Advanced Voice Operating Wheelchair using Arduino

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Abstract - *The idea of using voice activated technology for controlling the motion of the wheelchair is to help many people with disabilities especially quadriplegics who do not have the dexterity necessary to control a joystick on an electrical wheelchair. The aim of this study is to implement an interesting application using small vocabulary word recognition system.* The methodology adopted is based on grouping a microprocessor *with a speech recognition development kit for isolated word from a dependent speaker. The resulting design is used to control a wheelchair for a handicapped person based on the vocal command and furthermore the user can select either slow or fast speed to move the system. This speed selection is in important for safety and extra maneuverability of the user. For example, if the user need only to move in a short distance or to approach object, he should use the slow speed. This paper describes the design and development of the motion control using voice recognition for a wheelchair application.*

***Key Words*: Voice-operated wheelchair, VRM, Arduino, Drive Circuit, PWM, DC Motor etc.**

1. INTRODUCTION

Assistive Technology (AT), that refers to hardware and software solutions for persons with physical, cognitive or sensory disabilities, can help people to have a more productive and pleasant lives. There are several physical disabilities/conditions which require the use of a wheelchair including brain injury, stroke, fractures, amputation, pulmonary disease, neurological disorders, musculoskeletal diseases/injuries and spinal cord injuries. In such cases the use of a wheelchair can bring an enhanced independence that will increase the user's quality of life. However, some of the impairments cause severe difficulties on the use of wheelchair manual or electric.

In a survey aimed to collect information from patients concerning the usefulness of new electric wheelchairs. The study concluded that 9 to 10 % of patients who use power chairs and who received appropriate training "find it extremely difficult or impossible to use the wheelchair for activities of daily living". Some of the pointed reasons are difficulty on controlling the wheelchair with a joystick, uncomfortable and inappropriate interface for the disability (because users with severe motor impairments are unable to operate the joystick smoothly). For elderly patients' arthritis is one of the major reasons for wheelchair use. For the referred groups of users, a voice-based interface is highly encouraging because it represents a natural and simple way of controlling the device.

2. LITERATURE REVIEW

This project describes the design of a voice-controlled wheelchair and home appliances using embedded system. Proposed design supports voice activation system for severely disabled persons incorporating manual operation with switch. PIC Microcontroller (16F877A) and voice recognize processors (HM2007) were used to support the wheel chair and home automation. This is a unique system incorporating both wheel chair control through voice and the home automation which provides reliability, safety and comfort by Anoop.K. J1. [1]

This paper describes the design of a smart, motorized, voice-controlled wheelchair using embedded system. Proposed design supports voice activation system for physically disabled persons incorporating manual operation. Arduino microcontroller and speaker dependent voice recognition processor have been used to support the navigation of the wheel chair. The direction and velocity of the chair are controlled by pre-defined Arabic voice commands by Ali A. Abed. [2]

Many disabled people usually depend on others in their daily life especially in moving from one place to another. For the wheelchair users, they need continuously someone to help them in getting the wheelchair moving. By having a wheelchair control system, they become more independent. The aim of this research project is to design and fabricate a voice-controlled wheelchair for physically disabled people by G Azam and M T Islam. [3]

Powered wheelchairs with the standard joystick interface are unable to control by many people. A voice-controlled wheelchair can provide easy access for physical disabled person who cannot control their movements especially the hands. The powered wheelchair depends on the motor control and drive system which consists of ARM Processor LPC2138 and DC Motor by Ms. S. D. Suryawanshi, Mr. J. S. Chitode and Ms. S. S. Pethakar. [4]

This paper by Coelho, L & Braga, D. zGo deals on automatic wheelchair for physically disabled people. A dependent user recognition voice system and ultrasonic and infrared sensor systems has been integrated in this wheelchair. In this way we have obtained a automatic wheelchair which can be driven using voice commands and with the possibility of avoiding obstacles by using infrared sensors and down stairs

or hole detection by using ultrasonic sensors. The wheelchair has also been developed to work on movement of accelerometer which will help for the person whose limbs are not working. Accelerometer can be attached to any part of body of physically disabled person which he can easily move like head, hand etc. It has also provision of joystick for disabled person who can easily move his/her hand. [7]

3. PROBLEM STATEMENT

Research from University of Notre Dame, 2000, suggests that the current power wheelchair control interfaces used may not, be adequate to provide truly independent mobility for substantial number of people with disabilities. The Respondents to the survey reported on average that approximately ten percent of the patients trained to operate a power wheelchair cannot use the chair upon completion of training for activities of daily living or can do so only with extreme difficulty (Linda Fehr,2000). The data of the patients is as the table below-

Table -1: Power wheelchair control interfaces used.

