arduino controls the wheelchair direction based on voice and gesture commands [11].

This system develops an Arduino-based voice-controlled automated wheelchair. By using a voice recognition system, the wheelchair can be controlled by voice command by a physically disabled person who has issues with hand movement due to aging or paralysis [12].

Using speech processing technology and a local map navigation system, a voice control module for a motorized wheelchair is built. The wheelchair comes with a microphone, and if the user uses it to say their desired location, the wheelchair will move in that direction immediately [13].

The overall layout of a wi-fi home automation system (WHAS) is constructed and applied. The automation centers upon identification of voice instructions uses low-power RF ZigBee wi-fi communicate modules that are fantastically inexpensive. The home automation gadget is planned to manipulate all lighting fixtures and electric devices in domestic and residential areas with the use of voice instructions [14].

### 1.3 MOTIVATION

The wide variety of people who are disabled due to any disability or illness or any coincidence is continuously growing. The Census 2011 revealed that, in India, 20% of disabled individuals are having a disability in movement, 19% are with incapacity in seeing, 19 % are with disability listening and 8% has more than one disability.

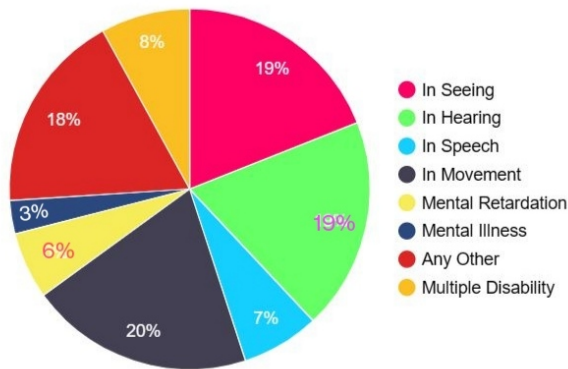


Figure 2: Pie chart about types of disability

As the majority are incapable of shifting their arms and legs, the only answer is to use a wheelchair to transport. Unbiased mobility is vital for the improvement of personal, logical and social talent for bodily impaired humans. Electric powered wheelchairs are evolved to assist impaired humans to stay independently but, they're very steeply priced and a maximum of them are not beneficial for folks who can't circulate their hands. Voice-controlled wheelchair facilitates disabled people and old folks and is value-effective.

### 1.4 SYSTEM IMPLEMENTATION

Android is the software program centre for cell gadgets. The voice recognition android application takes the human voice as a command and will send the signal to the Bluetooth HC-05 of the wheelchair as the android application is connected to HC05 wirelessly. Now Arduino gets the signal from Bluetooth as Bluetooth RX and TX are hooked up to Arduino TX and RX as shown in figure for serial communication . Arduino will check the command with the commands present in the code.

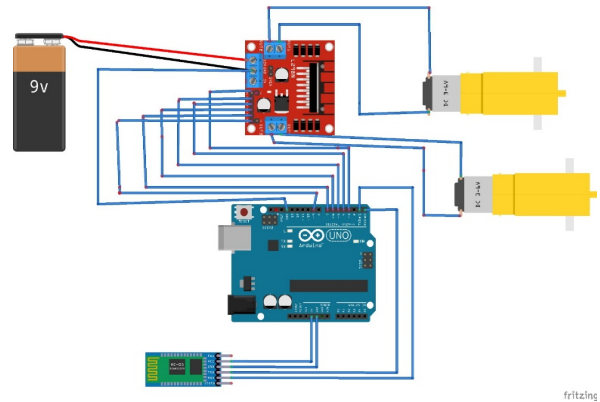


Figure 3: Connection diagram of the system

If the command is matched then the signal is forwarded to the driver L298N as inputs IN1, IN2, IN3, IN4, ENA, and ENB of LN298N driver module are linked to Arduino pins 3,4,5,6,7,9, and the IN1, IN2, IN3, IN4 pins of LN298N will become high or low as per the code which will make the DC motors to rotate in clockwise or anticlockwise direction as per the instruction given. Driver module can able drive the motors having a rating of 5- 35V, with a driving current of 2A. The driver module will obtain power from a battery of 9v.

