# Design and Development of Voice and Gesture Controlled Smart Wheelchair Using DC Motors for Specially Abled Persons


Session 2019-2023

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# Undertaking

It is declared that the work entitled **"Design and Development of Voice Controlled and Gesture Control Smart Wheelchair Using DC Motors for Specially Abled Persons"** presented in this report is an original piece of our own work, except where otherwise acknowledged in text and references. This work has not been submitted in any form for another degree or diploma at any university or other institution for tertiary education and shall not be submitted by me in future for obtaining any degree from this or any other University or Institution.

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# Abstract

Physically challenged persons those who are suffering from different physical disabilities face many challenging problems in their day to day life for commutating from one place to another and even sometimes they need other person to change their place. A sector of physically challenged people finds it very difficult to use traditional wheelchairs. The presented work is based on a design that aids the voice activation system for physically disabled people by incorporating manual operation. Arduino microcontroller and voice recognition have been used to support the movement of the wheelchair. The wheelchair does not respond to an incorrect speech command. Depending on the direction given through voice and gesture wheelchair will be able to move in four different directions i.e forward, left, right. The Arduino controls the wheelchair directions The prototype is designed in such a way that it can be used independently and efficiently with less effort only by giving voice command or by moving hand. Developed wheelchair with mentioned attributes saves time, reduces cost and energy of the users.

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# List of Acronyms

RF: Radio Frequency

DC: Direct Current

MPU: Memory Protection Unit

HMI: Human Machine Interface

HC: High Com

PID: Proportional Integral Derivative

PIC: Peripheral Interface Controller

PMDC: Permanent Magnet Direct Current

GPS: Global Positioning System

GSM: Global System For Mobile Communication

DIP: Digital Image Processing

RX: Receiver

TX: Transmitter

LED: Light Emitting Diode

IDE: Integrated Development Environment

PCB: Printed Circuit Board

AC: Alternating Current

ANFIS: Adaptive Network Based Fuzzy Interface System

USART: Universal Synchronous And Asynchronous Receiver And Transmitter

# Chapter # 1

# Introduction

## 1. Introduction

There are various types of disabilities including hearing loss, vision loss, physical impairment, speech impairment, and mental incapacity. These persons with disabilities deal with a variety of problems on a daily basis. Since they are unable to move like other individuals, people view them as being heavy. 15% of the global population is hampered by physical failure, according to those obstacles. Many years ago, individuals began to think about wheelchairs as a way to simplify their lives. Nevertheless, as everything is changing in a controlled manner, the evolution of wheelchairs is also changing. People used a self-moving wheelchair right away. The electric wheelchair had already been invented by then, in 1890, but there have since been several problems with them alterations to increase adaptability and comfort for vulnerable groups of people. Our main goal is to provide those who are physically unable with the chance to develop. This is a sobering reality for them, and occasionally they must deal with this calumnious situation in their daily lives. Aside from the 15% of people who are debilitated, 3% of people are disabled in some way. People with disabilities in their hands as well as their spinal cord cannot use standard wheelchairs. In this way, the voice control system will assist them and eliminate any problems they may have with wheelchair control. Between 10% and 16% of the country's population in Bangladesh is thought to be disabled. 2011 is the evaluation year that there are more than millions of people with disabilities in Asia, including about 101,585 in Bangladesh, who usually go without the benefits of social improvement From an Asian perspective, it will also make various disabilities possible for people and work to reduce costs. Two basic types of wheelchairs are available for the disabled; one is operated physically using our bodies, and the other is operated in a similar manner using an engine. However, when using these wheelchairs, several people groups have difficulties. The risk of client weakness and upper-extremity injury is increased when manual wheelchairs are considered because of their severe mechanical decline. Due to their disability, people frequently face a variety of problems that they do not need to deal with [1].

## 1.1 Rights to Wheelchair

The UN Standard Rules (1994) Rule 4; the CRPD (2006) Articles 20 (Personal Mobility) and 26 (Habilitation & Rehabilitation) call on Member States to promote the creation, manufacturing, distribution, and maintenance of assistive devices and equipment as well as the spread of information about them. It should be highlighted that an environment that is both accessible and barrier-free is crucial for getting the most out of a wheelchair.

## 1.2 Benefits of Wheelchairs

Providing suitable wheelchairs not only improves mobility but also starts the process of opening up a world of social, professional, and educational opportunities. In addition to improving mobility, the right wheelchair helps users maintain their physical health and quality of life by preventing common issues including pressure sores, the progression of deformities, and deteriorating breathing and digestion.

## 1.3 Features of a Wheelchair

A wheelchair is a type of chair which facilitates flexibility. People with incapacities that limit their capacity to walk use it. Typical components include a cushion, footrests, good decelerating system and seat supported by four large wheels attached to the back of the seat and in front of the seat near the feet. Smaller extra elements are frequently present to help ascend curbs or avoid tumbling. User controls the movement of wheelchair by pushing on the push rings or hand rim, which are spherical bars on the outside of the wheels. 400 million of the 650 million estimated individuals with disabilities worldwide—or more than 40%—live in the Asia-Pacific area of them are impoverished. There are no statistics on the no of people with impairments, particularly those who need wheelchairs or other mobility aids. There is a tendency to under report disability and impairment rates since many of them are challenging to quantify in statistics without a strong support network [2].

## 1.4 Types of Wheelchairs Based on Variations in the Basic Design

Wheelchairs come in a wide variety of designs and levels of customization to meet different demands.

### 1.4.1 Manual Wheelchairs

The user propels manual wheelchairs primarily themselves. The basic model can be upgraded with controls, front caster frameworks, foot/leg rests and adaptable backrests. The seat's dimensions (width and depth), height from the floor, and with respect to the horizontal plane can all be changed. A wheelchair that has been specifically designed for a user's needs is an option. Chairs that can be moved by an attendant typically have smaller, rimless back wheels since they are intended to be moved by an attendant using the handles. These wheel chairs are commonly used as "transfer chairs" to transport a person who is limited in their movement when a better option or

### 1.4.2 Rigid Frame Wheelchair

This type of wheelchair is often a non-folding variety with a base of sustenance on which the person takes a seat when the user's regular wheel chair is not accessible.

### 1.4.3 Folding Frame Wheelchair

This wheelchair is one whose mount is folding sideways by use of a "X" machine in the mount. In some representations, the back of the chair can be folded down, and the wheels feature a quick proclamation mechanism to permit convenient conveyance and storage. The wheelchair folds when two locking levers on the chair are released, and this mechanism is lockable

### 1.4.4 Electric Wheelchair

An electric motor, as opposed to manual power, propels a motorized wheelchair, power chair, electric wheelchair, or electric-powered wheelchair [3]. For people unable to push a manual wheelchair or somebody would need to use a wheelchair over terrain that would be exhausting in a manual wheelchair or for long distances. People with heart-related and fatigue-related problems may also utilize them.

## 1.5 Need of Electric Wheelchairs

With the use of an electric wheelchair, users can experience a level of independence that was previously impossible. By offering the most extreme comfort to people who are unable to stand or struggle to stand

### 1.5.1 Increased Independence

Electric and manual wheelchairs both allow the user to get around and undertake daily activities without assistance. An electric wheelchair, in particular, provides

increased independence due to its ease-of-use and the ability to travel without experiencing fatigue. However, even a manual wheelchair provides additional flexibility for the user and their career. For someone with limited mobility who may not be able to walk unaided, a wheelchair can reduce the risk and fear of falling in the home or outdoors allowing you to move around with confidence.

### 1.5.2 Mobility

Wheelchairs are perfect for use around the house because they are made to navigate and fit into compact areas. Additionally, wheelchairs that are more durable are made to be used outside and on challenging surfaces like slopes and tarmac. A wheelchair can be used in addition to other transportation options or mobility aids. For instance, transit wheelchairs are portable and perfect for vacations and travel. Similarly, the majority of public transportation options allow for the use of both manual and motorized wheelchairs.

### 1.5.3 Socialization

The difficulty a loved one may have participating in social activities is of greatest concern when they have restricted or limited mobility. Maintaining a healthy social life is crucial since we know that socialization is essential for both emotional and physical health [4]. A wheelchair and other mobility aids can enable the user to carry on with their favorite activities, such as going for a stroll around the neighborhood park, shopping at the nearby stores, or visiting a gallery. With a wheelchair, the user can lead a more active lifestyle, which might improve their attitude on life.

## 1.6 General Idea

The concept behind this project's design is on the creation of five voice and gesture commands that can be utilized to control the wheelchair. The goal of this project is to create an accurate, intelligent system that can recognize when words are spoken in English and respond to voice commands with the greatest performance possible.
The following commands will be used:

- Forward
- Backward
- Stop
- Left
- Right.

There are two primary components to this project:

We will utilize the Arduino software package to build the software and components needed to perform the real voice and gesture detection.

### 1.6.1 Voice Controlled Mode

We have vocal control over the wheelchair. Forward, Stop, Left, Right, and Back are the five vocal commands that can be recognized by the speech recognition software operating on a Module as being issued by a specific user. Following speech processing, the mobile platform receives the required motion commands over an RF link. Additionally, it offers a wide range of other facilities for using the wheelchair. The micro controller takes input from the RF receiver, checks its database, and executes operations like move forward, which causes the motors to go forward.

### 1.6.2 Gesture Controlled Mode

Instead of using the old buttons, we can control our wheelchairs with hand gestures. You simply need to carry a little transmitting gadget with an acceleration meter in your palm. This will give the Wheelchair the proper instructions so that it can carry out our requests. The transmitting device includes an Arduino Nano, an mpu6050 and RF transmitter module. The encoded data is received by a slave RF module at the receiving end. Our relays will subsequently be operated in accordance with the instructions after this data has been evaluated by a micro controller.