Percent of patients using	Simple Average	Weighted average
Joystick	81	81
Head or chin control	9	9
Sip and puff	6	9
Others- Eye gaze; tongue pad; head, hand, foot switch controls	4	1
Total	100	100

The challenge for engineering is to provide safe and effective mobility in a dynamic environment. Through thoughtful research and design, power wheelchair control will progress along safe and effective pathways towards providing users independent and self-guided mobility. This project will give the severely disabled people an innovative solution to control their wheelchair using voice interfacing.
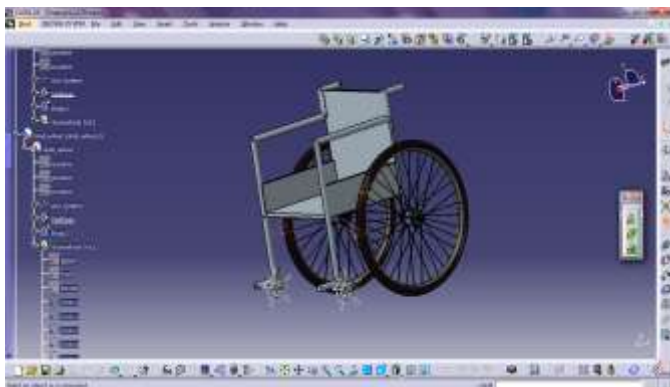
3. PROPOSED MODEL

Fig -1: Catia Model of Wheel Chair

The design and development of the system involves the implementation of both hardware and software. These approaches must be well implemented so that it will produce satisfactory outcome of the system which is to produce the correct wheelchair movement upon receiving the voice input command.

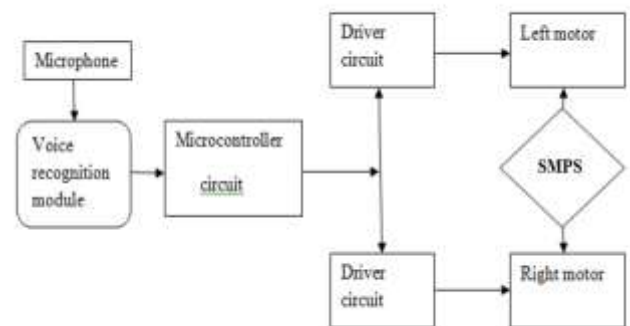## 4. SYSTEM BLOCK DIAGRAM AND COMPONENTS

Fig -2: Block diagram of System Mechanism

The wheelchair movement control system block diagram is shown in Fig-2 which can be divided into four different blocks:

1. Microphone unit.
2. Voice recognition module.
3. Main control system block
4. Power Supply Block.

4.1 Microphone Unit-

Fig -3: Microphone

A microphone, colloquially nicknamed mic or mike is a transducer that converts sound into an electrical signal. Microphones typically need to be connected to a preamplifier before the signal can be recorded or reproduced.
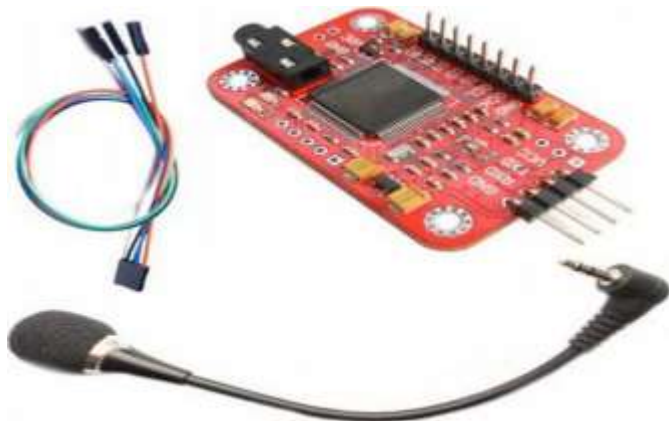
4.2 VOICE RECOGNITION MODULE (HM2007)-

Fig -4: VOICE RECOGNITION MODULE

The speech recognition system is a completely assembled and easy to use programmable speech recognition circuit. Programmable, in the sense that you train the words (or vocal utterances) you want the circuit to recognize. This board allows you to experiment with many facets of speech recognition technology. It has 8 bit data out which can be interfaced with any microcontroller for further development.

Some of interfacing applications which can be made are controlling home appliances, robotics movements, Speech Assisted technologies, Speech to text translation, and many more.