TABLE 1: Look up table for voice commands

Voice command	Left wheel direction	Right wheel direction	Motion of wheelchair
Forward	Forward	Forward	Move forward
Back	Reverse	Reverse	Move backward
Left	Forward	Stop	Move right
Right	Stop	Forward	Move left
Stop	Stop	Stop	stop
up	Forward	Forward	Move forward with half speed
down	Reverse	reverse	Move backward with half speed

To obtain the desired velocity, the disabled person can additionally use a slow or speedy pace. Deliberate velocity is vital as the user needs to transport in small distances. It is designed such that by way of commanding an application that is programmed with distinctive commands for unique guidelines.

## 1.5 LIST OF COMPONENTS

### A. ARDUINO UNO

Arduino uno is universally used microcontroller board through which wide variety of projects can be designed. It uses an IC called Atmega328p which is demountable. It has 14 digital pins in which 6 pins are PWM pins and having 6 analog pins. It is having a 16 MHz quartz crystal oscillator, a USB port for external power supply with an input voltage of 5V-9V. By using the USB port, we can also connect to PC to supply the board. It is also having a power jack, an ICSP header, and a reset button. The output voltage from Arduino is 3.3V or 5V. To indicate the power, the board itself is having an LED. It has 32KB of flash reminiscence for storing the code. The working voltage is 5V.

#### Arduino IDE Software

Arduino Integrated Development Environment is used to write code, compile it and upload the code into Arduino board. It is very important to connect the board to PC while uploading the code to Arduino. It is also important to remove TX and RX pins of Arduino while uploading the code.

### B. BLUETOOTH MODULE HC-05:

For interacting with devices HC05 Bluetooth module uses serial communication. For interacting with microcontroller, it uses serial port USART. It is used in many applications like wireless headset controllers, wireless mouse, wireless keyboard and many more applications. The range of HC05 is less than 100 meters which depends on climatic conditions. It uses frequency-hopping spread spectrum radio technology to send data over air. The module is having a frequency of 2.4GHz ISM band, PIO control and comes with an integrated antenna and edge connector. It can be used in master or slave configuration. It is having an onboard regulator.

HC-05 Bluetooth has 6 pins:

- 1.Key/EN: The module will work in command mode if Key/EN pin is high otherwise it will be in data mode.
- 2.VCC: This pin is used in order to supply the module. HC05 module requires 3.3V or 5V power supply.
- 3.GND: It indicates the ground of the module.
- 4.TXD: This pin is used to transmit the data serially.
- 5.RXD: This pin is used for receiving the data serially.
6. State: It describes the state of the module whether the module is connected properly or not.

There is an onboard LED on the module itself which blinks at faster rate when it is not connected to any device. It blinks slowly when it is properly connected.

### C. DC MOTOR

The biggest advantage of dual shaft battery operated motor is it gives good torque and rpm at lower operating voltages. It is the alternative solution to the metal gear DC motor. Its operating voltage is 3-12V. The dual shaft of it is used to run two applications on either side of the motor. A small shaft with matching wheels gives an optimized design to the application. It has mounted holes on the body and its weight is very less which makes it suitable for placing it on the circuit itself.

It has the capability to absorb shock and vibration because of elastic compliance. The motor is of low cost and is small in size and can be easily installed.

### D. L298N DRIVER MODULE

The L298N chip contains two typical H-islands that can drive a pair of DC motors. This means that it has a maximum combined driving capacity of two motors, which makes it perfect for building a two-wheeled robotic platform.

It works well with the majority of our DC motors thanks to its force range of 5V to 35V and ability to handle 2A of continuous current per channel.

### E. MOBILE APPLICATION (AMR):

AMR is a mobile application that will take human voice as input and will do speech to text conversion. This application is used to control wheelchair by using voice commands. It is an application that will add voice recognition to the Arduino using a Bluetooth link.

