# VOICE CONTROLLED WHEELCHAIR

*Project report submitted in partial fulfillment of the requirement for the degree of*

## BACHELOR OF TECHNOLOGY

## IN

## ELECTRONICS AND COMMUNICATION ENGINEERING

By

**JAYA KHANNA (123010)**

**KARAN SHARMA (121111)**

**SUNNY BHUSRI (123005)**

UNDER THE GUIDANCE OF

**Dr. MEENAKSHI SOOD**

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

Month-June , year-2016

# TABLE OF CONTENTS

# ACKNOWLEDGEMENT

We are highly indebted to **Dr. Meenakshi Sood** for motivating and enlightening us for our project work. We thank you for being a constant support throughout, without whose valuable guidance and insights, this project would not be a complete one. We offer you our sincere gratitude to you for instructing and directing us through thick and thin.

We thank our **Dean, Prof. T.S. Lamba**, who has always served as an inspiration for us. We would like to express sincere appreciation to our , Head of Dept. Electronics and Communication **Prof.(Dr.) Sunil Bhooshan**, for providing us the opportunity of working on a project.

We would also like to acknowledge **Mr. Mohan Sharma** for helping us in the labs. Thank you for being there and helping us in and out.

# ABSTRACT

This project is based on voice/joystick controlled wheelchair system by using speech recognition module and joystick circuit.

The system is operated by voice of consumer or by joystick circuit. The main objective is to facilitate the movement of physically handicapped or diseased and elderly people who can't move well. This design will help handicapped or diseased people to operate and live independently. Speech recognition and joystick control is a new key in advancement which will provide a whole new way of interacting with machines and tools.

A handicapped or diseased person having locomotive disabilities needs a wheelchair for performing functions that require them to move around. They may do it manually with his hands but as many of them have upper weak limbs so it is desirable to provide them with a voice control motorized wheelchair. As the wheelchair can move at a good speed it becomes important for the wheelchair to avoid obstacles automatically in real time. All this must be provided at a affordable cost for as many handicapped or diseased persons as possible. With all this in mind we provide a voice/joystick controlled easy operation wheelchair.

# LIST OF ACRONYMS

| | |
|---|---|
| USB | Universal Serial Bus |
| IDE | Integrated Development Environment |
| NHIS | National Health Interview Survey |
| WHO | World Health Organization |
| IC | Integrated Circuit |
| SRAM | Static Random Access Memory |
| AC | Alternating Current |
| DC | Direct Current |
| EMF | Electromotive Force |
| UART | Universal Asynchronous Receiver /Transmitter |
| PWM | Pulse Width Modulation |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| ADC | Analog-to-Digital Converter |

# LIST OF FIGURES

# LIST OF TABLES

# CHAPTER 1

# INTRODUCTION

## 1.1. Introduction

Voice activated technology for controlling the motion of the wheelchair is to prove that it can be a unique concept that would stand apart from the rest of the average projects. The use of this technology in conjunction with a mechanical system in order to simplify everyday life and it would generate interest in an ever growing modern society. This can be a great for the person who is permanently unable to move any of the arms or legs. Handicapped people can use their wheelchair easily only using voice commands. The aim of this project is to implement an interesting application using small word recognition system. The methodology adopted is based on grouping a Arduino with a speech recognize development kit for isolated word from a independent speaker. The resulting design is used to control a wheelchair for a handicapped person based on the human command. "World report on disability" (2013) jointly presented by World Health Organization (WHO) and World Bank says that there are 80 million handicapped people in the world. Unfortunately day by day the number of handicapped people is going on increasing due to road accidents as well as disease like paralysis. Among all the disabilities percentage of physically handicapped person is most. If a person is handicapped he/she is dependent on other person for his day to day work like transport, food, orientation etc. So a voice operated wheel chair is developed which will operate automatically on the commands from the disable user for movement purpose. As an input device voice recognition is used. Arduino which controls the direction of wheel chair. Two DC motors are used with L298D which is a H-bridge driver IC. The following section gives an idea about statistics on disability in India among which physical disability is having highest percentage.

Indian Statistics on Disability We know that at every second the population of World as well as India is increasing very fastly. In India 120 million people are disabled out of which 41.32% are physically disabled as shown below in figure 1.

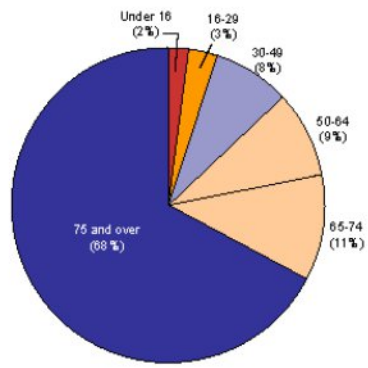


**Figure 1:** Data Calculated for year 2013-2014

Naturally, a wheelchair joystick/human voice control system should operate reliably for a large number of users, reduce the physical requirements; and if avoiding the need to move on one or more road extremities, should assist a user in maintaining well the wheel chair position. The automated wheel chair using head joystick/human voice produces the driving assistance module by altering the translational and rotational velocities. In particular, this is useful for the person where they can move their chair in their own directions, without any third party's help or support. Wheelchairs provide unique mobility for the disabled paralyzed and elderly with motor impairments. The designed system is based on grouping a Arduino with a new voice recognition processor/joystick.

The goal of this wheelchair project is to enhance an ordinary powered wheelchair using sensors to perceive the wheelchair's surroundings, a speech/joystick interface to interpret commands. Intelligent wheelchair will play an important role in the future welfare of the society. The use of intelligent wheelchair encourages the view of the wheelchair machine as a partner rather than as a tool. The population of people with disabilities has risen tremendously during the past century. As the data collected from the National Health Interview Survey (NHIS), two distinct trends have contributed to the increasing overall of disability: a gradual rise, due largely to demographic shifts associated with an aging population, as well as a rapid increase that is due to health impairments and accidents. Many individuals have problems to use a wheelchair. A recent clinical survey indicated that around 9%-10% of patients who received power wheelchair training found it very difficult or impossible to use it for their activities of daily living, and 40% of patients found the maneuvering tasks difficult or impossible. These people, suffering from motor deficits, disorientation, or cognitive deficits, are independent upon others to push them, so often feel powerless and out of control. Wheelchair has the potential to provide these people with effective ways to alleviate the impact of their limitations, by compensating for their specific impairments. In particular, intelligent wheelchairs may help in maneuvering a wheelchair and planning motion. Voice recognition aims to classify data based on either a priori knowledge or on statistical information extracted from the patterns. The patterns to be classified are usually groups of measurements and observations, defining points in an appropriate multidimensional space. This is in contrast to pattern matching, where the pattern is rigidly specified.

Different disability or disease levels require different assistive user control interfaces. Some of assistive interfaces can provide motion based command such as a joystick or some the voice recognition command. However, such interfaces are not able to adapt to different control requirements. A conventional wheelchair requires the mobility of the upper body. In many cases, this cannot help people who are paralyzed. Technologies like voice recognition provide a solution for people to communicate with bluetooth, android phone which can then be used to send out the operation commands for the users.

To increase the control abilities and personalize the control interfaces for different individual requirements, we decided to integrate the control interfaces into a wheelchair system. By merging multiple user control interfaces such as voice control and EMG control with traditional controls, adaptive wheelchair can help to assist more people who have different level of mobility impairment.