Specifications and features of HM2007 are as follows-

1. Single chip voice recognition CMOS LSI.
2. Speaker –dependent isolates-word recognition system.
3. External 64k SRAM can be connected directly.
4. Maximum 40 words can be recognized for one chip.
5. Maximum 1.92 sec of words can be recognized.
6. Two control modes are supported: manual and CPU mode.
7. Response time: less than 300ms
8. A microphone can be connected directly.
9. 5V single power supply.

4.3 ARDUINO-

Arduino is open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing).

Fig -5: Arduino

Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, MaxMSP).

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm

Fig -6: Specifications of Arduino

The machine part is open source, which means that anybody can make their own version of an Arduino machine for free.

4.4 DC MOTOR-

Fig -7: DC Motor

In this project two 12V Series DC motors were used. Series motors are commonly used as traction motors in many applications, as they offer high starting torque, are robust, have a simple design and are relatively low cost.

Specifications are as follows-

1. Model- MY1016Z2
2. Voltage- 24VOLT DC
3. Output-250 Watt
4. Rpm (After reduction)-300
5. Full load current- 13.4Amp
6. No Load current-2.2Amp
7. Torque Constant- 8Nm
8. Torque stall -40Nm

When voltage is applied, current begins to flow from negative power supply terminals through the series winding and armature winding. The armature is not rotating when 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 these conductors are so large, they will have a small amount of resistance. This causes the motor to draw a large amount of current from the power supply. When the large current begins to flow through the field and armature windings, it causes a strong magnetic field to be built. Since the current is so large, it will cause the coils to reach saturation, which will produce the strongest magnetic field possible.

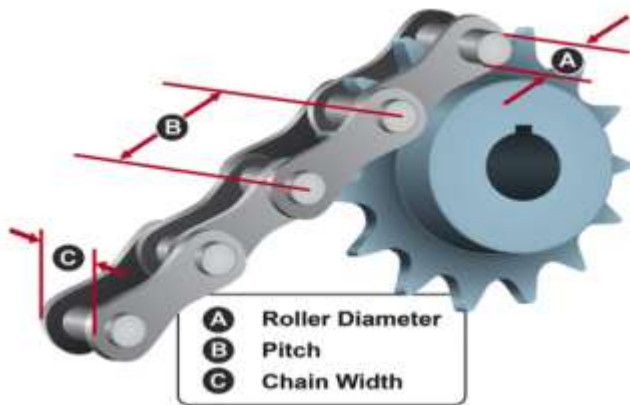## 4.5 - CHAIN AND SPROCKET-

Fig -8: Chain and Sprocket

A sprocket is a toothed wheel that fits onto a shaft. It is prevented from rotating on the shaft by a key that fits into keyways in the sprocket and shaft.

A chain is used to connect two sprockets. One sprocket is the driver sprocket. The other sprocket is the driven sprocket. Motion and force can be transmitted via the chain from one sprocket to another, therefore from one shaft to another. Chains that are used to transmit motion and force from one sprocket to another are called power transmission chains. Specifications of used chain and sprocket are-

1. Pitch = 0.5inch
2. Roller diameter= 0.3inch
3. Chain width = 0.16 inch
4. Sprocket Teeth = 9
5. Diameter = 5.020 inch
6. Weight= 3.0Lbs

4.6 - SMPS (switched mode power supply)-

Fig -9: SMPS

A switched mode power supply (SMPS) offers the same end results as a commonly used 12V DC supply but at a lower cost and higher efficiency. For a given output power, an SMPS is lighter and smaller. This is because, if the frequency of operation is increased, one can get away with using a smaller core cross-sectional area. Besides, an iron-core transformer works only up to about 10 kHz, and if we need something in 50-100kHz range, we need a ferrite core.
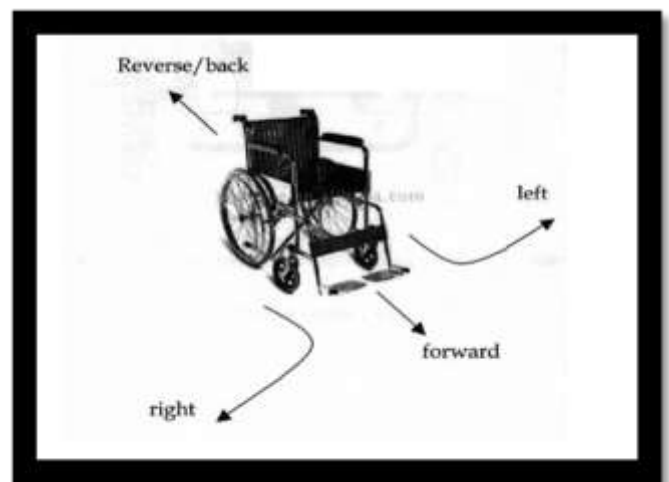
5. METHODOLOGY