AMR voice app in a voice controlled wheelchair would be a software application that allows a user to control the movement of the wheelchair using voice commands that are recorded and stored in the AMR format. The app would be able to process the user's voice commands, convert them into commands for the wheelchair's motor controller, and then send those commands to the controller. This would allow the user to move the wheelchair forward, backward, turn, and perform other actions, all by speaking simple commands. The implementation of such an app would require integration of the voice recognition and voice compression technology, as well as the wheelchair motor controller.

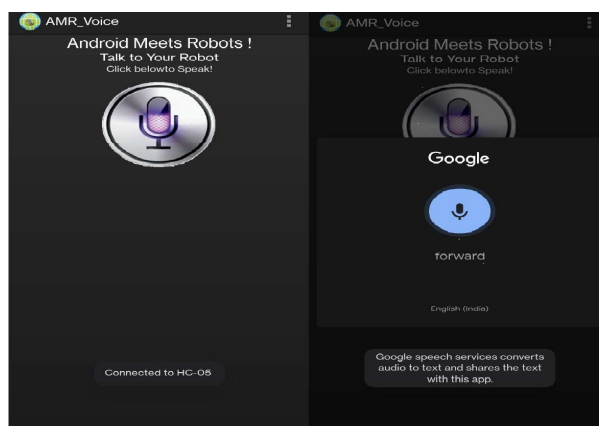


Figure 4: AMR mobile application

### F. BATTERY

The most popular and portable 9V battery is the Hi-Watt 9V Battery. For many electronic equipment's, it is a high-capacity and affordable alternative to rechargeable batteries. It is based on Zinc-Carbon Chemistry and may be quickly changed out if drained, exactly like regular AA and AAA batteries. LEDs, toys, flashlights, torches, multi-meters, wall clocks, and other 9V-compatible devices can all be powered by the battery. It is often connected to a breadboard using a battery snap connector.



## 1.6 RESULT

The final prototype model of voice-controlled wheelchair was trailed with all the commands given in the Arduino code. When a command is given using the android application the wheelchair is moving in that particular direction. For example, command like forward is given as input to the wheelchair the android application is properly recognizing the command and the wheelchair is moving forward. But it is not properly recognizing some commands. The commands like “stop” is recognized as “top” and the command “up” is not recognized properly. After the person is giving the commands frequently, the commands are properly recognized, and the wheelchair is moving in the desired direction.

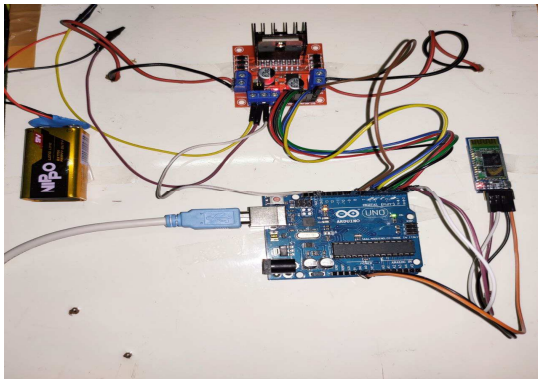


Figure 5: Prototype model of voice controlled wheelchair

Afterwards, the wheelchair is trailed by placing it in a street where some disturbance is present. The wheelchair is properly responding to all the commands given by the person using a microphone even some disturbance is present. When the wheelchair is placed in a crowded street where more commotion is present, the wheelchair is not taking the commands properly and also recognizing the words which are spoken by others. This can be eliminated and can be further developed using voice cancelling applications to reduce the background noise such that the wheelchair will only respond to the person who is using it.

## 1.7 CONCLUSION AND FUTURE WORK

Voice-controlled wheelchair is a boon to the physically challenged. The wheelchair is making the disabled persons to live individually without turning on others for fulfilling their works. The cost of the wheelchair is very less even the common people can afford the wheelchair. The wheelchair can be further advanced by finding an alternative way to charge the battery of the wheelchair using renewable energy resources like placing a solar panel to charge the battery. We can also do advancement in the wheelchair by charging the battery by using the motion of the wheelchair. We can even install ultrasonic and other feedback to avoid collision. The delay in the response can reduce by introducing better sensors. High speed wheelchair can be designed by fitting a gearbox in the wheelchair.

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