A complete voice recognition system consists of a method that gathers the observations to be classified; a feature extraction mechanism that computes symbolic information from the observations, and a classification or description scheme that does the actual task of classifying or describing observations, relying on the extracted features. The classification or description scheme is usually based on the availability of a set of patterns that have already been described. This set of observations is termed the training set and the resulting learning strategy is characterized as supervised learning. Learning can also be unsupervised, in the sense that the system is not given a prior labeling of patterns, instead it establishes the patterns itself based on the statistical regularities of the classes. The classification or description scheme usually uses statistical pattern. Statistical pattern of voice recognition is based on statistical characterizations of patterns, assuming that the patterns were generated by a probabilistic system. A wide know range of algorithms can be applied for pattern recognition.

## 1.2. Background

This presents the relevant research conducted to better understand the topics related to the successful completion of this project. Using the knowledge obtained for this research, we were able to make more educated design decisions. Before attempting to improve the design of the smart wheelchair, or develop new methods for interfacing with the wheelchair, previous work on this project was consulted and research into existing methods of controlling powered wheelchairs for users unable to use their hands was conducted. These changes and improvements also stuck to the idea of keeping the system modular and working in a variety of wheelchairs. The knowledge obtained from this research guided us in making sound design choices supported by facts. This presents the relevant research conducted to better understand the topics related to the successful completion of this project. Using the knowledge obtained for this research, we were able to make more educated design decisions. Before attempting to improve the design of the smart wheelchair, or develop new methods for interfacing with the wheelchair, previous work on this project was consulted and research into existing methods of controlling powered wheelchairs for low mobility users. These changes and improvements also stuck to the idea of keeping the system modular and working in a variety of wheelchairs.

## 1.3. Motivation

It is know that every second the population of World is increasing very tremendously. As estimated in India 120 million people are disabled out of which around 41.32% are physically disabled. Unfortunately the number of physically disabled people is increasing on regular basis due to reasons like accidents and the disease like paralysis.

The statistics given below is in percentage out of 120 million people (estimated)

1. Physical Disability 41.32%
2. Visual Impairment 10.32%
3. Hearing Impairment 8.36%
4. Speech Disability 5.06%
5. Locomotors Disability 23.04%
6. Overlapping 11.54%

"World report on disability" jointly presented by World Health Organization (WHO) and World Bank says that there are million handicapped people in the world

[Suravanshi et al] It is important to see the recommendations of WHO in case of disabled person

1. Enable access to all mainstream policies, systems and services.
2. Invest in specific programs and services for people with disabilities.
3. Adopt a national disability strategy and plan of action.
4. Involve people with disabilities.
5. Improve human resource capacity.
6. Provide adequate funding and improve affordability.
7. Increase public awareness and understanding of disability.
8. Improve disability data collection.
9. Strengthen and support research on disability.

So, a voice/joystick operated wheelchair is proposed that will operate automatically by the commands from the handicapped user.

### 1.4. Objective

The main goal of this system is to design and implement a wheelchair for handicapped user which is controlled with the voice/joystick command from handicapped person. The long term objectives of this proposed system are;

1. To design voice/joystick actuated miniature model of wheelchair with the help of Arduino software.

2. To recognize voice command by Voice Recognition kit for the control of the wheel chair

3. To design a voice/joystick controlling system with the use of Arduino.

4. To interface Voice Recognition circuit with voice control system and joystick circuit to control a proposed model of wheelchair.

5. To build a wheelchair control project to move in response to the disabled person’s voice.

The project aims at controlling a wheelchair by means of human voice/joystick. To equip the motorized wheelchair control system with a voice command system and joystick. By having this features, disabled people especially with severe disabilities that they are unable to move their hand or other parts of a body, are able to move their wheelchair around independently.

### 1.5. Literature Review

[Sagarbayas et al] According to the several studies we have shown that the independent mobility; which is included power wheel chair, manual wheelchair and walker access the benefit to both children and adults Independent mobility increases vocational and educational opportunities, reduces dependence on caregivers and family members, and promotes feelings of self-reliance. For young children, independent mobility serves as the foundation for much early learning. Non ambulatory children lack access to the wealth of stimuli afforded self-ambulating children. This lack of exploration and control often produces a cycle of deprivation and reduced motivation that leads to learned helplessness. For adults, independent mobility is an important aspect of self-esteem and plays a pivotal role in “aging in place.” For example, if older people find it increasingly difficult to walk or wheel themselves to the commode, they may do so less often or they may drink less fluid to reduce the frequency of urination. If they become unable to walk or wheel themselves to the commode and help is not routinely available in the home when needed, a move to a more enabling environment (e.g., assisted living) may be necessary. Mobility limitations are the leading cause of functional limitations among adults, with an estimated prevalence of 40 per 1,000 persons age 18 to 44 and 188 per 1,000 at age 85 and older. Mobility difficulties are also strong predictors of activities of daily living (ADL) and instrumental ADL disabilities because of the need to move to accomplish many of these activities.

In addition, impaired mobility often results in decreased opportunities to socialize, which leads to social isolation, anxiety, and depression. While the needs of many individuals with disabilities can be satisfied with traditional manual or power wheelchairs, a segment of the disabled community finds it difficult or impossible to use wheelchairs independently. This population includes, but is not limited to, individuals with low vision, visual field reduction, spasticity, tremors, or cognitive deficits. These individuals often lack independent mobility and rely on a caregiver to push them in a manual wheelchair. To accommodate this population, several researchers have used technologies originally developed for power wheelchairs have been designed of different ways, such as assuring collision-free travel, aiding the performance of specific tasks (e.g., passing through doorways), and autonomously transporting the user between locations.

The idea of using voice activated technology for controlling the motion of the wheelchair is to prove that it can be a unique concept that would stand apart from the rest of the average projects. The use of this new technology in conjunction with a mechanical system in order to simplify everyday life would spark interest in an ever growing modern society. Many people with disabilities do not have the dexterity necessary to control a joystick on an electrical wheelchair. This can be a great for the quadriplegics who is permanently unable to move any of the arms or legs. They can use their wheelchair easier only using voice commands.

[Krishna, Kranti et al] As mentioned in this paper, many researches done in the field of speech recognition are due to sophisticated signal processing algorithms and powerful computers available, computer based speech processing system nowadays have reached complex structure with high accuracy. The challenge is to maintain standard performance while using limited computation and memory resources. Researches in the area of wheelchair control system are still going on. Many people with disabilities do not have the skill essential to control a joystick on an electrical wheelchair. This can be a great drawback for the user who is permanently unable to move any of the arms or legs. They can use their wheelchair easier only using voice commands. In the proposed design, the main idea of using voice activated technology for controlling the motion of the wheelchair is to prove that it can be an exclusive solution for severely disabled. The purpose of this project is to implement an speech recognition system to recognize the input words from the user. The approach implemented is based on interfacing a microcontroller with a speech recognition IC from a dependent speaker. For future technology wheelchair would be fully autonomous that will move automatic based on the user expression and behavior. That should be fully automatic and wireless. In this project firstly we are working on the voice based automatic wheelchair and after that we will combine software based that will be controlled by computer and GSM mobile phones. After that we are thinking on putting a biometric feature in it that should be little bit secured. A lot of efforts have been made to develop robotic wheelchairs that operate in the same way to an autonomous robot so that the user gives a final target and directs as the smart wheelchair moves to the goal. Other smart wheelchairs limit their assist level to collision avoidance, these systems do not normally require prior knowledge of an area. A voice controlled wheelchair can assist by giving input as a voice commands like right, left, back, forward, etc. here we can also controlled our wheelchair by some angle where user wants to rotate its wheelchair by like 30˚,45˚, 60˚ etc. This implementation is new from the other prototype developed and it is very useful for turning the wheelchair left and right with some angle. And this method can be achieved by using servo or stepper motor of high torques and less RPM.