Fig -10: Moment of Wheel Chair

In our model, voice recognition system is used as user interface. The block diagram of the smart wheelchair system is shown in figure 1. Here we are creating a speech recognition based wheel chair for handicapped patients. The patients who cannot walk and have to use a wheel chair can steer the wheel chair by their voice. Here in our project there is one input device i.e., mic which takes input from the user

in the form of speech, speech recognition system recognizes the input word spoken from mic. On receiving the Signal, the microcontroller directs the motors through the control circuit. In this, two DC high torque stepper motors are used for controlling the two wheels of the chair independently. These stepper motors are very useful for rotating in a particular angle. If a user wants to rotate its motor in 30 just, he has to give a command to a motor by a simple program and motor shaft will move to that particular angle. This mechanism will be very useful in rotating the wheelchair left or right at particular angle which user wants to rotate it. The changed instructions of motions possible are-

Forward: Both the motors in the forward direction.

Backward: Both the motors in the reverse direction.

Left: Left motor stopped/Right motor in the forward direction.

Right: Right motor stopped/Left motor in the forward direction.

6. WORKING PROCESS

First the user has to mount on the wheel chair. Then the patient can give voice commands via a head phone or mic. These commands are processes in the speech recognition system and according signals are then sent to the microcontroller to drive the wheel chair. We have made a motorized small model of the wheel chair. The wheel chair is operated by 2 DC stepper motors. The microcontroller controls these DC motors and controls the wheel chair accordingly. The voice commands are: Forward, Reverse, Left, Right, stop.

When the user gives the voice input, voice input voice is detected, the wheelchair can be controlled to move in that direction by giving commands to the wheelchair. These commands are transmitted to the wheelchair using electrical signals which are used the drive the left or right motor of the wheelchair. There are basically two motors connected to the left and right wheels of the wheelchair. The electrical signals are transmitted to these motors using some hardware ports. Generally, the communication port is the parallel port. There are some basic predefined pins of this parallel port which accept the commands given to the wheelchair in the form of electrical signals Four wheels are used in the wheelchair for accurate balancing. The movement of wheels is controlled by DC motors which are attached to the wheelchair. Two wheels located on left side of the wheelchair are controlled by one motor and similarly the wheels on the right side are controlled by the second motor. The other circuitry built into the wheelchair includes the transmitter and receiver circuits and the obstacle recognition circuit. It involves two IR signal emitters which emit IR signals constantly when some hurdle appears in front of the wheelchair, these IR signals are obstructed, and reflected back. These reflected signals are then sensed by the IR sensor present just at the side of the

emitters. As the IR signals are sensed, a circuit is connected to the beeper, and the beeper beeps. At the same time, signal is transmitted back to the voice recognition system so as to stop the wheelchair.

The voice recognition IC HM2007 is capable of operating in speaker dependent speech recognition mode. In speech recognition mode, first, the voice is recorded to the IC with the help of a directly connected microphone at the analog input terminal of HM2007 keeping the mode selection key in the record mode. In this way 40 0.9- second long words or 20 1.92-second long words or phrases can be recorded into the memory. After training the voice recognition IC like above the mode selection key is switched to voice input mode. Here at a particular instant the speech through the microphone is compared with the recorded sound and according to that digital output is generated. The output of voice recognition IC is then nourished to the digital input ports of the ATMEGA 16 microcontroller. The microcontroller on receiving the Signal directs the motors through the control circuit. The control of speed and direction are done in this way. The change of direction is achieved by changing the direction of current flow through the motor and speed control is achieved by varying the current through the motor. Speech recognition is allocated into two types:

 1) speaker dependent

 2) speaker independent.

Here the speaker dependent module is taught by the particular user who will be using the system. This module is capable of achieving a high command count and better than 95% precision for word to be recognized. The difficulty to this module is that the system only responds exactly only to the user who trained the system.

Speaker independent module is the module who trained to respond to a word irrespective of who speaks. So the system must respond to a huge range of speech pattern of the target word. Speech recognition module receives voice commands of the user and sends binary code corresponding to the received command to the microcontroller.

7. ELECTRICAL DESIGN

The electrical design of this project consisted of motors' drive circuit, battery, Pulse width modulation, the voice recognition kit and the connections between them, in addition to the connection with the joystick and microphone.

7.1 – DRIVE CIRCUIT-

Drive circuit is a circuit used for the purpose of controlling another circuit of component, in order to control and regulate their operation. Motor drives have been developed to offer power supply for the motors and isolate the

electronic components, such as the ICs, from electrical problems.