## 1.7 Problem Statement

The number of aged and disabled individuals is rising, and they increasingly rely on others' assistance for basic daily tasks. For those with partial disabilities, designing a smart and simple-to-use wheelchair is necessary since enhancing quality of life has become a social obligation.

## 1.8 Statement of Projects

Design and implementation of a smart wheelchair with voice and gesture controls. It has been determined via numerous research and surveys conducted all around the world that having access to a means of independent, unrestricted movement benefits both children and adults significantly. Even though many disabled persons are content using standard manual or motorized wheelchairs, some disabled people find it difficult or impossible to use wheelchairs on their own. To make wheelchairs usable for this demographic, many researchers have used a variety of technologies. Designing and creating a smart wheelchair that uses head gestures and voice recognition is the suggested effort control mechanism. Users may operate it

effectively and effortlessly with little effort, enabling autonomous use.

## 1.9 Aims & Objectives

Following are the objectives of our project:

- To create a voice-activated system design.
- To create a device that can be operated by hand gestures.
- To increase the user's independence.

## 1.10 Methodology

There are two specific features for various types of impaired persons who can operate the wheelchair with speech recognition and gesture control. The wheelchair may also promptly stop travelling in case of an emergency or if there is an obstruction in its path. Additionally, each feature's methodology is broken down into its component elements in detail.

- It will first determine whether hand gestures are enabled or disabled.
- If the answer is yes, the accelerometer will generate a numerical value in accordance with hand movement and communicate it to the Arduino Nano.
- A command will be created by the Arduino Nano and sent to the RF transmitter module.
- When data is received, the RF transmitter will transmit it to the RF receiver module, and finally to an Arduino Uno.
- The Arduino Uno will transmit a signal to the drivers of vehicles, and the drivers will then turn the wheel.
- It will wait for a verbal instruction if a hand motion is not detected.
- Voice commands are transmitted via an Android app, picked up by a Bluetooth module, and then relayed to an Arduino Uno, which controls relays [5].

## 1.11 Block Diagram

Block diagram of hand module circuit has been shown in figure given below.

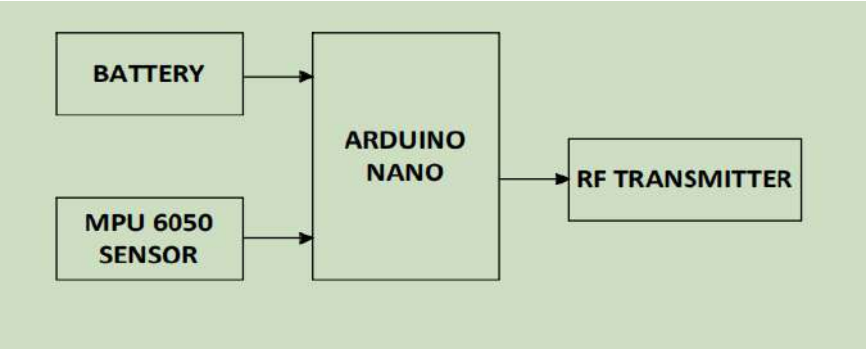


**Fig 1.1 Transmitter Module**

Through the fig, we can see that a value will be generated by mpu6050 when hand will move in a specific direction that value will be transferred to arduino nano and arduino nano will generate a commandacoording to the value received and that command will be transferred to rf transmitter module which will send that command to rf reciever module connected to main circuit.

Block diagram of main circuit has been shown in fig 1.2 given below

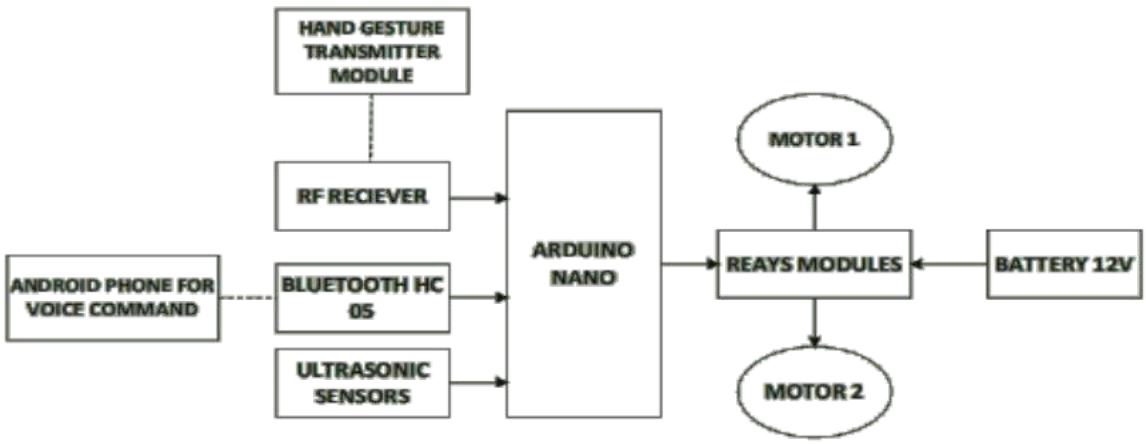


**Fig 1.2 Receiver Module**

Through the fig, we can see that at very beginning it will check if hand gesture is on or not. If yes, then accelerometer will create a numerical value according to movement of hand and send it to Arduino Nano. Arduino Nano will create a

command and transfer it to RF transmitter, it will send the received data to RF receiver and then to Arduino Uno. Arduino Uno will send signal to relays and relays will move the wheel. If hand gesture is not on then it will wait for a voice command. Voice command is transferred through an android app and received by Bluetooth module and signal will be sent to Arduino Uno and it will control motor drivers.

# Chapter # 2

# Literature Review

## 2.0 Literature Review

The literature review will be discussed in detail in this chapter. In this class, we'll become familiar with previously published articles and discover how they might aid us with our senior project.

## 2.1 Relevant Work

In 2020, AKM Bahalul Haque proposed a voice and gesture Controlled Wheel Chair with Obstacle Detection power by solar. The majority of the times, people with disabilities are ignored. To continue, they now require human assistance 24 hours a day. To travel from one location to another as needed, they require a wheelchair. In contrast to another ongoing human interaction, it would be considerably simpler if the wheelchair they need for their job was automated and under their direct control. In this study, a design that considers these factors were suggested. Voice commands and hand gestures operated the wheelchair. Solar power was utilized in the system to increase its energy efficiency. Accordingly, the battery successfully rejuvenated while moving across the entire area. Additionally, suitable for obstacle recognition is this smart wheelchair [6].

In 2017, S.H.Shete cooperated on design of Solar Powered Touch Screen Wheel chair .Our daily lives depend heavily on the sun. This essay examined how solar energy can be utilized to power a wheelchair, reducing the effort required from the disabled individual. For people with physical disabilities, a wheelchair is a basic necessity. There must be an outside person or somebody who is willing to exert significant effort in order to maneuver the wheelchair. Their study focused on using an Android mobile application on a smart Android phone to control a wheelchair system. It is advised to use the wheelchair control system in conjunction with an Android application on a mobile device. This project makes use of a microcontroller circuit, sensors Arduino kit and DC motors to make the wheelchair move and identify obstacles in its path [7].

Neela Madheswari worked on solar powered wheel chair for physically challenged

persons with Voice Controller in 2017. A smart system controlled by any smart phone for automatic motion made possible by this paper and can be economically assembled into any existing wheelchair. The primary idea at play is a smart phone with an Android operating system, Bluetooth wireless technology and a 3-axis accelerometer. By disseminating the application, they created; the goal of this method can be expanded to additional smart phone devices operating on Android. System's microprocessor, the PIC16F877, controls the DC motor that powers the wheelchair's linear motion as well as the wheelchair's multiple dc motor directions in the major second section of our system architecture. The wheelchair's front wheels are turned by the DC motor, which is controlled by a pair of dc rear wheels [8].

In 2019, Varsha Pathak worked on Android based Automated Smart Wheel Chair; - Their idea focuses primarily on using an application on a smart Android phone to handle a wheelchair system. It is advised to use the wheelchair system using an android application on a smart mobile device and system. A wheelchair may be operated using the technology by utilizing an Android device. The goal of this initiative is to make it easier for elderly persons who have trouble moving about and disabled or handicapped people to move around. As a result of this design, the exceptional people will be able to live a life with less reliance on other people. A new method of interacting between people and tools or machines may be possible with the help of Android technology. Thus, using Android technology, their issue can be resolved to control the movement of a wheelchair [9].

Sasikala in 2020 worked on Wi-Fi Communication based Human Machine Interface (HMI) Wheel Chair for Disabled Person. The people who are really put to the test have difficulty walking because of a sickness, injury, or disability. With a wheelchair, you can go around without relying on your abilities to be outgoing and make money. Through the Android mobile device, the person speaks, and the voice command is then translated into material. This product is finally delivered to the small controller. A Bluetooth module controls the development of this structure with the assistance of servo engines; the suggested agenda includes servo-powered wheelchairs that are battery-operated. Additionally, the current framework should be extended to include the existing joystick-based framework [10].

Dr. Emna Baklouti presented work on Self-directed wheelchair guidance with Real time Hindrance Detection Using 3D Sensor in 2017 In order to avoid collisions and safeguard the rider, autonomous wheelchairs working in dynamic environments

must assess their surroundings and real time alteration of the control signal. In this study, paper offer a reliable, straightforward, and real-time self-governing navigation module that moves a wheelchair in the direction of a predetermined objective while also having the ability to avoid hindrances in a 3D dynamic environment. They employ a fuzzy logic controller to instruct the mobile robot to go toward the objective (FLC). They used the Xbox 360 Kinect to give an accurate map of the area for obstacle avoidance. The obstacle evasion control Deformable Virtual Zone receives the created map as input (DVZ). Results from simulations and actual experiments are provided to demonstrate the viability and effectiveness of the suggested control system [11].

