DESIGN AND FABRICATION OF AN ELECTRIC WHEELCHAIR WITH AN AUTOMATIC OBJECT DETECTION SENSOR POWERED BY SOLAR ENERGY

A project report submitted to the Department of Mechanical Engineering, Sonargaon University, in partial fulfillment of the requirement for the degree of Bachelor of Science in Mechanical Engineering.

Supervised by:

Saikat Biswas

Lecturer,

Department of Mechanical Engineering,

Sonargaon University (SU), Dhaka

Submitted by:

TIPU SULTAN

BME1803016361

MAHMUDULLAH

BME1803016280

MD. SHOHEL AHMED

BME1803016194

MD. DELWAR HOSSAIN

BME1803016197

MD. HADIUR RAHAMAN

BME1803016290

Sonargaon University (SU)

147/1, Green Road, Panthapath, Tejgaon, Dhaka

September 2022

DESIGN AND FABRICATION OF AN ELECTRIC WHEELCHAIR WITH AN AUTOMATIC OBJECT DETECTION SENSOR POWERED BY SOLAR ENERGY

A project report submitted to the Department of Mechanical Engineering, Sonargaon University, in partial fulfillment of the requirement for the degree of Bachelor of Science in Mechanical Engineering.

Submitted by:

………………………
Saikat Biswas

Lecturer,

Department of Mechanical Engineering,

Sonargaon University (SU), Dhaka

…………………………
TIPU SULTAN

BME1803016361

…………………………
MAHMUDULLAH

BME1803016280

…………………………
MD. SHOHEL AHMED

BME1803016194

…………………………….
Md. Mostofa Hossain

Professor,

Head of the Department

Department of Mechanical Engineering,

Sonargaon University (SU), Dhaka

…………………………
MD. DELWAR HOSSAIN

BME1803016197

…………………………
MD. HADIUR RAHAMAN

BME1803016290

Acknowledgement

Our utmost gratitude to Allah, the almighty, without his mercy and blessing this work would not been possible. We are grateful to our supervisor **Saikat Biswas**, Lecturer, Department of Mechanical Engineering, Sonargaon University for his guidance, encouragement many ways throughout his project work. We also appreciate his vision, experience, interest and support for this project which came to us with greater help to write this paper.

We are also thankful to **Md. Mostofa Hossain**, Professor, Head, Department of Mechanical Engineering, Sonargaon University for suggestions. We are also thankful to our classmates for their support and also who helped us to make this project successful. Finally we convey our heartily gratitude to our parents and family members for their moral support.

I would like to express my sincere gratitude and thanks to the **Vice Chancellor** of Sonargaon University (SU), Dhaka

.

Abstract

There are two possibilities of either using manual driven or electric powered driven wheel chairs. The former solution is only for the people who have disability in lower limbs and also long term usage poses further health problems. Additionally, the efficiency of the manual driven wheel chairs are merely 10 to 20%. This project aims to control a wheelchair by means of electric joystick. Smart wheelchair has gained a lot of interests in the recent times. These devices are useful especially in transportation from one place to another. The project also aims to build a similar wheel chair which would have a sort of intelligence and hence helps the user on his/her movement. The prototype of the wheelchair is built using an Arduino microcontroller based computer software, in addition to its versatility and performance in mathematical operations and communication with other electronic devices such as wheelchair control joystick, DC motor control relay module, and ultrasonic sensor. The system has been designed and implemented in a cost effective way so that if our project is commercialized, the needy users in developing countries will benefit from it. To do that, we applied a program carried on Arduino circuit which is connected to the joystick the signal operates a motor to control the movement of the chair. In this way, we have obtained a wheelchair that can be driven using joystick commands and with the possibility of avoiding obstacles and downstairs or hole detection. In the project, in which a prototype has been produced, an Electronic system configuration, a sensor system, a mechanical model, and joystick control are considered.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