One popular type of motor drive circuits is the H-Bridge (sometimes called: The Full Bridge). It has been named that because it looks like the letter H when viewed on the discrete schematic. An H-Bridge is an electronic circuit that allows the voltage to be applied on the load in either direction. It is used to allow DC motors to operate in two opposite directions i.e. forward and Backward. The direction of rotation of a series motor can be changed by changing the polarity of either the armature or field winding.:
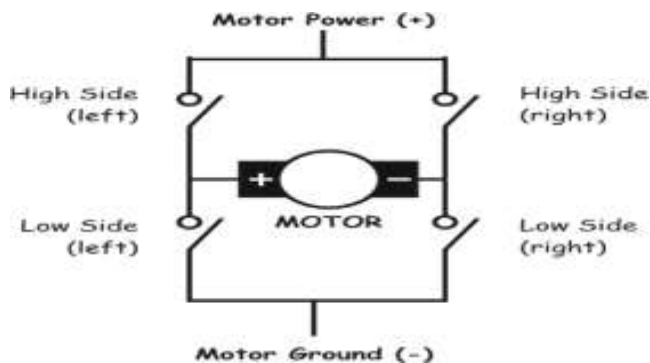

Fig -11: Simple H-Bridge

The four sides of the H-Bridge represent four switches that are activated in pairs; (1) High left and Low right, (2) High right and low left. This will result in controlling the current flow direction and therefore the direction of rotation of the motor. In this project two H-Bridges were used; one for each motor.

Four BJT transistors were used as switches for the H-Bridge. They take their signals from the microcontroller through resistors and transmit it to the four relays that control the power supply of the motors, thus deterring the direction of rotation of the motors and consequently the direction of the wheelchair's motion.

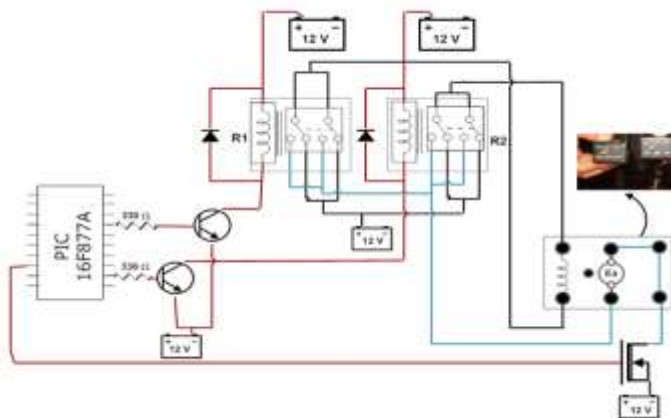The figure bellow demonstrates the connection of the drive circuit:

Fig -11: Motors' drive circuit schematic.

The table below shows the direction of rotation of the Wheelchair based on the direction of rotation of the two motors.

Table -2: Wheelchair motion-

Direction	Right Motor	Left Motor
Forward	ON (CW)	ON (CW)
Backward	ON (CCW)	ON (CCW)
Right	OFF	ON (CW)
Left	ON (CW)	OFF

Where:
CW: Clockwise
CCW: Counter Clockwise
The table below shows the direction of rotation of the motors based on the state of the transistors i.e. on – off.

Table -3: the direction of rotation of the motors based on the state of the transistors.

Direction	Left motor		Right motor	
	Transistor 1	Transistor 2	Transistor 3	Transistor 4
Non	0	0	0	0
Forward	1	0	1	0
Reverse	0	1	0	1
Right	1	0	0	0
Left	0	0	1	0

7.2 – DRIVE CIRCUIT SIMULATION-

In order to verify our design prior to the circuit's actual construction a computer simulation was conducted using the software: Proteus VSM version 7.6.

Proteus Virtual System Modelling (VSM) combines mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete microcontroller-based designs. The simulation takes place in real time (or near enough to it): a 1GMHz Pentium III can simulate a basic 8051 system clocking at over 12MHz. Proteus VSM also provides extensive debugging facilities including breakpoints, single stepping and variable display for both assembly code and high-level language source.

7.3 – PULSE WITH MODULATION (PWM)-

Pulse width modulation is used to control the average power that goes a load in a motor. A digital signal is used to generate an analogue output that is intended to go to the motor. It operates by changing the average voltage level through generating a constant frequency signal in which the pulse width is manipulated or changed.