In 2020, Tan Kian Hou presented work on Arduino Based Voice Controlled Wheelchair prototype to help those with both limb limitations, utilizing a manual wheelchair that is easily available on the market everywhere. The speech recognition module's voice commands are processed by an Arduino controller, which also manages motorized mobility of wheelchair. The prototype design also included an optional joystick command and a Bluetooth module to do away with unsightly wires. The wheelchair proved quite successful at understanding voice instructions in Chinese, English and Malay. The prototype's overall price was kept low to make it accessible [12].

Aayushi B Thakur, Dr. Shubhangi D C worked on Design and Development of Smart Solar Based Wheelchair Using Voice Recognition and Head Gesture Control System in 2020 System introduce a solar-powered wheelchair in this paper, together with a 3-axis accelerometer (ADXL335) controlled gesture, a Bluetooth module setup for voice recognition, and an ATmega microcontroller. The entire device was set up using an Arduino board and a few mathematical techniques. The movements can be distinguished from any type of physical movement picked up by an individual's accelerometer, and the voice recognition worked using an Android application and a Bluetooth module. Prototype only need to issue a few commands to Android device in order for the voice to be recognized and the necessary action to be taken as a result. Voice and gesture recognition can be explained as a process or method that describes how computers can read body language and builds a connection between the human and computer worlds [13].

Jigmee worked on Wheelchair based on Head Gesture movement for Quadriplegic Patients in 2018. For the purpose of assisting paraplegic patients with movement,

paper presents a Robotic Wheelchair that can be controlled using a head motion. A DC stepper motor, Raspberry Pi, a relay, gyroscope, ultrasonic sensors, and accelerometer are all part of the Robotic Wheelchair. Head's movements are picked up by MPU 6050 sensor and a signal is sent to the Pi controller. After analyzing the signal controller allows the movement of wheelchair for navigation. Navigational data is used by ultrasonic sensors to assist in avoiding hindrances. The wheelchair is created in a way that is economical, but still guarantees the users' security, adaptability, and mobility [14].

Gaurav Kumar Soni in 2017 proposed work on AVR Micro-controller Based Wheel Chair Direction Control using Hand Gesture Recognition. The proposed task involves designing and creating a wheelchair that uses hand gestures and a gesture control system. People who are unable to walk due to a physical condition, an injury, or impairment use wheelchairs. The potential for developing hand gesture-based wheelchairs or smart wheelchairs is vast, according to recent developments. The wheelchair in the current article is gesture-based and uses an accelerometer sensor to control the wheelchair's direction. This study proposes a hand-gesture controlled user interface model and highlights usability, application, and technological developments. We describe a highly helpful integrated solution to actual detection. The glove hand gesture-based data technology, which uses an accelerometer sensor to track hand movements to control a wheelchair, is widely utilized. This study suggested control mechanism for wheelchair by a small 3-axis wireless system, low voltage supply and low-cost system using AVR microcontroller [15].

Dr. V. Balambica1 in 2021 presented work on Automatic Wheelchair for Physically Disabled People controlled by PID Sensor. Proposed wheelchair operates on the straightforward idea of SENSOR. The wheelchair is controlled using hand obstruction by using a PID SENSOR, resulting in reflected infrared light falling on the sensor which will give the received information to Arduino board in order to give a signal to the motor in order to move the wheelchair in the desired direction as per the person's wishes. Additionally, we have PID sensors fitted for left, right, and reverse directions. As a result, the wheelchair begins to move when the infrared sensor module receives a signal from an object (in this case, a hand or finger) that is blocking the infrared beam from reaching the IR receiver. Moreover, for halting the wheelchair simply place an object, such as a hand, above the PID sensor to prevent infrared rays from being detected by the IR receiver. This will prevent the IR receiver from signaling the

wheelchair's motors to advance any further and will cause the wheelchair to come to a stop. Therefore, this proposed wheelchair's design enables auto-control by applying infrared sensors and circuitry based on an Arduino Uno microcontroller. This concept aims to assist those who are physically challenged and live in poverty and cannot afford to purchase an expensive, fully motorized wheelchair. A standard wheelchair with DC motors powers the entire setup, which also includes an Arduino Uno, beeper, switch, motor driver modules, and batteries [16].

In 2022 Shwetha V, Gayathri P. presented work on voice-controlled wheel chair to assist people with physical limitations; a voice-controlled wheelchair built on the ANFIS platform was developed and put into use. The sufferer can operate the electrical wheelchair by speaking commands. Using a variety of test commands and perturbations, the implemented wheelchair prototype system's functionality and overall performance were evaluated. The simulator and prototype model findings show that the ANFIS-based controller used in conjunction with online sensor signals can increase wheelchair performance and improve quality of life for people with physical in-capacities. The implemented prototype offers a number of advantages, including affordability, position tracking, and safety. It features sensors that can identify both static and moving objects, as well as any slick roads. a feed-forward neural network having multiple layer structure of (7-25-10-5) was implemented for classification to identify the voice of each speaker using appropriate training and testing datasets [17].

Susan Shore in 2017 presented work on the long-term influence of wheelchair delivery on the lives of people with in-capacities to have a favorable continuous impact on income and employment in less resourced parts of the world, despite fluctuations in distance travelled into the community and overall health status over time. These findings should be confirmed by additional research, which should also look at the causes of varied fluctuation. This study supports the value of long-term monitoring of wheelchair distribution-related outcomes in low-resource settings [18].

In 2017 Sadaphal Avinash et.al proposed Self-control Solar Operated Wheelchair To provide an economical motion vehicle for the physically disabled, a wheel chair powered on solar is invented with the inherent materials like casters, PMDC motor, steel bars. The wheel chair is driven by the 12V rechargeable battery. The speed is restricted to 3km/hr for safety and to avoid shuddering of the solar frame. And by using the toggle jack which has the capacity of lifting load of 100kg, the seat

adjustment is done [19].

In 2019 V.seridevi and P.ashwarya cooperated on work on Automated Gesture Based Wireless Wheelchair Control by Means of Accelerometer according to a research there are about 6 million populations in the world who are paralyzed and needs a wheelchair for their mobility. Earlier the wheel chairs had to be moved and be externally supported by any person. To help overcome this “joystick-controlled wheelchairs” are developed. But in regular use, these joystick-controlled wheelchairs became difficult to use. Especially in the case of paralyzed people, the use of joystick became more difficult due to the hard buttons and unidirectional use of the joysticks. To overcome these problems we’ve tried to develop a “gesture-controlled wheelchair” which can be moved with a slight tilt of the hand. This can be used in both hands and can be controlled to come to the user from a distance. The current work is implemented with Arduino based devices such as Arduino NANO and UNO processors and programmed through Arduino IDE. The gestured detection-based wheel chair is designed with two Arduino processor and controlled left, right, forward and backward movement. Unlike traditional design the present method is successful in carrying paralyzed people without meeting any error. The functions invoked and respective directions are shown in table 1. Automated wheel chair can be used to help handicap people and the present work is aimed to help the paralyzed people who can only move one side of their body or partially paralyzed and help them to be able to move. In the present work the wireless system is successfully developed to move the wheel chair in various directions i.e., Forward, Backward, Left, and Right, or Stay in Same Position and also stop automatically when any obstacle is detected [20].

In 2020 Shanelle Fernandes proposed a work on Wireless Gesture Control Wheelchair Patients with a variety of physical limitations have used wheelchairs to help them move around and easily meet their daily demands. Yet in other situations, such as those involving patients who lack the necessary arm strength and range of motion to effectively push the wheels forward, such as quadriplegics, paraplegics, stroke patients, elderly people, etc., a wheelchair must be moved by another person. Thought to be a solution for these people, joystick-oriented wheelchairs can present distinct issues as they call for simple shoulder movement. For the patients in the aforementioned categories, it is not always feasible. Additionally, because our solution is wireless and can be moved about, it doesn't have the same positioning

restrictions that a joystick wheelchair could have allow the patient to sit in their desired position with the least amount of discomfort when worn on either hand. The goal of this initiative is to enable autonomous mobility for people with disabilities. Hence, in this study, we show a wireless gesture-based wheelchair prototype that may be operated with hand gestures. A transmitter and a receiver that can communicate wirelessly make up the framework. The 433 MHz RF Transmitter and Receiver Unit has been used for wireless transmission since it delivers data through an antenna at a rate of 1Kbps to 10Kbps and has adjustable range. An accelerometer that has been mounted to a hand glove and an Arduino Lily Pad microcontroller make up the transmitter unit. Using the accelerometer sensor to note the hand's location as it makes a motion. The patient is expected to wear this glove, which will allow them to move their hand comfortably while sending signals to the receiver unit attached to the wheelchair, which will cause the wheels to move in the desired direction. Motor drivers in the reception unit convert voltage as needed by the wheels. This study offers an efficient, affordable, and user-friendly wheelchair alternative to the market-leading models. The paper explains how the system operates and is put together [21].

In 2018 Deepabala Singh and Vishal Verma presented a work on Gesture Controlled Wheelchair. The hardest tasks for physically challenged people are those that require them to depend on others. They must wait for someone to take them out before they may go anyplace. Alternately, make it nearly impossible to move manual wheelchairs constantly. It ultimately limits the freedom. We hope to make them autonomous through this endeavor. The user simply needs to wear a gesture gadget with a sensor. The sensor will capture a hand movement in a certain direction, which will cause the wheelchair to travel in the corresponding directions. This article describes a gesture-based wheelchair that employs an accelerometer sensor to control its orientation with hand gestures. GPS and GSM modules are also used for an actual location. In this paper, a hand-gesture controlled user interface model is presented. We offer a very practical and comprehensive solution to real-time detection, employing a hand gesture-based data glove technology that makes use of an accelerometer sensor to control the wheelchair with hand movements. In this study, a low voltage supply, inexpensive and compact 3-axis wireless system using two AVR microcontroller is presented. Wireless radio waves are used to connect the wheelchair to the Gesture device. Due to wireless connectivity, the wheelchair and

user can engage more amicably. Essential words: RF module, GPS, GSM, accelerometer sensor, wheelchair control, microcontroller, and hand gesture recognition [22].