# CHAPTER 2

# TECHNOLOGY USED FOR IMPLEMENTATION

## 2.1. Arduino 1.6.9

Arduino is a company of software for project buildups for the use by the community which aims at designing and manufacturing computer open source hardware, open source software, and Arduino-based kits for building up digital devices and interactive objects that can sense and control physical devices.

This project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards (termed *shields*) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also support the language C and C++.

Key features of ARDUINO include -

1. An open source design as it makes debugging easier for the projects.
2. An easy USB interface- the chip on the board plugs straight into your USB port and registers on your computer as a virtual serial port. This allows you to interface with it as through it were a serial device.
3. Very convenient power management and built-in voltage regulation. You can connect an external power source of up to 12v and it will regulate it to both 5v and 3.3v. It also can be powered directly off of a USB port without any external power.
4. An easy-to-find, and dirt cheap, microcontroller "brain." The ATmega328 chip retails for about $2.88 on Digikey. It has countless number of nice hardware

features like timers, PWM pins, external and internal interrupts, and multiple sleep modes.

5. A 16mhz clock. This makes it not the speediest microcontroller around, but fast enough for most applications.
6. 32Kb of flash memory for storing the code.
7. 13 digital pins and 6 analog pins. These pins allow you to connect external hardware to your Arduino. These pins are key for extending the computing capability of the Arduino into the real world. Simply plug your devices and sensors into the sockets that correspond to each of these pins and you are good to go.
8. An ICSP connector for bypassing the USB port and interfacing the Arduino directly as a serial device. This port is necessary to re-bootload your chip. If it corrupts and can no longer talk to your computer.
9. An on-board LED attached to digital pin 13 for fast an easy debugging of code

### 2.1.1. Hardware

An Arduino board historically consists of an Atmel 8-, 16- or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which let users connect the CPU board to a variety of interchangeable add-on modules termed shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial bus—so many shields can be stacked and used in parallel. Before 2015, Official Arduinos had used the Atmel megaAVR series of chips, specifically the ATmega328. A handful of other processors have also been used by Arduino compatible devices. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator(or ceramic resonator in some variants), although some designs such as the LilyPad run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions. An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232logic levels and transistor–transistor logic(TTL) level signals. MInni Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods, when used with traditional microcontroller tools instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers. Several plug-in application shields are also commercially available.is shown in the figure 2.1 below


**Figure 2.1:** Arduino UNO

### Interfacing of Arduino with HC-05:

Interfacing of Arduino and Bluetooth HC-05 consists of the following connections as shown in figure 2.2.

1. VCC voltage in HC-05 is given from the +5V pin of the Arduino board.
2. GND of the HC-05 is connected to the GND pin of Arduino board.
3. Transmitter (TX) of HC-05 is connected to the Receiver (RX) pin of the Arduino board.
4. Similarly Receiver (RX) of HC-05 is connected to the Transmitter (TX) pin of the Arduino board.
5. The first and last pin of HC-05 is not connected.

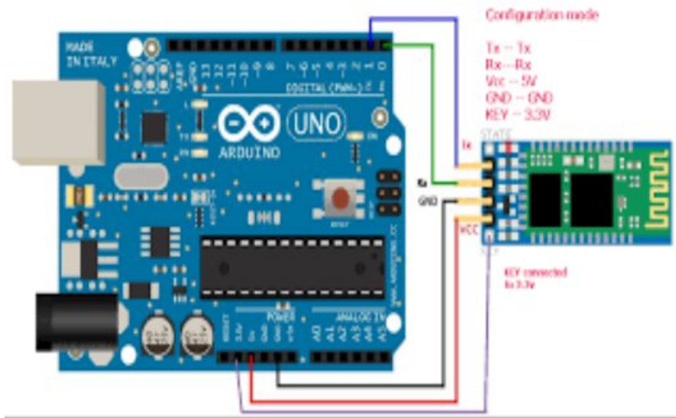


**Figure 2.2:** Interfacing

### 2.1.2. Software

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub *main()* into an executable cyclic executive program shown in figure 2.3.

1. setup(): a function that runs once at the start of a program and that can initialize settings.
2. loop(): a function called repeatedly until the board powers off.


**Figure 2.3:** Software Implementation

## 2.2. Proposed Methodology

### 2.2.1. Problem Statement

Advancements in today's technology has greatly affected the life of average people during the past decade, but unfortunately wheelchair users around the world have seen little to no improvement on the commercially available wheelchair controllers. It is estimated that there are about 200 million people worldwide using wheelchairs and in the U.S.A. alone roughly 11000 people are affected by spinal cord injury every year. About 47 percent of those injuries lead to quadriplegia. This growing demand for wheelchairs calls for better advancements for powered wheelchair controllers to better suit the needs of these patients. The extreme difficulty that patients with severe disabilities have been trained to maneuver a power wheelchair has been described in case studies and subjective evidence suggests the existence of a patient population for whom mobility is severely limited if not impossible given currently available power wheelchair control interfaces. An interesting survey by Hines VA Hospital Rehabilitation Research and Development Center was done among 200 practicing clinicians, asking them to provide information about their patients and to give their impressions of the potential usefulness of a new power wheelchair navigation technology. Significant survey results were 2 Clinicians indicated that 9 to 10 percent of patients who receive power wheelchair training find it extremely difficult or impossible to use the wheelchair for activities of daily living. When asked specifically about steering and maneuvering tasks, the percentage of patients reported to find these difficult or impossible jumped to 40%. Eighty-five percent of responding clinicians reported seeing some number of patients each year that cannot use a power wheelchair because they lack the necessary motor skills, strength, or visual acuity. Of these clinicians, 32% (27% of all respondents) reported seeing at least as many patients who cannot use a power wheelchair as who can. According to this survey nearly half of patients unable to control a power wheelchair by conventional methods would benefit from an automated navigation system. We believe these results indicate a need, not for more mechanical and systematic improvement, but for entirely new technologies for supervised autonomous navigation.

### 2.2.2. Present Scenario

There are many types of commercially available controllers for powered wheelchairs such as joystick, voice recognition. All of these controllers are widely used among wheelchair users with different types of injuries. According to the survey respondents, the vast majority of patients who use a power wheelchair rely on joystick, human voice control interfaces. The survey responses summarized below in Table 2.1 suggest that the power wheelchair control interfaces used may not, in fact, be adequate to provide truly independent mobility for substantial numbers of persons with disabilities. On average approximately 10 percent of the patients trained to operate a joystick, voice recognition wheelchair cannot use the chair upon completion of training for daily activities or can do so only with extreme difficulty.

**Table 2.1:** Adequacy of existing control interfaces

| **Measure** | **Simple Average** | **Weighted Average** |
|---|---|---|
| Percentage of patients who: after training, have extreme difficulty using a power wheelchair for daily activities | 6 | 6* |
| Percentage of patients who after training, find it impossible to use a power wheelchair for daily activities | 4 | 3* |
| Total Percentage | 10 (n=42) | 11(n=38) |
| Percent of power wheelchair users who: have difficulty with steering tasks | 32 | 35** |
| Percent of power wheelchair users for whom: steering tasks are impossible without assistance | 9 | 5** |
| Total Percentage | 41 (n=42) | 40 (n=38) |

* weighted by numbers trained, reported in survey

** weighted by total number of power wheelchair users reported in survey

With the advancements of microprocessors, significant innovation has occurred in power wheelchair control interfaces, as well as many other areas related to control of assistive technology.