For example, if a the normal digital signal (5V = on, 0V = off) is to be changed to an average of 2.5V, the signal 5V will be on for half of the time. As shown in the figure below:
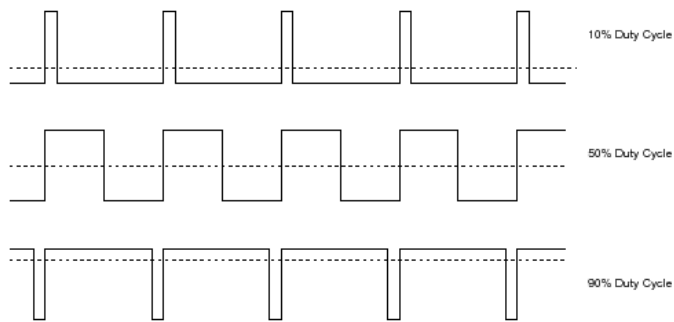

Fig -12: PWM digital output and average output.

1. PWM Duty cycle and frequency-

The Duty cycle refers to the percentage of time that a signal is high or low. For example, in the upper graph of above figure, the signal is 10% of the time high so the average is low. Whereas in the lower graph, the signal is 90% of the time high so the average is high. In this project the duty cycles 100% and 50% to represent to speeds modes High speed and low speed.

The importance of the frequency of the PWM depends on the driven device; it should be high (KHz) if the target is to create a DC signal. The magnitude of it depends on the desired output, the amount of tolerated error and the use.

2. Averaging the PWM microcontroller output-

We need to average the PWM signal by converting it to a useful analogue signal so that we can benefit from it. This is done by using a capacitor as a low pass filter, in which the output frequency will decrease as the input frequency increases.

8. PROJECT CODE

Software code:

```
Program wheelchair
dim j as byte
dim v as byte
main:
trisb=$ff        'define port b as input
trisd=$ff        'define port d as input
trisc=$00        'define port c as output
pwm_init(5000) 'initialze the PWM with a desired frequency
in Hz
pwm_start        'starts PWM
if portd.3=1 then        'check the selector button if
pressed or no
        delay_ms(300)
        goto wheel
else
```

```
        delay_ms(300)
        goto voice
end if
wheel:
while true
 j=portd          'the four direction of wheel and the selector
button(selector d3)
select case j
case  $18        'left
pwm_change_duty(90)        'changes PWM duty ratio
portc.4=0        'output to translator1
portc.5=0        'output to translator2
portc.6=1        'output to translator3
portc.7=0        'output to translator4
case  $28        'right
pwm_change_duty(90)        'changes PWM duty ratio
portc.4=1
portc.5=0
portc.6=0
portc.7=0

case  $48        'forward
pwm_change_duty(240)        'changes PWM duty ratio
portc.4=1
portc.5=0
portc.6=1
portc.7=0
case  $88        'backward
pwm_change_duty(90)        'changes PWM duty ratio
portc.4=0
portc.5=1
portc.6=0
portc.7=1
case  else        'if we not press any button
portc.4=0
portc.5=0
portc.6=0
portc.7=0
end select
delay_ms(200)
if portd.3=0 then        'Confirmation of the selector case
        goto voice
end if
wend
voice;
        portc.4=0        'output to transistor1
        portc.5=0        'output to transistor2
        portc.6=0        'output to transistor3
        portc.7=0        'output to transistor4
while true
        v=portb        'the output of SRC
        select case v

case$81,$82        'forward
        pwm_change_duty(240) 'changes    PWM
duty ratio
        portc.4=1
        portc.5=0
```

```
                    portc.6=1
                    portc.7=0
                    delay_ms(1000)
case$83,$84         'backward
                    pwm_change_duty(90)         'changes
PWM duty ratio
                    portc.4=0
                    portc.5=1
                    portc.6=0
                    portc.7=1
                    delay_ms(1000)
case$85,$86         'right
                    pwm_change_duty(90)         'changes
PWM duty ratio
                    portc.4=1
                    portc.5=0
                    portc.6=0
                    portc.7=0
                    delay_ms(1000)
case$87,$90         'left
                    pwm_change_duty(90)         'changes
PWM duty ratio
                    portc.4=1
                    portc.5=0
                    portc.6=1
                    portc.7=0
                    delay_ms(1000)
case$91,$92         'speed
                    pwm_change_duty(255) 'changes   PWM
duty ratio
                    portc.4=1
                    portc.5=0
                    portc.6=1
                    portc.7=0
                    delay_ms(1000)
case$81,$82         'stop
                    portc.4=0
                    portc.5=0
                    portc.6=0
                    portc.7=0
                    delay_ms(500)
case$81,$82         'for any turbulence
                    portc.4=0
                    portc.5=0
                    portc.6=0
                    portc.7=0
          end select
if portd.3=1 then          'Confirmation of the selector case
goto wheel
end if
wend
end.
```
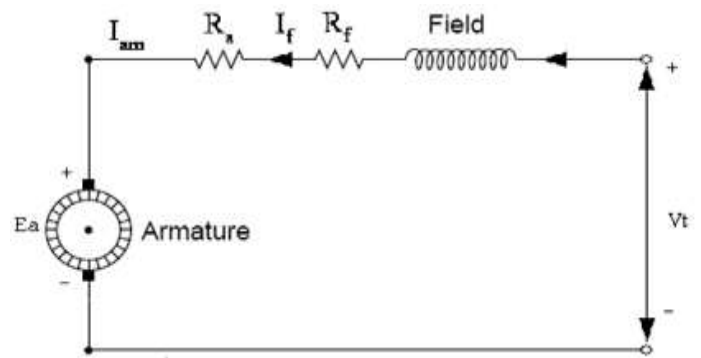
8. CALCULATIONS