In 2018 Abu Tayab Noman presented work on A New Design Approach for Gesture Controlled Smart Wheelchair Utilizing Micro controller Many individuals lose their ability to walk properly owing to a car accident each year. The ideal assistive device for older and differently able people who are unable to walk normally is a wheelchair. Traditional manual wheelchair control and operation are substantially more difficult tasks. For some persons, such as the elderly and physically weak, modern wheelchairs like joystick-controlled and voice-controlled wheelchairs can be a little challenging to use. Also, this wheelchair is not economical. So, the purpose of this study is to develop an affordable electronic gesture-based wheelchair that is simple to use instead of a joystick input to control a wheelchair using a smart phone's built-in gesture feature and touch sensor. Processor used is ATMega328 along with the IP camera, DC Gear Motor, Bluetooth Module, TTP224 Capacitive Touch Sensor, Ultrasonic Sensor, and L298N Motor Driver. This wheelchair has the unique ability to identify impediments in its path, helping to prevent collisions between the wheelchair and those obstructions. Using an IP camera to provide audio and video information to the rider's career is another function of this chair [23].

In 2017 Siddharth M. Ahluwalia presented a paper on Design and Fabrication of Sensors Assisted Solar Powered Wheelchair. Modern technological progress is detrimental to society. The goal of this project is to assist physically disabled persons by developing a solar-powered wheelchair with various sensor enhancements. The smart wheelchair has PIR sensors, an accelerometer, and an ultrasonic sensor. For recharging the battery, we used solar panels and two D.C. motors. Because it is secure and safe, lead acid batteries are used. Those who are partially blind cannot see clearly, so an actuator is included for their convenience so they can feel impediments through vibrations. This work also focuses on the wheelchair's ability to sense obstructions in front of and behind it using PIR and ultrasonic sensors. This wheelchair can be used in both indoor and outdoor settings. While the most technologically advanced components were used to create this wheelchair advancement [24].

In 2020 Shadman Mahmood Khan Pathan and Wasif Ahmed cooperated on work on Wireless Head Gesture Controlled Robotic Wheel Chair for Physically Disable

Persons It is expected that a robotic wheelchair can use sensors and intelligence to perform operations like navigation, obstacle detection, etc. The building of a cap-controlled wheelchair was the first step in the project, which was done to test and validate the gesture operation. The next step was to create a real-time wheelchair that could switch between joystick and head gesture control modes in response to the needs of the user. MPU6050 sensor, joystick module, RF module, battery, dc motor, toggle switch, and Arduino make up the wheelchair. The MPU6050 monitors head movement and sends a signal to the microcontroller when it does. The signal is then analyzed by the controller, enabling wheelchair movements for navigation. The wheelchair could turn to the left, forward, backward, left, and right directions. When tested, the wheelchair travelled at a speed of 4.8 km/h. The wheelchair's design goal was to be as affordable as possible without sacrificing the users' movement, flexibility, or safety. In this essay, we create a wheelchair that enables a disabled person to live a normal life at a reasonable cost. We employ a straightforward sensor to keep costs down, and a joystick module serves as a backup control system for the user interface. The rest of the components are user-friendly and straightforward to access, despite the strength of the motor we used. By switching their modes with a toggle switch, the head gesture and joystick controls for this wheelchair can both be used. We created a prototype cap-controlled wheelchair and tested the operation before using it for real. For the gesture to operate effectively, one must maintain the appropriate head position for a specific amount of time. Real-time Robotic Wheel follows. According to the needs of the user, a chair with joystick control mode and head gesture control mode has been developed. The controller analyses the signal and permits the wheelchair to move in order for it to navigate. The wheelchair was implemented successfully, and it moved in the left, right, backward, and forward directions in accordance with the microcontroller software. [25].

# Chapter # 3

# Components Description

## 3. Components Description

The hardware components of proposed system have been discussed below.

### 3.1 12v Battery (80-100amp)

An unusual battery utilized in particular electronic applications is the 12-volt battery. The 12-volt battery is one of the battery kinds that takes on a significantly diverse appearance depending on what it is used for. It is among the most varied batteries in certain ways. Large, small, heavy, or light are all possible. Sometimes they may resemble standard AA batteries in appearance . A 12 v DC battery has been shown below.

**Fig 3.1 12 V Battery [26]**

A 12-volt battery is frequently used in vehicles like cars and boats, making transportation applications one of its most popular uses. In these circumstances, the battery might be able to be recharged since the car simply needs power to start. If everything is running smoothly, the alternator then takes over and runs the electrical system. The battery receives a charge from the alternator as well. Lead-acid 12-volt batteries are used in almost all automobile, motorbike, and tractor batteries. For a brief amount of time, these batteries are capable of delivering hundreds of amps of electrical current. These batteries are frequently employed in automotive applications as a result. However, not all 12-volt lead-acid batteries may

be used interchangeably. Before attempting to, it's crucial to take the car's electrical requirements into account [26].

## 3.2 Arduino Nano

The Arduino Nano is a compact, feature-rich, adaptable, and breadboard-friendly microcontroller board based on the ATmega328p that was created in 2008 by Arduino.cc in Italy. It has 30 male I/O headers that are arranged in a DIP30 format. Following figure 3.2 shows Arduino Nano.

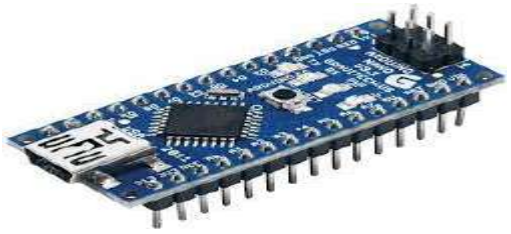

**Fig 3.2 Arduino Nano [27]**

Arduino nano has been shown above in fig 3.2 it has total 14 digital and 8 analog pins.miroconroller used in arduino is atmega 328 it has 32 kb memory with 2kb memory used for boot loader.The ATmega328 has 2 KB of SRAM and 1 KB of EEPROM.

## 3.3 Arduino Uno

An open-source electronics platform called Arduino is built on simple hardware and software. A motor can be started, an LED can be turned on, and anything may be published online by using an Arduino board to receive inputs like light on a sensor, a finger on a button, or a tweet. The board has a number of I/O pins operating on 5V which are both analog and digital having typical occupied values ranging between 20 -40 mA. This Arduino UNO uses inner pull-up resistors to limit current from surpassing the stated operational conditions. These resisters become useless, however, and the device is damaged by an unnecessary surge in current. A computer, other Arduino/Genuino boards, or other micro controllers can all be communicated with using the Arduino/Genuino Uno's many communication features. UART TTL (5V) serial communication is offered by the ATmega328 and is accessible on digital pins 0 (RX) and 1 (TX). This serial communication is routed through USB by an ATmega16U2 on the board, which is seen by computer software as a virtual com

port. There is no external driver required because the 16U2 firmware works with the built-in USB COM drivers. On Windows, however, a.inf file is necessary. A serial monitor is included in the Arduino Software (IDE) and allows straightforward textual data to be delivered to and received from the device. When data is transmitted using the USB-to-serial chip and USB, the RX and TX LED's on the board will flash.Arduino UNO has been shown in fig 3.3.

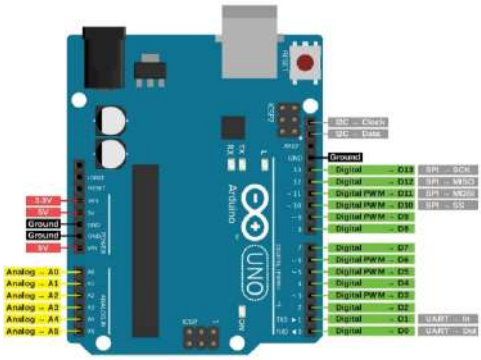

Fig 3.3 Arduino Uno [28]

Arduino UNO is an ATmega328P based microcontroller board having six analog inputs, 14 digital input/output pins, a 16 MHz ceramic resonator, Power jack, a Universal Serial Bus port, reset button and ICSP header. It comes with the whole thing needed for sustenance of microcontroller; to get started, just plug in a Universal Serial Bus cable, a battery or an AC-DC adapter.

## 3.4 Relays

An electrical relay is a sort of powerful, remote-control switch that can manage high-current accessories while needing significantly less current to operate. Relays are installed between the power source and the electrical component that has to be switched on and off. The high current required to operate the accessory goes from the power source through the relay and directly to the part when the relay is activated. Heavy-gauge wire is needed to provide high-current devices; the longer the circuit, the larger the conductor needed. Even tiny resistance quantities can result in a substantial voltage drop in 12-volt automobile circuits. By reducing the necessary length of the heavy-gauge power supply line from the battery or alternator to the load, relays offer a solution. Relays are often activated by a remote pressure-, or by an operator-controlled switch installed on the dash, switches that are vacuum or linkage -actuated. You can connect the switch to the power source and relay using a low-

amp switch and small-gauge wire (even on long lengths), as just a tiny amount of current is required for the circuit's relay-actuation side. Relays are heavy-duty, remote -control devices that guarantee the transmission of full power to electrical components with high loads: Your electric fan will spin more quickly, your headlights will burn brighter, and your fuel pumps will function as efficiently as possible. The overall switch and electrical system's performance and longevity are improved, and the voltage drop at the dash harness is decreased. Following figure 3.4 shows relays.


**Fig 3.4 6v/100 Amp relay [29]**

This is a SPDT 12V 100A Power Relay . The larger version of the little 12V SPDT relay is this one. The size of the relay makes it clear that it is made for high amperage loads.There are a total of 5 contacts on this relay, and each one is properly labelled. This relay has the same connections as the tiny SPDT type relay that was previously described. It includes the coil connections needed to power the relay coil. It has the common contact as well as the typically closed and open contacts.