### 2.2.3. Flow Chart:

The main part of the designed project is to control the motion of the wheelchair. There are four condition of motions are considered, moving forward, moving in reverse direction, moving to the left and moving to the right. For the speed, the user may use slow or fast speed command. The system starts by applying the supply voltage to the voice recognition circuit. For fast condition the system will supply higher current to the motors. If the user does not want the wheelchair move in high speed, the slow speed command can be set by applying low current supply to the motors. The direction and speed of wheelchair depends on the user as shown in figure 2.4.

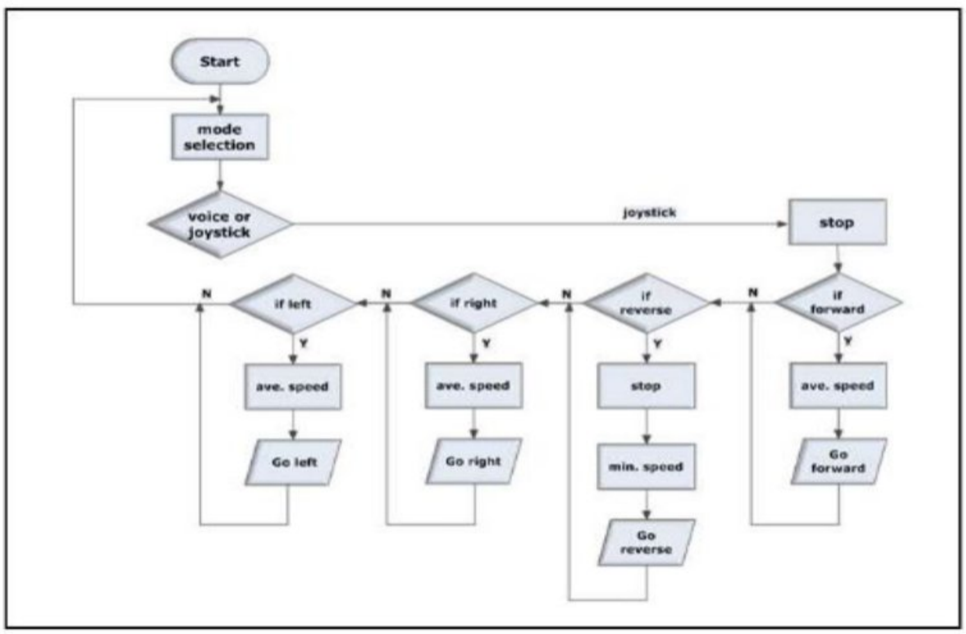


**Figure 2.4:** Flow Chart

### 2.2.4. Proposed Solutions/Model

The mentioned survey clearly indicates that individuals with severe disabilities which compromise respiratory drive and/or limit the dexterity of the head and hands have few options for steering a power wheelchair. This notion is further reinforced by the fact that 85 percent of respondents reported evaluating some number of patients annually for whom a power wheelchair is not an option because they cannot control it. Of these clinicians, 32 percent indicated that they evaluate at least as many patients who cannot use a power wheelchair as patients who can. These include persons with high level spinal cord injury, nervous system diseases, cognitive impairment, and blindness, presumably in conjunction with mobility impairment. One must conclude that, for these persons, no independent mobility options exist at this time. Furthermore this clinical survey provides evidence that existing control technologies may not be entirely adequate even for persons who use a power wheelchair on a regular basis. On average, responding clinicians reported that approximately 40 percent of their patients who use power 7 wheelchairs have difficulty with steering tasks and that between five and nine percent find such tasks impossible without assistance.

**Complete List of Voice Commands for Hum-power Controller Interface**

1. **Control:** This is a “Mode” command which starts the manual control of the wheelchair. This control command can be given without any prerequisite command at any time and stops the wheelchair resulting in termination of previous mode. After the user is done with this command the user will be prompted for a direction command in which the speed of the movement will be dictated by the frequency of humming.
2. **Go:** This is a “Mode” command which starts the automatic control of the wheelchair. This command can be given without any prerequisite command at any time and stops the wheelchair resulting in termination of previous mode. After the user has given this command the user will be prompted for a direction command in

which the initial speed of the movement is set to one. After the wheelchair starts moving the user will be able to change the speed using the speed command.

3. **Stop:** This command terminates any operating control mode and stops the wheelchair immediately. After the stop command is given the voice recognition process performs a self-test and restarts in a neutral mode.
4. **Forward:** This is a direction command that will set the direction of the movement for the wheelchair. It can be given in any control mode but it is must to be given after the Control or Go command.
5. **Reverse:** This is a direction command that will set the direction of the movement for the wheelchair. It can be given in any control mode but it must be given after the Control or Go command.
6. **Right:** This is a direction command that will set the direction of the movement for the wheelchair. It can be given in any control mode but it must be given after the Control or Go command.
7. **Left:** This is a direction command that will set the direction of the movement for the wheelchair. It can be given in any control mode but it must be given after the Control or Go command.

The operator gives voice as input in order to drive the wheelchair to the desirable position. Mic which converts the voice signal to the electric signal and the signal is given to the voice recognition module. The voice recognition module converts the analog signal into digital signal and the signal is transferred to the microcontroller. The microcontroller will take the decision to move forward or backward or left or right with help of relay switching unit. As shown below in figure 2.5.

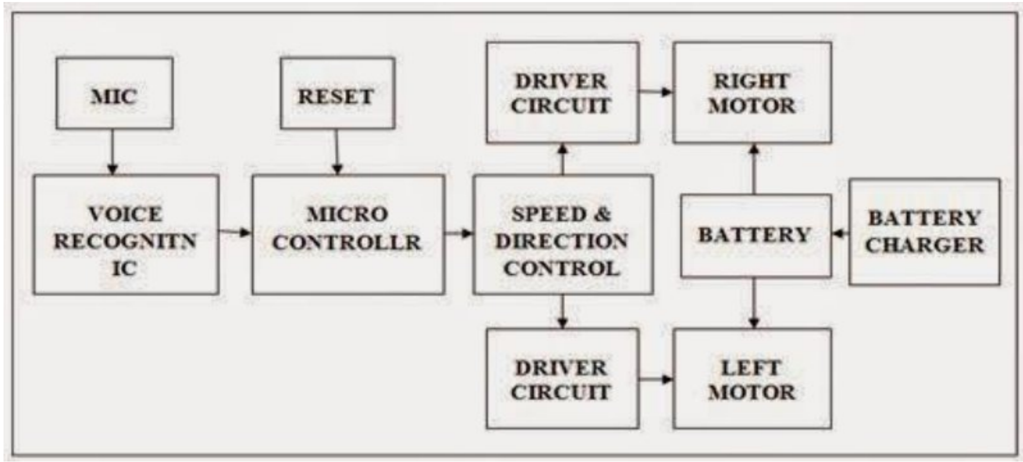


**Figure 2.5:** Block diagram for wheel chair

The voice recognition Bluetooth HC-05 is capable of operating in speaker independent voice to the IC with the help of a directly connected android phone at the analog input terminal of Bluetooth HC-05 keeping the mode selection key in the record mode. In this way 40 words of maximum 1.92sec duration can be recorded in the memory. After training the voice recognition bluetooth like above the mode selection key is switched to voice input mode.

Here the speech through the android phone at a particular instant is compared with the recorded sound and according to that digital output is generated. The output of voice recognition IC is then fed to the digital input ports of the Arduino. On receiving the Signal the microcontroller directs the motors through the control circuit recognition mode. In this mode, at first, the voice is recorded to the external SRAM attached. The speed and direction controls are done in this way. The direction control is achieved by changing the direction of current flow through the motor and speed control is achieved by varying the current through the motor.