The figure below demonstrates a schematic of the series DC motor:

Fig -13: Series DC motor schematic.

1.   Power and Torque calculations-

The Rotational Speed of each of the available motors = 4000 rpm.

The relation between the rotational speed and power is given by the equation:

Torque = Output Power/Rotational Speed

$E_a = V_t – I_a (R_a + R_f)$

Where:

E_a is the armature voltage (Volt).

V_t is the total voltage (12V).

I_a is the armature current (Ampere).

R_a is the armature resistance (Ohm).

R_a is the field resistance (Ohm).

$P_d = I_a * E_a$

Where:

P_d is the Electrical power developed inside the motor.

$\tau_e = P_d / \omega_{motor}$

Where:

τ_e is the electrical torque developed inside the motor (N.m).

ω_{motor} is the rotational speed of the motor (r.p.m).

$\omega_{motor} = 2* \pi *$Number of rotations per minute / (60 Second/Minute)

$P_{out} = P_d - P_r$

Where:

P_{out} is the mechanical output power of the motor (Watt).

P_r is the rotational power losses (%).

$\tau_{shaft} = (P_d-P_r) / \omega_{motor}$

Where:

τ_{shaft} is the mechanical torque on the shaft.

2.   Gear Box Calculations-

By using a gear box with a step-down ratio = 0.08 we find that:

$\omega gear = 0.08 * \omega motor$

Where:

$\omega gear$ is the rotational speed of the gear (r.p.m).

$\omega motor$ is the rotational speed of the motor (r.p.m).

And:

$\tau gear = P_{out} / \omega motor$

Where:

$\tau gear$ is the torque on the gear.

3. Extra pulley calculations-

Gears and Chain transmit rotary motion from one shaft to another, often changing speed and torque in the process. Gear sets are generally used where the two shafts are close together. Chain and Sprocket, or sheaves, on the other hand, link shafts that are farther apart. [15]

4. Gears-

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 fewer teeth than the one on the machine shaft. The speed ratio is $R = NL/NS$, where NL = number of teeth in large gear, and NS = number of teeth in small gear. If the large gear has 40 teeth and the small one 20, the speed ratio is 2:1, and the machine shaft turns once for two turns of the motor shaft. The speed is cut in half, and torque is doubled.

5. Chain and Sprocket-

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Sprockets are of various designs; a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centred. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

The figure bellow shows the speed profile of the wheelchair. The speed profile is obtained from the assumption that the wheelchair will accelerate from 0 to 0.5 m/s speed in 1 second. Then it will continue its motion in a constant speed equals to 0.5 m/s.
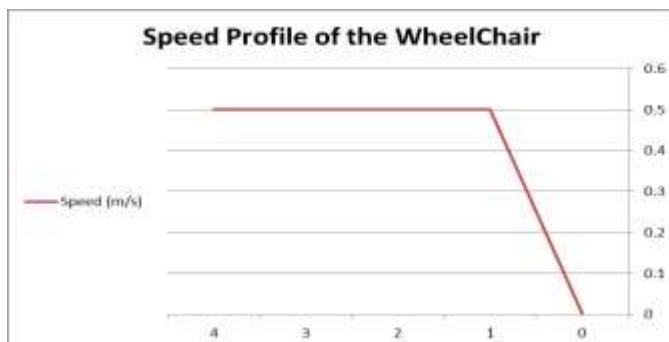

Chart -1: Speed profile of the wheelchair

We want the wheelchair to reach a constant speed of (0.5 m/s) during (1 second):

From profile speed we determine the angular acceleration and then the required torque as follows:

$\alpha = a/r$
Where:
α is the angular acceleration of the Wheel (rad/s^2).
a is the linear acceleration of the wheel (m/s^2).
$a = 0.5/1 = 0.5$ m/s^2
$\alpha = 0.5/0.3 = 1.666$ rad/s
$\tau_{required} = 0.8$ N.m + 9 kg/m^2 * 1.666 rad/s^2 = 15 N.m

Because we have 2 motors (one for each wheel) we need a total torque of: 27.0 N.m. This value is based on the extreme conditions of operation, i.e. the belt losses are 10% and the Load = the max load = 100 Kg at the required speed profile.