### 3.4.1 PCB

PCB-Mounted A printed circuit board (PCB) that houses an integrated circuit (IC) chip, chipset, or module (PCB). A PC Board Device is a printed circuit board that plugs into the motherboard or backplane of a personal computer, industrial computer, PLC, etc. Modular OEM Designed to be included into devices by original equipment manufacturers (OEMs).

## 3.5 Voltage Regulators

In order to maintain a constant voltage supply under all operational circumstances, a voltage regulator is a part of the power supply unit. During power outages and changes in load, it controls voltage. Both AC and DC voltages can be regulated by it.

Fig below shows voltage regulator.

**Fig 3.5 Voltage Regulator [30]**

Regulator shown in fig is a integrated circuit voltage regulator An integrated circuit (IC) that regulates voltage output regardless of changes in load or input voltage is known as a voltage regulator. It can accomplish this in a variety of ways depending on the internal circuit layout, but in order to keep this project simple, we will mostly concentrate on the linear regulator.

## 3.6 Mpu6050 Sensor

MPU6050 is also known as a Micro Electro mechanical system (MEMS). It is a comprehensive 6-axis Motion Tracking Device. It cartels 3-axis Accelerometer, digital motion processor and 3-axis gyroscope all in one minor package. It consists of 3–axis gyroscope and 3-axis accelerometer. It helps us to portion orientation, displacement, velocity, acceleration and other features like motion. Following figure 3.6 shows MPU 6050.

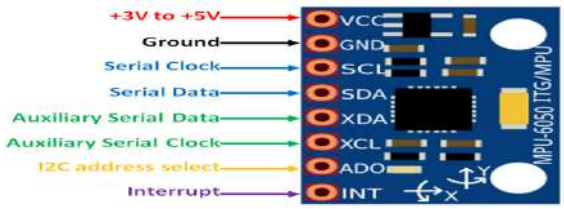


**Fig 3.6 MPU 6050 [31]**

The MPU6050 module shown above contain a 3-axis accelerometer and a 3-axis gyroscope. This makes it easier for us to measure a system's or object's acceleration, velocity, direction, displacement, and many other motion-related parameters.

## 3.7 Bluetooth Module HC 05

A well-liked module like the hc-05 Bluetooth can give your projects two-way (full-duplex) wireless communication. We can use it by connecting with any Bluetooth–enabled device, such as laptops, phones, as well as two microcontrollers

like an Arduino. It is a slave node in HC-05 Bluetooth cannot initiate a connector to additional devices but can accept networks. This method is significantly facilitated by the plenty of present Android applications. The module can easily be interfaced with any microcontroller that supports USART because it communicates using USART at a 9600 baud rate. Using the command mode, we can also set the module's default values. Bluetooth module is shown below.

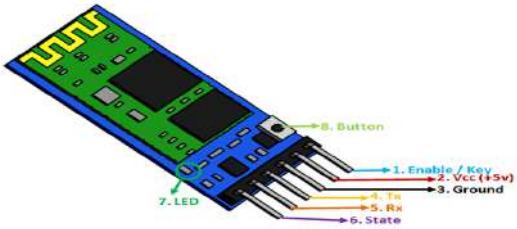


**Fig 3.7 Bluetooth HC 05 [32]**

As shown above The HC-05 module has a Serial Port Protocol (SPP) to communicate, which makes pairing it with microcontrollers fairly simple. Connect the Rx pin of the module to the Tx of the MCU and the Tx pin of the module to the Rx of the MCU to power the module with +5V.

## 3.8 Resistors

It is an electrical constituent that regulates or limits the movement of electrical current in an electric circuit. They can also be used to offer a specific voltage for transistor like active devices. In a direct-current (DC) circuit, the current through a resistor is directly proportional to the voltage across it and inversely proportional to its resistance, all other things being equal. This criterion also holds true for alternating-current (AC) circuits as long as the resistor has no inductance or capacitance. Resistors have been shown in fig 3.8.

**Fig 3.8 Resistors [33]**

Above shown fig indicates different types of resistors that can be used with different colour band each colour band indicate specific value of resistor

## 3.9 Jumper Wires

Jumper wires are employed to link two circuit terminals together. Jumper wires are available from all electronics in a range of lengths and collections used frequently in breadboards and other prototype tools to make changing circuits simple.Figure 3.9 shows jumper wires.

**Fig 3.9 Jumper Wires [34]**

## 3.10 RF module

A radio-frequency module, or RF module, is a (often) compact electronic gadget used to send and/or receive radio signals between two devices. It is frequently useful to connect wirelessly with another device in an embedded system. Radio-frequency (RF) communication or optical communication can be used to carry out this wireless communication. RF is the preferred medium for many applications since it doesn't require line of sight. In RF communications, a transmitter and a receiver are used. They come in a wide range of types. Some have a 500-foot transmission range. RF CMOS technology is commonly used to build RF modules. Due to the complexity of constructing radio circuits, RF modules are frequently employed in electronic design. The complexity of good electronic radio design is well known because of the radio circuits' sensitivity as well as the precision of the parts and layouts needed to accomplish functioning at a certain frequency. RF transmitter and receiver has been shown in fig 3.10.

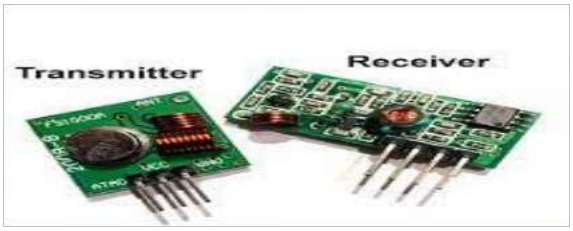


**Fig 3.10 433 MHz transmitter and Receiver [35]**

Above shown fig is of 433 MHZ RF transmitter and receiver module this module has a range of 300 m and operating at 2 - 5V, The module monitors their battery voltage and can sleep with very low standby current.

# Chapter # 4

# Project Layout and Software Simulation

## 4. Project Layout and Software Simulation

The software, which is used for the simulation of this project, is Proteus. Layout and Software simulation of the voice and gesture controlled smart wheelchair_is given below.

## 4.1 Block diagram of Hardware

Block diagram of hardware has been shown below.

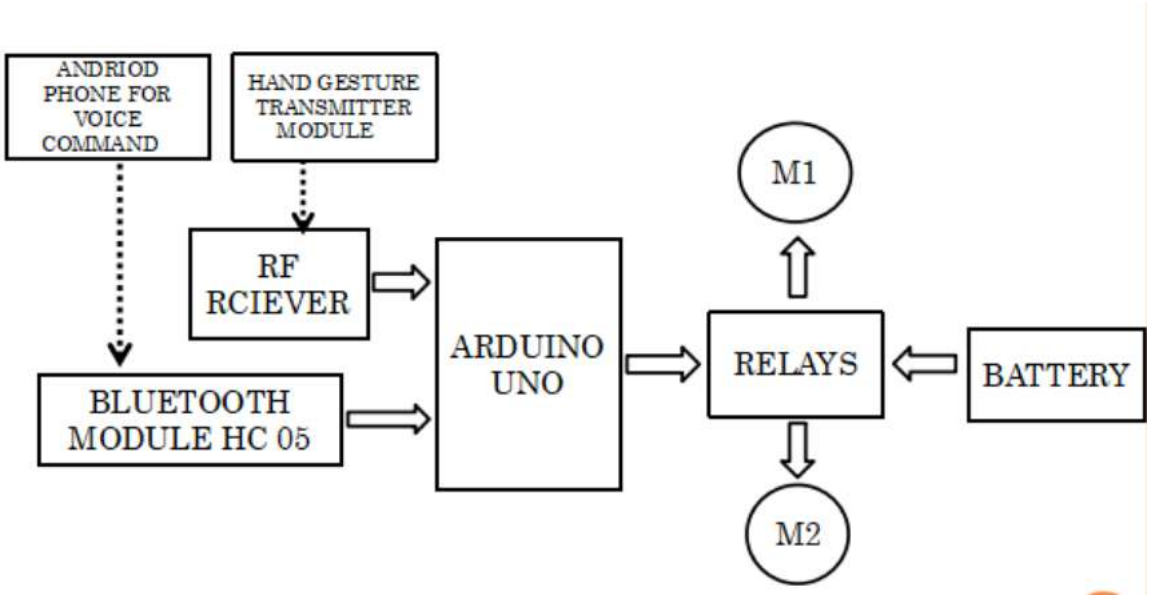


**Fig 4.1 Block Diagram of Hardware**

Through the figure, we can see that at very beginning it will check if hand gesture is on or not. If yes, then accelerometer will create a numerical value according to movement of hand and send it to Arduino Nano. Arduino Nano will create a command and transfer it to master Bluetooth module. Master Bluetooth module will send the received data to slave Bluetooth module and then to Arduino Uno. Arduino Uno will send signal to motor drivers and motor drivers will move the wheel. If hand gesture is not on then it will wait for a voice command. Voice command is

transferred through an android app and received by Bluetooth module and signal will be sent to Arduino Uno and it will control motor drivers.

## 4.2 Working principle

This wheelchair has two special features for different types of abled people who can use gesture control and the voice recognition method for the movement of the wheelchair. In addition to the movement in case of emergency or any obstacle found in front of the wheelchair, the wheelchair can immediately stop moving. Moreover, the methods of the individual features are split into several parts in detail.

Gesture control uses an accelerometer, it is an electromechanical gadget used to quantify speeding up powers. An accelerator resembles a primary circuit for some bigger electronic gadgets. The capacitance accelerometer detects changes in capacitance between microstructures situated in the gadget. If an accelerative power moves one of these structures, the capacitance will change, and the accelerometer will interpret that capacitance to voltage for elucidation. After the conversion analog to digital converter over the Arduino, the signals are passed to the DC motor. DC motors themselves are extremely basic; any fundamental DC Motor will have two leads that can be legitimately joined to a battery or power supply of adequate limit. The side of the engine that is associated with the positive of the power source will figure out what direction the engine rotates.