# CHAPTER 3

# MECHANICAL DESIGN

## 3.1. Series Dc Motors

Series motors used are of 12V. Series motors are commonly used as tractions motors in many applications, as they offer high starting torque, are robust, have a simple design and are relatively low cost. DC series motors are an ideal choice for battery-operated equipment over AC motors, as they don’t require the use of expensive complicated inverter circuitry to convert DC voltage to an AC voltage required by the operator

### Operation

When the voltage is applied, currents starts to flow from the negative power supply terminals through the series winding and armature winding. The armature is not rotating when the voltage is first applied, and the only resistance in this circuit will be provided by the large conductors used in the armature and field windings. Since, the conductors are so large they will have small amount of resistance. This causes the motor to withdraw large amount current from the power

### Reversing the Rotation of Motor

The direction of rotation of the series motor can be changed by changing the polarity of either the armature or field winding. If you simply changed the polarity of the applied voltage of 12V, you would be changing the polarity of both the armature and field winding and the motor’s rotation will remain the same as shown in the figure 3.1 below.

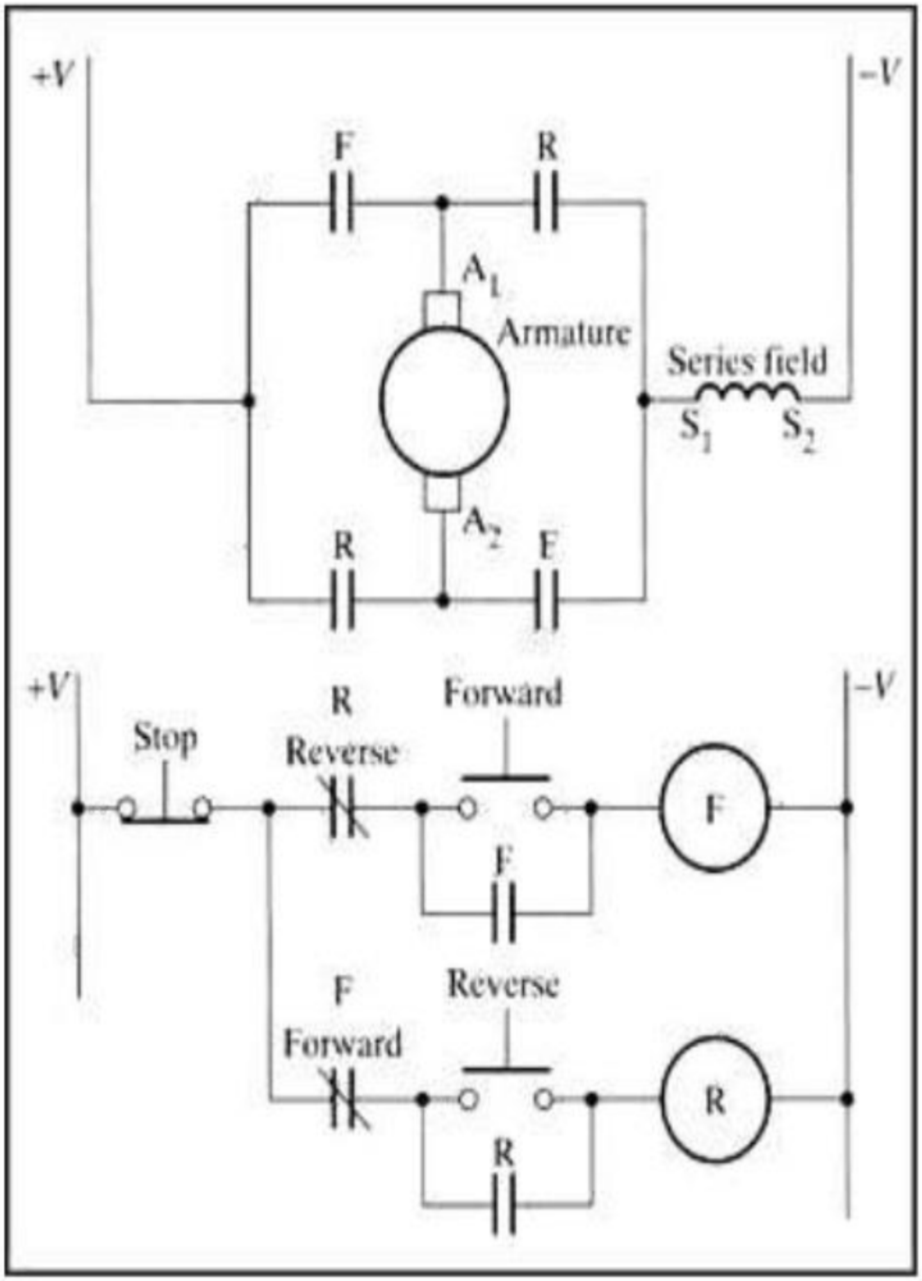


**Figure 3.1:** Rotation/movement of motor

### 3.2. Gearbox and Motor

A pair of gears reduces speed in proportion to the relative number of teeth. The gear on a motor shaft is typically smaller and has a fewer teeth than the one on the machine shaft as shown in figure 3.2.


**Figure 3.2:** Motor with 60RPM

**Features**

1. 60RPM 12V DC motors with Gearbox
2. 3000RPM base motor
3. 6mm shaft diameter with internal hole
4. 125gm weight
5. Same size motor available in various rpm
6. 2kgcm torque
7. No-load current = 60 mA(Max), Load current = 300 mA(Max)

### 3.3. Tyres

The type of wheelchair tyres for wheelchair will dramatically impact your ride's smoothness, maneuverability, speed and control as shown in figure 3.3.1 and 3.3.2

**Figure 3.3.1:** Pneumatic Tyre **Figure 3.3.2:** Tyre and motor

**Features of wheel chair tyres**

1. Size
2. Material
3. Type of wheelchair
4. Pneumatic or airless
5. Maintenance

**Wheelchair Tyres Maintenance and Mounting Information**

Always make sure that correct tyre pressure is maintained as this can have an effect on wheelchair performance.If the tyre pressure is too low, rolling resistance will increase, requiring more effort to move the chair forward.

## 3.4. Batteries

Three different types of batteries can be used .They are “Wet”, “Gel”, and the new “AGM”

**Wet Batteries:** Uses chemical reaction between lead and Sulphuric acid to create electrical energy.

**Gel Batteries:** Contains a mixture of Sulphuric acid, fumed silica, pure water and phosphoric acid, which forms a thixotropic gel.

**AGM Batteries:** Have an absorbent glass mat sandwiched between the plates, and saturated with acid electrolyte.

**Figure 3.4:** Battery

**Key Features:**

1. 12V 20AH wheelchair battery
2. Low rate of self-discharge
3. Maintenance free
4. No pollution and no harm

### 3.5. An Android Mobile

Any an android mobile can be used. It is used as input device it receives the voice command from the handicapped user and converts this speech signal into text with the help of an android application. Transfer this text to Bluetooth module with the help of Bluetooth wirelessly.

### 3.6. Bluetooth Module

Bluetooth module HC-05 is used for the transfer of data from an android mobile to the Microcontroller wirelessly. This module enables the serial data to transmit wirelessly and receive. This module HC-05 is having 10 meters range. It operates on 5v supply. It can easily interface with Microcontroller.

Bluetooth HC-05 module is an easy to use SPP (Serial Port Protocol) module, designed for wireless serial connection setup. Serial port HC-05 module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete radio transceiver and baseband of 2.4GHz. HC-05 uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with **AFH (Adaptive Frequency Hopping Feature)**. HC-05 has the footprint as small as 12.7mmx27mm. Figure 3.5 below is an HC-05 module image.