9. RESULTS

Fig -14: Manufactured Model Side View.

Fig -15: Manufactured Model Back View.

After the design and development of the wheel chair with respective interfacing circuits, the technology was tested for

the motion of the wheel chair and home automation using trained voice.

This design is experimented based on two important aspects, firstly, on the accuracy of the system and secondly, wheelchair velocity & home automation control by means of on & off control commands.

The proposed design was implemented using normal people. This would be implemented for disabled people after having the smoothly furnished design of the wheel chair.

10. CONCLUSION

Recent advancements in the technology are making lives easier for everybody. The system was successfully implemented to move the wheelchair left, right, forward, backward or stay in same position. This work is to help the disabled persons by providing alternative methods to control the equipment either by joystick or through voice, there by serving many disabilities. Thus the wheelchair understands the signals coming from control system and reacts accordingly. A smart wheelchair using voice and head joystick control is designed and developed. It is easy to understand and process. It contains two modules to control the movement of the wheelchair according to user commands. If any patient is unable to move hand then voice commands can be used for the navigation of the wheelchair independently. The joystick provides help for the manual control. A microphone can be used to give voice commands. This system provides independent mobility as well as many intelligent facilities to the rising disabled population.

11. FUTURE SCOPE

Efficiency of the voice command control system can be further improved by implementing neural network-based algorithms. As the future work, we can provide a friendly atmosphere for disabled persons that is alerting in case of obstacles and updating the whole indoor environment condition to wheel chair and giving controlling of the devices at wheel chair itself which avoids the problem of approaching the switch. To be able to perform a wheelchair transfer up or down a set of stairs, it is important to have 2 people available to help the user in the process. The user can not attempt this type of transfer if helpers are not available. A wheelchair up and down (step) movement is very difficult, even if there is a helper. In order to overcome this problem, WHEELCHAIR TREADS can be used. The person using the wheelchair should be seated with their entire body fitting in the chair. A seat belt should be used in order to keep the patient/user in the chair while attempting the transfer.

12. REFERENCES

[1] University of Pune, AISSMS Institute of Information Technology. E&C Dept. Volume 4, Issue 4, April 2014.ISSN: 2277- 128X.

[2] JavajjiVeeraiah., P.V.N AravindSyam,.N.NagaDurga., K.RaviKanth., G.Vasudha, "Accelerometer Based Gesture Recognisation for

[3] Wheel Chair Direction Control Using ZIGBEE Protocol", International Journal of Technological Exploration and Learning (IJTEL), Vol.2, No.2, pp.104-108, April 2013.

[4] ShreedeepGangopadhy., SomsubraMukherjee, Soumya Chatterjee, "Intelligent Gesture Controlled Wireless Wheelchair For The Physically Handicapped", Proceedings of Fifth IRAJ International Conference, Pune, India,Vol.1,No.7,pp.47-52, 15 September 2013.

[5] MoniruzzamanBhuiyan, Rich Picking, "A Gesture Controlled User Interface For Inclusive Design And Evaluation Study Of Its

[6] Usability",Journal of Software Engineering and Applications,Vol.4,No.9,pp.513-521,September 2011.

[7] Coelho, L & Braga, D. zGo: A Voice Operated Wheelchair with Biosignal Monitoring for Home Environments. Proceedings of the 2th International Conference on Software Development for Enhancing Accessibility and Fighting Info-Exclusion, June 3-5, Porto Salvo, Portugal. 2009. http://www.danielabraga.com/PDF/DSAI09_3.4.p84.pdf

[8] Mano, M et al.. Wheelchair for physically disabled people with voice, ultrasonic and infrared sensor control. Aotonomous Robotics, 2, 203-224. 1995.

[9] http://en.wikipedia.org/wiki/Motorized_wheelchair

[10] http://www.nskelectronics.com/files/hm2007_voice_recog_kit.pdf

[11] http://www.imagesco.com/article/hm2007/SpeechRecognitionTutorial02.html

[12] http://zone.ni.com/devzone/cda/ph/p/id/53

[13] http://www.lmphotonics.com/DCSpeed/series_dc.html

[14] http://www.rehab.research.va.gov/

[15] http://electric-wheelchairs-pro.com/

[16] http://www.robotroom.com/HBridge.html