Voice controller is fundamental point to control the wheelchair through the human voice. This venture is for the most part utilized for physically tested individuals who are subject to a wheelchair and particularly those people who control utilize their hands to drag their wheelchair because of some incapacity. In this framework, we have utilized the voice acknowledgment module to perceive the voice of the client for controlling the bearing of the wheelchair. The progression of utilized in this venture is to utilize voice in order to this task can likewise fill in android application. The accepting circuit is available at the switchboard. The direction was set in the Arduino board. The android app can be constrained by giving voice directions.

## 4.3 Project PCB Layout

Project PCB Layout is a high-level board design tool that includes sophisticated manual high-speed and differential signal routing, shape-based Auto Route enhanced verification, and several import/export options. Each class or layer's design needs

are established by net classes, class-to-class rules, and object type-specific parameters. Dip Trace uses a design philosophy that includes real-time DRC, which finds and reports issues in real time. The board may be studied in three dimensions and exported as a mechanical engineering CAD model. Design Concepts Everything looks to be in order after extensive detailing, Net Connectivity testing, and a comparison to the original schematic.

### 4.3.1 Types of PCB

There are three major types of PCB layout according to the complexity and quality of circuit and component use in circuit which are concisely expressed as follows.

#### i.Single Layer PCB

- A single-sided PCB, which has only one layer of substrate or base material, is the most common form of circuit board. A thin coating of metal, such as copper, is applied to the layer to make an electrical conductor. A protective solder mask and a silkscreen coat are applied to the copper layer on these PCBs. Some of the advantages of single-sided PCB are as follows:
- Single-sided PCB are utilized for volume creation and are inexpensive
- They are also employed in basic circuits such as power sensors, transfers, sensors, and electronic toys.

#### ii. Double Layer PCB

Both sides of the substrate display the metal conducting layer on double-sided PCB. Through openings in the circuit board, metal items can be joined from one side to the next. These PCB use both the through-opening and surface mount mounting schemes to connect the circuitry on each side. The through-opening innovation entails the embedding of lead pieces into the circuit board's pre-bored openings, which are then linked to the cushions on the opposing sides. Surface mount technology allows electrical components to be placed directly on the circuit sheets' outer layer. Two-sided PCB have the following advantages:

In comparison to through-opening installation, surface mounting allows for additional circuits to be added to the board.

These PCB are used in a wide range of applications, including cell phone framework, power testing, test hardware, speakers, and numerous others.

### iii. Multi layers PCB

Multi-layer PCB, such as 4L, 6L, 8L, and so on, have more than two copper layers. The technology used in these circuit boards is the same as that used in two-sided circuit boards. Different layers of a substrate board and protective coatings divide the layers of multi-facet PCB. The PCB are conservatively estimated. resulting in weight and space savings. PCB with several faces have a number of benefits, including:

- Multi-facet PCB have an unquestionable degree of plan adaptability
- They play an important role in high-speed circuits. They provide more room for leadership by example and power.

## 4.4 Software simulation

Software simulation depends on the most common way of displaying a genuine peculiarity. This simulation shows connection of Arduino with motor drivers, LCD, ultrasonic sensors, motors and Bluetooth modules. All the data is sent to Arduino and Arduino control and manage the whole process.Circuit simulation in off condition is given below.

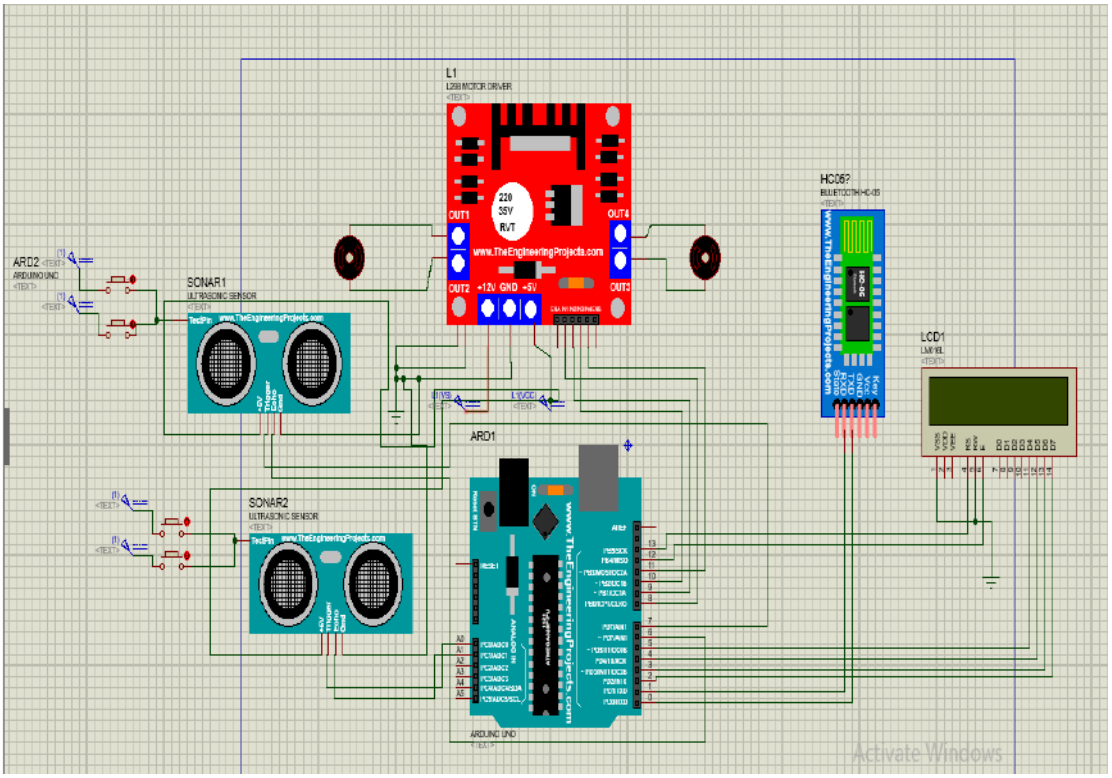


**Figure 4.2: Software Simulation patching in OFF condition**

Through the fig we can see that circuit is closed and no signal is being transferred

from arduino to the circuit

Figure 4.3 shows software simulation of circuit in voice control mode

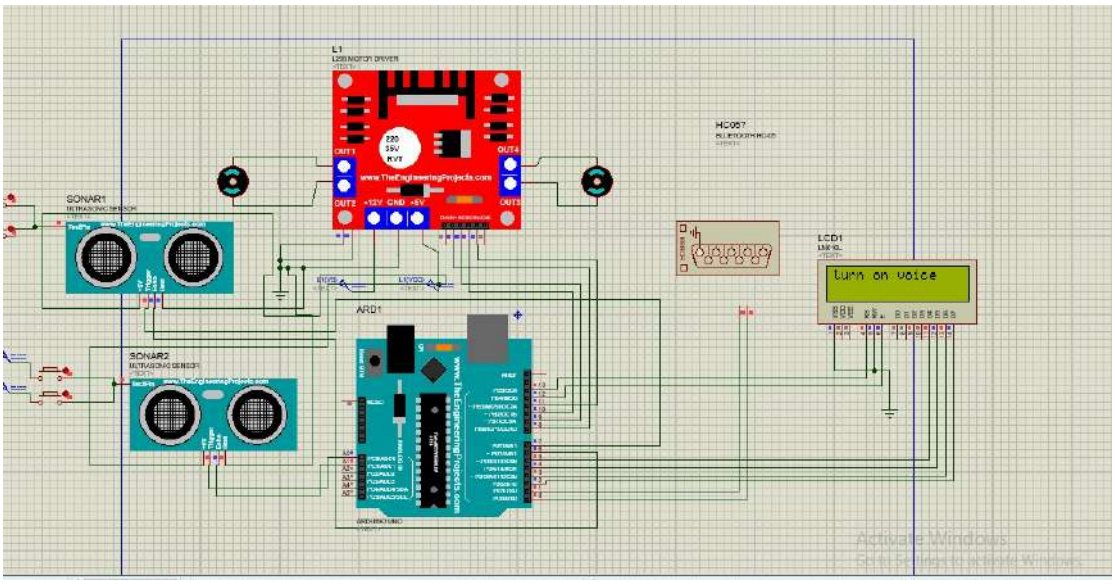


**Fig 4.3 Software Simulation having voice controller ON condition**

When circuit is turned on it will wait for gesture command we can see that when hand gesture is not working it is automatically asking for a voice command

Figure 4.4 shows software simulation of circuit in gesture control mode

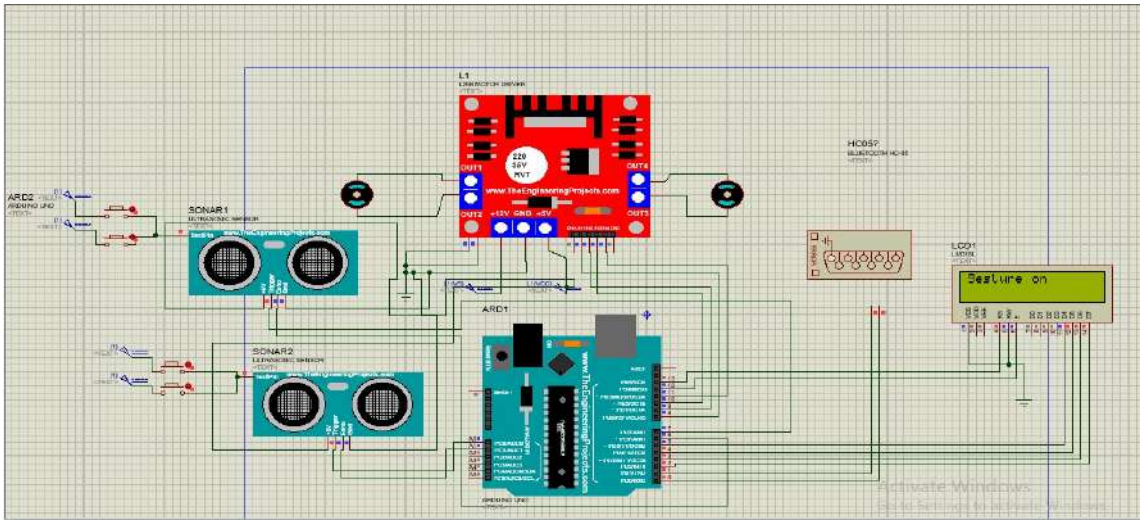


**Fig 4.4 Software Simulation having gesture controller ON condition**

From above fig we can see that when gesture is turned on main circuit will automatically shift to gesture mode and display a message of gesture on on the screen.