**Figure 3.5:** HC-05 Module

### 3.7. L298D (Driver IC)

L298D is a high voltage and high current dual H- bridge driver IC having 15 pin. It is used to drive the DC motors. It operates on 12V power supply. It provides DC current up to 4A. The operating supply voltage is applied up to 46V. It has over temperature protection and also has high noise immunity means logical “0” voltage is up to 1.5V.

L298D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers as they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. Figure 3.6 L298D is the image below.

**Figure 3.6:** L298D image

### 3.8. Voice Recognition Kit

#### 3.8.1. Bluetooth HC-05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.

Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

**Specifications:**

**Hardware Features:**

1. Typical -80dBm sensitivity
2. Up to +4dBm RF transmit power
3. Low Power 1.8V Operation ,1.8 to 3.6V I/O
4. With integrated antenna
5. PIO control
6. With edge connector

**Software Features:**

1. Default Baud rate: 38400, Data bits:8, Stop bit:1,Parity:No parity, Data control: has supported baud rate: 9600,19200,38400,57600,115200,230400,460800.
2. Status instruction port PIO1: low-disconnected, high-connected;
3. PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
4. Auto-connect to the last device on power as default.
5. Permit pairing device to connect as default.
6. Auto-pairing PINCODE:"0000" as default.

**Hardware:**

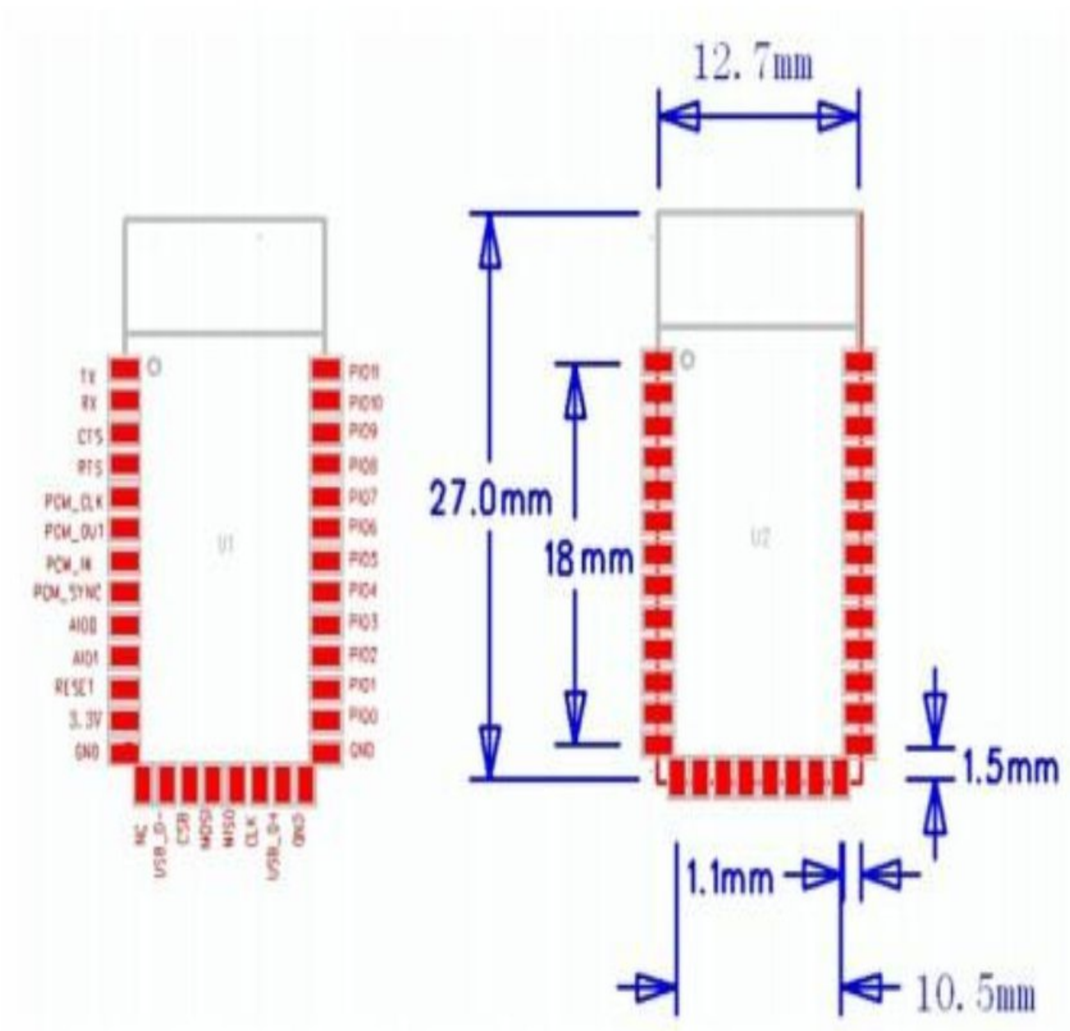


**Figure 3.7:** Basic Structure of HC-05

The basic structure of Bluetooth HC-05 with basic dimensions mentioned and with the pin number mentioned in the IC. The dimensions of the pin are mentioned in the figure 3.7 above.

**Table 3.1:** Basic Pin Description

| PIN Name | PIN # | PAD Type | Description |
|---|---|---|---|
| GND | 13,21,22 | VSS | Ground Pot |
| 3.3 VCC | 12 | 3.3V | Integrated 3.3V(+) supply with On-chip linear regulator output within 3.15-3.3V |
| AIO0 | 9 | Bi-directional | Programmable input/output line |
| AIO1 | 10 | Bi-directional | Programmable input/output line |
| AIO0 | 23 | Bi-directional RX EN | Programmable input/output line, control output for LNA (if fitted) |
| AIO1 | 24 | Bi-directional RX EN | Programmable input/output line, control output for PA (if fitted) |

**Table 3.2:** PI Pin Description

| PIN Name | PIN # | PAD Type | Description |
|---|---|---|---|
| PIO3 | 26 | Bi-directional | Programmable input/output line |
| PIO4 | 27 | Bi-directional | Programmable input/output line |
| PIO5 | 28 | Bi-directional | Programmable input/output line |
| PIO6 | 29 | Bi-directional | Programmable input/output line |
| PIO7 | 30 | Bi-directional | Programmable input/output line |
| PIO8 | 31 | Bi-directional | Programmable input/output line |
| PIO9 | 32 | Bi-directional | Programmable input/output line |
| PIO10 | 33 | Bi-directional | Programmable input/output line |

**Table 3.3:** Pin Names Description

| **PIN Name** | **PIN #** | **PAD Type** | **Description** |
|---|---|---|---|
| RESETB | 11 | CMOS input with weak internal pull-up | Resetof low.input debouncde so must be low for >5MS to cause a reset |
| UART_RTS | 4 | CMOS output, tri-stable with weak internal pull-up | UART request to send, active low |
| UART_CTS | 3 | CMOS input with weak internal pull-down | UART clear to send, active low |
| UART_RX | 2 | CMOS input with weak internal pull-down | UART Data input |
| UART_TX | 1 | CMOS output, tri-stable with weak internal pull-up | UART Data output |
| SPI_MOSI | 17 | CMOS input with weak internal pull-down | Serial peripheral interface data input |