## 4.9. Flow chart

A flowchart shows the phases of a process in a logical order. It's a general-purpose tool for outlining a variety of processes, such as manufacturing, administrative, and service processes, as well as project plans. It is a common process analysis tool and one of the seven basic quality tools. A flowchart could show a series of events, materials or services entering or departing the process (inputs and outputs), choices to be made, workers engaged, time spent at each stage, and/or process metrics. Figure 4.5 depicts a flowchart of our system.

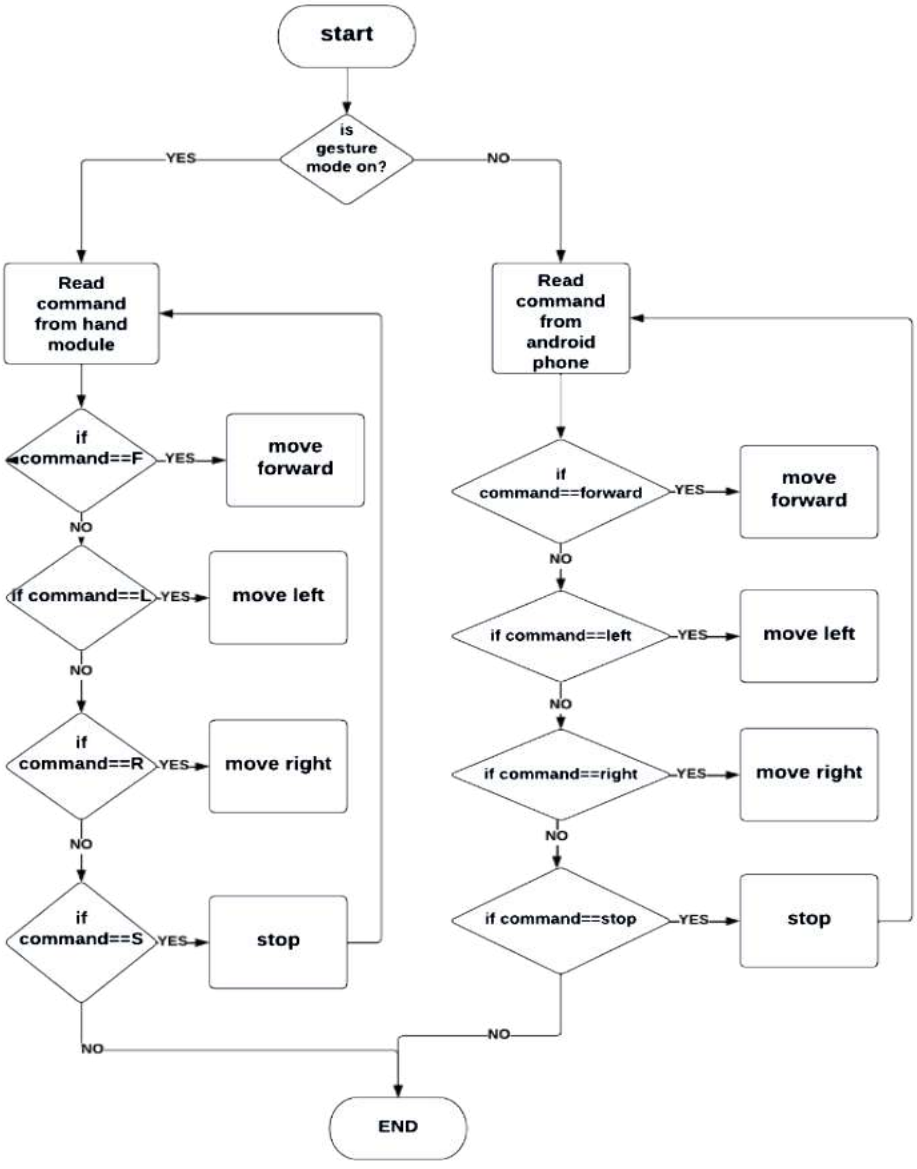


**Fig 4.5 Flow chart of system**

The flow chart explains the working of wheelchair as first of all system will check if

gesture mode is on or not if not then it will move towards voice mode and accept the respective commands and execute them and it will also check obstacle if obstacle is detected then wheel chair will stop moving and wait for command if obstacle is not detected it will accept the command from android phone and move in that direction if gesture mode is on system will move towards the gesture mode and receive commands from hand gesture module it will again check for the distance and then move in required direction.

# Chapter # 5

# Hardware Implementation

## 5. Design and implementation

### 5.1 Introduction

This chapter is about the design and implementation of modules used in the project. The project involves implementation of voice and gesture controlled wheelchair which involve a hand module and a android phone for giving voice and gsture commands which are received by bluetooth and  rf module and then the command are sent to arduino uno the main controller which controll the motion of wheelchair.

### 5.2 Interfacing of Motors

As the wheelchair is electrically powered so it has two 650Watt motors already implemented on it figure 5.1 shows the implementation of the motor on the one side of the wheelchair. The motors are connected to the relay module which powers the motor in order to move in a specific direction. As the wheels are independent to each other's rotation, in order to synchronize the rotation one motor is connected to equally distribute the weight balance. motor implementation has been shown below.

**Fig 5.1 (650) Watt Motor Implementation**

Fig shows the implementation of motors that are attached to the wheels these are 650 w 12 v gear motors and can bear weight of upto 170 kg.

## 5.3 Interfacing of Relays

In order to give the control to the motors which will allow them to turn in specified direction electromechanical relays are used. As we are using 4 relays as shown in Fig 5.2, so we have implemented four relays on both sides two relays for the respective motor. According to the command given by arduino a certain relay operates and powers the motor in certain direction  The relay we used are electromechanical switch that uses an electromagnet to generate a magnetic field that can open or close the relay's contacts, depending on the commands to turn in the desired direction.  Relay module has been shown below.

**Fig 5.3 Relays Module implementation**

Above fig shows relay driver circuit four relays are used each two relays are for first motor and two relays are for other motor these relays provide power to the motors to move in a specific direction.

## 5.4 Implementation of hand module Module

The initial input will be taken from Gesture mode. It is placed onto the patient's hand as shown in Fig 5.3. The Gesture mode that is used for hand directions has an accelerometer that will create a numerical value according to movement of hand and send it to Arduino Nano. Arduino Nano will create a command and transfer it to master Bluetooth module. Master Bluetooth module will send the received data to slave Bluetooth module and then to Arduino Uno. Arduino Uno will send signal to relays and relays will move the wheelchair according to signal. The voice mode will take commands if gesture mode is not activated. It is transferred through an android app placed on wheelchair and received by Bluetooth module and signal will be sent to Arduino Uno and it will control relays according to the specific instruction given in

android app.  Figure 5.4 shows hand module.

**Fig 5.4 Implementation of Hand Module**

The hand module as shown in fig is used for giving command to wheel chair through hand gestures the circuit for hand module is attached to a glove patient will wear the glove and move hand in specific direction.

Figure 5.5 shows  hardware implementation.

**Fig 5.5 Complete Hardware**

Above fig shows complete hardware with wheelchair and hand module main controller circuit and battery is mounted on the back side of the wheelchair.

# Chapter # 6

# Results and Discussion

## 6. Results and Discussion

In this chapter results of project will be discussed in detail various parameters effecting the performance of wheelchair will also be discussed.

## 6.1 Results

The independence of those who are physically handicapped is a social requirement. The usage of wheelchairs enables the mobility of those with physical disabilities. Physically challenged individuals utilized manual wheelchairs at first. However, electrically powered wheelchairs are becoming more and more common in society. The project's objective was to create a voice- and gesture-controlled wheelchair for people with disabilities. The technology was tested for the motion of the wheel chair utilizing voice and gesture after the design and construction of the wheelchair with the corresponding interface circuits. Modern concepts were used to implement the suggested design. Following the development of the wheelchair's smoothly equipped design, this would be adopted for individuals with disabilities. We have chosen a Bluetooth module for communication of voice because we are employing dual modes, and each mode has a different communication module. The Bluetooth communication with the wheelchair can operate at its best range of 10 meters with a response latency of 0.47 seconds before the connection becomes unreliable. A 433 MHz frequency RF module was used for gesture. The test results showed that 100 m with a 0.6 second response time was the ideal distance for Bluetooth communication with the wheelchair.It is necessary to test the wheelchair's velocity in two different scenarios. The velocity is first measured in an unloaded state. The wheelchair was designed to move straight ahead, and its speed was measured at 1.53 feet per second. Second, the wheelchair was permitted to transport 15kg of weight, and the velocity was determined to be 1.24ft/s. Finally, a 30-kg person sat down in the wheelchair. The voice-activated wheelchair was permitted to travel straight ahead. With this load, the wheel chair moves at a 1.21 ft/s speed. Based on the aforementioned finding, the load has an impact on the voice-controlled

wheelchair's velocity. As the load carried by the wheelchair system increases, it is noted that the wheelchair system's velocity would drop proportionally.