**Table 3.4:** Pin Name PAD Type Description

| PIN Name | PIN # | PAD Type | Description |
|---|---|---|---|
| SPI_CSB | 16 | CMOS input with weak internal pull-up | Chip select for serial peripheral interface, active low |
| SPI_CLK | 19 | CMOS input with weak internal pull-down | Serial peripheral interface clock |
| SPI_MISO | 18 | CMOS input with weak internal pull-down | Serial peripheral interface data output |
| USB_- | 15 | Bi-directional | |
| USB_+ | 20 | Bi-directional | |
| NC | 14 | | |
| PCM_CLK | 5 | Bi-directional | Synchronous PCM data clock |
| PCM_IN | 7 | CMOS input | Synchronous PCM data input |
| PCM_SYNC | 8 | Bi-directional | Synchronous PCM data strobe |

### 3.8.2. JOYSTICK CONTROLLER:

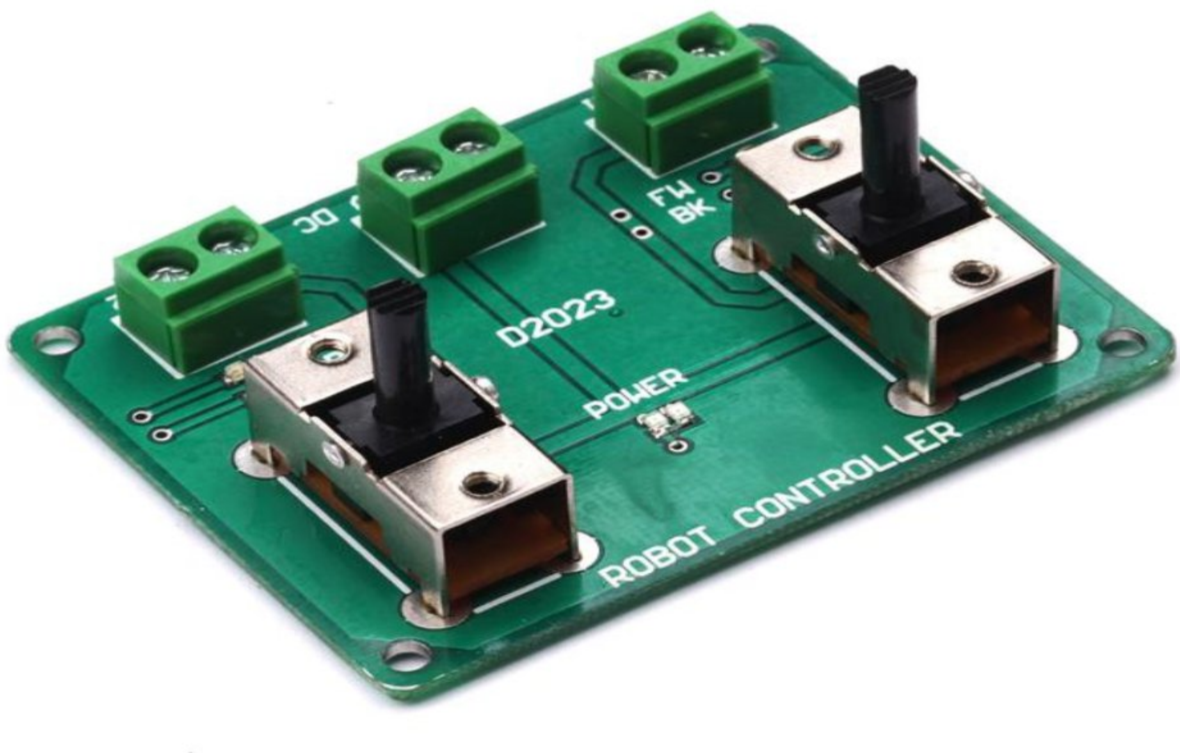


**Figure 3.8:** Joystick Controller

The Rhino Robot control board is versatile and expandable platform for robotics. Due to its expansion capabilities the board can be used to control all robots starting from beginner's robot to advanced robots with multiple functionality.

The board is compatible to 6-25VDC input compared to all robot control boards available which accepts inputs just up to 12VDC.It has onboard two 5Amp motor drivers MC33932 and expandable to four motor drivers onboard. The motor drivers have inbuilt protection for overheating so you would not see your motor drivers burnt in any case.

The high capacity motor drivers give an edge to the development board for driving big robots without any problems. The board is designed in such a way that Back EMF for big motors do not affect working of microcontroller. Also the motor drivers give very good breaking and linear speeds of motors with input PWM compared to conventional motor drivers. The board comes with a boot loader software pre-programmed in ATMega16 microcontroller and can be easily programmed through USB within few seconds. The Quick-C platform for programming this board with multiple libraries is offered with this board as shown in the figure 3.8 above.

**Features**

1. On Board Regulator with filters and Operating voltage from 6V-25V
2. 2 General purpose LED's
3. 2 Switches including reset
4. Power on/off toggle switch 10A
5. 16MHz crystal for maximum speed
6. Onboard LCD connector compatible to HD44780 LCD Modules
7. LCD brightness control
8. Power Indicator LED
9. 4 DC/2 Stepper motor 5A driving capability
10. PWM pins connected to motor drivers for speed control of motors for two DC motors
11. 8 ADC/Standard servo compatible connectors
12. All Pins accessible through male header pins
13. Onboard 36Khz receiver to receive signals from RC5 remote
14. USB to UART converter onboard
15. Can be expanded for I/O through expansion connector via SPI/I2C/UART.
16. Reverse polarity protection using a diode

# CHAPTER 4

# WORKING & RESULTS

## 4.1. Working

The input is taken from the android mobile; speech signal is converted into the text with the help of an android application. This text is transfer to the Microcontroller which controls the movement and direction of wheel chair via a Bluetooth module wirelessly. Microcontroller decides the operation of the two DC motors depending on the text received.L298D is a dual full bridge driver IC which is used for driving purpose of DC motors.

The wheel chair directions and movement possible are as given below.

1. Forward: Both motors are in forward direction.
2. Reverse: Both motors are in reverse direction.
3. Left: Left motor stopped and right motor in forward direction.
4. Right: Right motor stopped and left motor in forward direction.
5. Stop: Both motors are stopped.

Movement of the motors is controlled with the help of joystick commands and Ardunio UNO and battery using joystick controller board**.**

When the DC driver is connected to the motors and supply of 12v is given from the external voltage chargeable source. Interfacing of Arduino and HC-05 is done. With the help of android phone connect the Bluetooth HC-05 to the android app it is an independent speaker app. Following voice commands are given below in figure 4.1(a) and figure 4.1(b).

1. **Backward:** Motor1 moves in clockwise direction. Similarly Motor2 moves in the clockwise direction and the tyres of the wheelchair moves in backward direction.

2. **Forward:** Motor1 moves in the anti-clockwise direction. Similarly Motor2 moves in the anti-clockwise direction and the tyres of the wheelchair moves in forward direction.

3. **Left:** Motor1 or the left tyre moves in the anti-clockwise direction and simultaneously Motor2 or the right tyre moves in the clockwise direction.

4. **Right:** Motor2 or the right tyre moves in the anti-clockwise direction and simultaneously Motor1 or the left tyre moves in the clockwise direction.

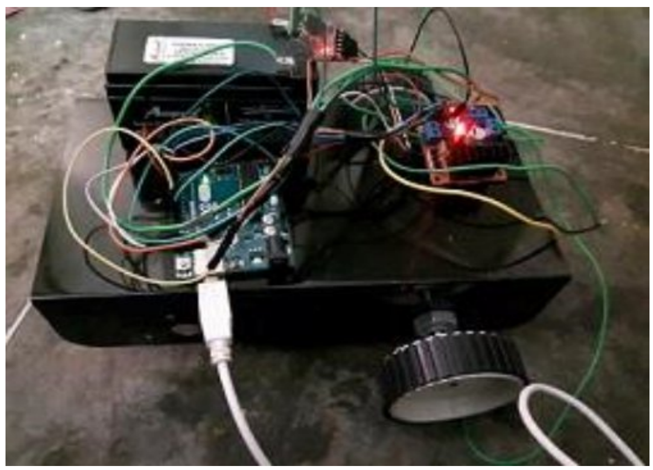

**Figure 4.1(a):** Wheelchair Model

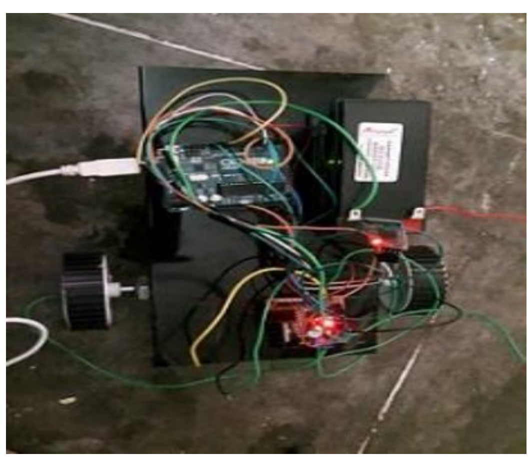

**Figure 4.1(b):** Complete Wheelchair Model

**Advantages**

1. A handicapped person even with Legs and Hand can use this and become Independent.
2. Very rapidly changing input can be easily recognized due to Android mobile.
3. Suitable for practical application as compared to HM 2007.
4. Requires less wiring because of Bluetooth section.
5. Less Hardware require i.e. compact.
6. Economical.
7. Reduce manpower.

**4.2. Results**

Joystick/voice operated wheelchair is the modified version of the manual wheelchair. It is operated on the joystick of patient (i.e. commands such as forward, left, right, stop, etc.) and voice of the patient .The wheelchair does not require any person to move it as it is automated with motors. Voice of an independent speaker is send through the android app,which is paired to HC-05 and interfacing of the Arduino and HC-05 converts the voice signals and with the help of L298D Driver motors are driven and hence the wheelchair moves in the direction directed from the independent speaker.

**4.3. Future Scope**

The current system limits its application in noise free environment. Future studies should aim at making it insensitive to noise by introducing proper noise filter into it. By making advanced and partial modifications, and also should focus on the IR sensors if the wheelchair is interrupted by some objects. This project can be used in acoustic control of vehicles' braking systems thus reducing risk of accidents.

Further advancement in this wheelchair are possible by decreasing the power requirements of the wheel chair or finding a way to automatically charge the battery with the help of motion of the wheel chair or solar panel.

# REFERENCES

[1] Ms. S. D. Suryawanshi, Mr. J. S. Chitode, Ms. S. S. Pethakar, “Voice Operated Intelligent Wheelchair” (IJARCSSE), Volume 3, Issue 5, May 2013.

[2] J.Z.Yi, Y.K.Tan, Z.R. Ang, “Microcontroller Based Voice Activated Powered Wheelchair Control” ACM 2007.

[3] S.A. Chhabria and R.V. Dharaskar ‘Multimodal Interface for Disabled Persons’, international Journal of Computer Science and Communication-January-June 2011,

[4] R.C. Simpson, ‘Smart Wheelchairs: A Literature Review’, J. Rehabil. Res. Develop., 42, pp. 423-436, 2005.

[5] Yasunari Obuchi, Multiple-Microphone Robust Speech Recognition Using Decoder-Based Channel Selection, Advanced Research Laboratory, Japan, 2004

[6] Javier Hernando and Climent Nadeu, Speech Recognition In Noisy Car Environment Based On OsaLPC Representation And Robust Similarity Measuring Techniques, Signal Theory and comm. Dept., Spain, 1994

[7] http://www.who.int/mediacentre/news/notes/2013/disability_and_development_20130920/en

[8] "Hardware Index". Arduino Project.Retrieved 2013-12-10.

[9] Jump up^ "Optiboot Bootloader for Arduino and Atmel AVR".Retrieved 2015-10-01

[10] https://en.wikipedia.org/wiki/Arduino

[11] http://www.instructables.com/id/Voice-Activated-Arduino-Bluetooth-Android/

[12] http://wiki.iteadstudio.com/Serial_Port_Bluetooth_Module_(Master/Slave)_:_HC-05

[13] http://www.ijircce.com/upload/2014/december/6_Voice.pdf

[14] M.A. Perkowski and K. Stanton, "Robotics for the handicapped",Northcon Conference Record, pages 278 (284, 199)

[15] R.C. Simpson, S.P. Levine, D.A. Bell, L.A. Jaros, Y. Koren and J. Borenstein,"Navchair: an assistive wheelchair navigation system with automatic adaptation"Assistive Technology and AI, LNAI 1458, pp. 235–255, 1998

[16] D.P. Miller and M.G. Slack."Design and testing of a low-cost robotic wheelchair prototype"Autonomous Robots,vol 2:77 - 88, 1995

[17] http://www.ijareeie.com/upload/2014/apr14-special/7_anoopsaveetha.pdf

[18] M.A. Perkowski and K. Stanton, "Robotics for the handicapped",Northcon Conference Record, pages 278 (284, 199)

[19] Aruna C., Dhivya P., Malini M., Gopu G., "Voice recognition and touch screen control based wheelchair for paraplegic persons", IEEE International Conference on Green Computing Communication and Electrical Engineering, 2014, P.1-5, India

[20] Kepuska V.Z., Klein T.B., "A novel wake-up word speech recognition system wake-up-word recognition task, technology and evaluation",Nonlinear Analysis 71, Science Direct, Elsevier, P. 2772-2789, 2009.

[21] Alan G.S., "Introduction to Arduino", 2011 Alan G.Smith Press.

[22] http://www.instructables.com/id/Motor-DriverBTS7960-43A

[23] Simpson R.C., Levine S.P., "Voice control of a power wheelchair", IEEE Transaction on Neural Systems and Rehabilitation Engineering, Vol.10, Issue 2, P. 122-125, 2002.

[24] Cooper, R.A. (2002).Intelligent Control of Power Wheelchair.IEEE Engineering in Medicine and Biology Magazine. 14: 423-431.

[25] Linda Fehr, MS. W. Edwin Langbein, Steven B. Skaar.(2000).Journal ofRehabilitation.Research and Development. Adequacy of power wheelchaircontrol interfaces for persons with severe disabilities: A clinical survey. 37(3):353-360.

[26] Kailash Pati Dutta, et al., Microcontroller Based Voice Activated Wireless Automation System, VSRD-IJEECE, 2 (8), 2012, 642-649.

[27] http://www.ijsr.net/conf/NCKITE2015/33.pdf

[28] Autonomous Robots 1995, Volume 2, Issue 3, pp. 203-224

[29] “Voice Operated Wheelchair”, Aakash. A. Hongunit1, Mayauri. Deulkar2, Varsha. Sable3. Prof. Dr. P. B. Mane. University of Pune, AISSMS Institute of Information Technology. E&C Dept. Volume 4, Issue 4, April 2014.ISSN: 2277- 128X.

[30] Chung-Hsien Kuo and H. H. W. Chen, "Human-Oriented Design of Autonomous Navigation Assisted Robotic Wheelchair for Indoor Environments," Mechatronics, 2006 IEEE International Conference on, pp. 230-235, 2006.