## 6.2 Discussion

The prototype will initially wait for the turning on gesture mode in the absence of a gesture, speech mode will automatically switch on. Following cases were observed.

### Case 1: Voice Mode

The speech recognition module will accept a voice command from an Android phone and respond with the desired signal, which is represented as a voice command, while also recognizing the user's input. Forward, left, right, left forward, right forward, and stop are the six user instructions. The motor control direction for each command will vary and be adjusted separately.

**Left:**

if the voice command is left, the left wheel will be set to reverse, and right wheel will be set as forward.

**Right:**

if the voice command is right, the left wheel will set to forward, and right wheel will set as backward.

**Forward:**

if the voice command is forward, both left and right wheel will set to forward.

**Left Forward:**

if the voice command is left forward then the left wheel will be set to reverse, and right wheel will be set as forward and after some delay both wheels will stop and then both left and right wheel will set to forward.

**Right Forward:**

if the voice command is the left wheel will set to forward, and right wheel will set as backward. after some delay both wheels will stop and then both left and right wheel will set to forward.

**Stop:**

if the voice command is stop then both wheels will stop.

## Case 2: Gesture Mode

In gesture mode the system will accept command from gesture module and detect what is user input there are five-user commands forward, backward, left, right and stop.

**Forward:**

if the voice command is forward, both left and right wheel will set to forward.

**Left:**

if the voice command is left, the left wheel will be set to reverse, and right wheel will be set as forward.

**Right:**

if the voice command is right, the left wheel will set to forward, and right wheel will set as Backward.

**Stop:**

if the voice command is stop then both wheels will stop.

# Chapter # 07

# Environmental and Societal Aspects

## 7. Environmental and Societal Aspects

This chapter is all about the environmental and societal aspects that may be occurred in the presented work and will affect society.

## 7.1 Environmental Aspects

Environmental aspects are those elements of an organization The presented work plays a vital role for handling problems in environment because power wheelchair that collects information on driver behavior and interaction with their environment. This is done through the use of sensors to provide feedback on a driver's ability to control the device and navigate their environment safely. Some major aspects of this project that affects the environment positively are discussed below in detail.

### 7.1.1 Clean and Safe

This project is environmentally friendly because no waste is produced while working/operating the module. It causes the reducing risk of electric hazards from environment as most of work is done automatically based on conditions.

### 7.1.2 Cost/Energy Efficient

The dc battery supply will help organizations to manage their energy use in a sustainable way. Smart devices are used to assemble it. These smart devices are required the less electricity to power. This will Reduces the costs and environmental impacts as well.

### 7.1.3 Reduced Environmental Footprints

As the dc-based supply wheelchair system is based on automation which effect the environment by streamlining equipment and processes and using less space, automation uses less energy. Reducing your environmental footprint can save real money.

### 7.1.4 Enhancing Unsustainable exploitation of Natural Resources

Enhancement of unsustainable exploitation of natural resources is caused especially if our dependency on rare metals for production of electronic equipment further deepens. Hence, smart wheelchair system enhances those resources in each aspect as loss in products during development decreases as well as with by efficiently using the energy also enhances the exploitation of resources.

## 7.2 Societal Aspects

Societal aspects are the effects of a business or organization's activities, products, or services on society. These can include economic impacts, social impacts, and environmental impacts. A smart wheelchair system delivers a number of environmental benefits. It mainly Provides shared navigation assistance (obstacle avoidance) and target tracking. Provides obstacle avoidance and task specific operating modes. The use of smart wheelchair is important to human society for handling problems in the environment. The use of smart wheelchair has increased since the number of disable peoples increases. By using dc battery supply, we'll reduce our costs while being comfortable inside our homes. Some helpful aspects of designing in the presented work that are affected the society are explained below in detail.

### 7.2.1 Enhance Safety

In this project a smart wheelchair can be done by adding sensors to detect obstacles, implementing obstacle avoidance algorithms, and adding safety features such as seat belts and emergency brakes. designing processes have helped to reduce the suffering and risks to specially challenged persons, all without major disruptions. It can provide designing, fabrication and an ability to react against emergencies not often found in manual abilities.

### 7.2.2 Reduce Human Error

By reducing the risk of human error in common daily tasks, smart wheelchair gives us predictable and repeatable processes for managing patterns to improve stability, speed changes and increase uptime.

### 7.2.3 Performance and creativity

Smart wheelchair provides better and more efficient way of doing specific tasks but designing hardware and software will take time to replace the human intellectual skills. It means that boundaries of creativity have been extended with the introduction of smart wheelchair to the society but still it has limitation when it comes to the human intellectual skills for critical thinking. Smart wheelchair helps extending the limits of creativity but requires human interaction or collaboration.

### 7.2.4 Change in Education

Radical change of education is enforced by the dramatic changes of requirements. To operate a smart wheelchair the main directions are as follows:

- Physically challenged people to be educated
- Knowledge and skills to be learnt
- Methods and philosophy of education.

### 7.2.5 Changing in Labour

The major point about the future change has focused on the changing role of human labour in an age of designing. Indeed, the current technologies already allow smart wheelchair of half of all activities that physically challenged people are currently able to do. They also significantly transform current business models and producer-customer relationships and create new employment opportunities for those able to use them.

### 7.2.6 Enhancing Business

Making positive changes and implementing new software to operate the smart wheelchair can also give others a valuable awareness into your smart wheelchair business. By reporting on our improvements over time we can celebrate our transition and use this open approach to build trust with existing physically challenged people and attract new ones.

## 7.3 Mapping of FYDP with SDGs

SDG's are a collection of 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all", integrated and indivisible to balance the three dimensions of sustainable development. The mappings of SDGs

with our final year project (FYDP) are shown below in Table 7.1.

**Table 7.1 Mapping of FYDP with SGDs**

| Project Title<br>"Design and fabrication of Voice and Gesture controlled smart wheelchair using dc motors for physically challenged persons" | |
|---|---|
| GOAL 01: No Poverty | |
| GOAL 02: Zero Hunger | |
| GOAL 03: Good Health and Well-Being | ✓ |
| GOAL 04: Quality Education | |
| GOAL 05: Gender Equality | |
| GOAL 06: Clean Water and Sanitation | |
| GOAL 07: Affordable and Clean Energy | |
| GOAL 08: Decent Work and Economic Growth | ✓ |
| GOAL 09: Industry, Innovation and Infrastructure | ✓ |
| GOAL 10: Reduced Inequality | ✓ |
| GOAL 11: Sustainable Cities and Communities | ✓ |
| GOAL 12: Responsible Consumption and Production | |
| GOAL 13: Climate Action | |
| GOAL 14: Life Below Water | |
| GOAL 15: Life on Land | |
| GOAL 16: Peace and Justice Strong Institutions | |
| GOAL 17: Partnership to Achieve the Goal | |

# Chapter # 08

# Conclusion and Future Suggestions

## 8. Conclusion and Future Suggestions

Conclusion and future recommendation of voice controlled and gesture controlled smart wheelchair for especially able persons using DC motors are discussed in this part of thesis and are written below.

## 8.1 Conclusion

Being unable to utilize conventional wheelchairs, people with disabilities are encountered here. They require assistance from someone to complete their everyday tasks. This wheelchair can be utilized by people with a variety of disabilities, such as mental incapacity, physical disability, speech impairment, hearing loss, and visual loss. This wheelchair offers voice control and hand gestures for mobility, making it simple for people with multiple disabilities to operate. Wheels. The wheelchair's dual mode operation makes it special. It helps the patient become autonomous so that they can move around on their own. The voice-controlled mode is the first one we offer. We give it six spoken commands rather than utilizing the outdated buttons or dragging the wheels. Left, Right, Forward, Right, Left, Forward, Stop. that is recognizable by the RF module, which executes activities like moving ahead, which causes the wheels to go forward, etc., and checks its database.

Gesture-controlled mode: We can move our hands to man oeuvre the wheelchair. All you need is a little transmitting device that fits in your palm and has an acceleration meter. An Arduino Nano, an mpu6050, and an RF transmitter module make up the transmitting device. At the receiving end, a slave RF module takes in the encoded data. After the microcontroller has examined this data, our relays will thereafter operate as instructed. It operates using the strategy of switching to voice control first. If it doesn't get any commands, it switches to gesture control mode and begins taking them. It increases the independence, mobility, and social interaction of people with disabilities. We put this electric wheelchair through several tests and evaluated its performance. We are working to create a system that would greatly ease the lives of disabled individuals and help them become independent. Project requires

expertise in both software and hardware design.

## 8.2 Future Recommendations

- People with special needs who are unable to regulate their motions, especially their hands, can easily access wheelchairs thanks to voice control. For increased efficiency, we can add more commands, and we can teach our module to recognize other languages and sounds.
- By employing gesture mode on the wheelchair, the hand gesture gives a guy whose entire body is paralyzed full control so that he can live his life independently without anyone's help. It reduces the separation between humans and machines. By including face and hand motions, it can be made more powerful.
- This idea could eventually incorporate obstacle detection to improve its effectiveness and safety.
- We can include yet another function that allows the wheelchair to move. on various angles.
- To expand this project wider, variable speed can be included.
- The wheelchair's battery timing can also be improved to allow for longer operation.
- To make it more exact and safer, we may additionally incorporate obstacle avoidance.
- We can identify brain cells and steer the wheelchair along the designated course using brain sensors.
- This wheelchair can also be equipped with obstacle detection to alert the patient to any obstacles that may be approaching within a predetermined distance.
- Android applications can use tongue-operated technologies using Bluetooth.
- Wheelchair may be moved in different directions using eye retina and optical sensors.

- Using neural-based algorithms, we can also increase the effectiveness of a voice-controlled wheelchair.

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