Chapter I

Introduction

1.1 Introduction

“Give me a wheelchair that is light and compact, that fits in a small plane when I need tofly outing the wet season. Make sure it’s comfortable, does not give me pressure sores, to make me look like a cripple straight out of hospital. It has to be easy to push because I want to get out, go crabbing in the boat and go fishing on the beach.” (Hales S 2001) This quotation describes the needs of a wheelchair user in an Aboriginal community. The number of people, who need to move around with the help of some artificial means, whether through an illness or an accident, is continually increasing. These means have to be increasingly sophisticated, taking advantage of technological evolution, in order to increase the quality of life for these people and facilitate their integration into the working world. In this way a contribution may be made to facilitating movement and to making this increasingly simple and vigorous, so that it becomes similar to that of people who do not suffer deficiencies. Systems already exist which respond too many of the needs of people with different degrees of incapacity.

Wheelchair is a transportation device used by people who have difficulties in walking due to illness or disability. It is moved either by the handles or by turning the wheels. Today there are many options and many different types of wheelchairs such as manual wheelchairs, powered wheelchairs, and transport wheelchair. Wheel chair consists of mechanical components basically such as the hand rims, armrests, foot rests, castors, seat and back upholstery. However, the existing wheelchair has weakness such as not ergonomics enough to meet the users needed. Ergonomics can be defined as the application of knowledge of human factor to the design of systems (Taylor & Francis,2008). The first wheelchair was made for Phillip II of Spain. Later on in 1655 a disabled watchmaker called Stephen Farfler built himself a three-wheeled chair to help himself get about on. In 1881 the 'push rim' was invented which meant no dirtier hands for wheelchair users; they could use the push rim to move the wheels and not get covered in mud. From here wheelchairs have developed more and more over the years including easy use, more options, lightweight options, and adjustable seats and so on.

1.2 Objectives

Our main objective was to develop an electric wheelchair system using a joystick to control the motor speed and measure the object distance using an ultrasonic sensor automatically for the sound alert and stop the wheelchair.

1. To design a portable electric wheelchair for a disabled person.
2. Fabrication of a solar based electric wheelchair.
3. Performance test of an electric wheelchair.

Chapter II

Literature Review

2.1 Historical Background

Manual wheelchairs are the oldest type of wheelchair available and are either classified as self propelled or attendant propelled. One of the first self propelled wheelchairs was developed by a blacksmith over 300 years ago and used a hand crank to move the wheelchair. Today, there are a number of different types of self propelled manual wheelchairs, which are classified by their uses, but the most common type of manual wheelchair is the conventional wheelchair. A conventional wheelchair has hand rims which are attached to the outside of the rear wheels, which allow the user to turn the rear wheels. The rear wheels are much larger than the front wheels and are typically 24 inches in diameter (Martel et al., 1991). The Conventional wheelchair usually offers a folding design, so it can be easily transported, and has a steel tubes frame. However, to reduce weight aluminum and titanium frames are also used. The seat is typically made of vinyl, which is easy to clean (Martel et al., 1991). Attendant propelled wheelchairs, or transport chairs, often look very similar to a self propelled wheelchair; however they do not have hand rims on the rear wheels. Instead they are designed to be pushed by someone walking behind the wheelchair. Often the rear wheels will be much smaller than traditional wheelchairs.

Several studies have shown that the independence mobility 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 exploration and control often produces a cycle of deprecation and reduce motivation that leads to learned helplessness. Wheelchair is one of the best creations to provide independent mobility, but the idea of creating wheelchair is not a new one. It was started many years ago. These are the cycle of development of wheelchair:

2.2 First wheelchair

First record of combining wheels to furniture .Image on Greek vase of wheeled child's bed

Fig: 2.2.0.1: First wheelchair.

2.2.1Second wheelchair

Three centuries later in China. the Chinese used their invented wheelbarrow to move people as well as heavy objects. A distinction between the two functions was not made for another several hundred years, around 525 C.E. when images of wheeled chairs made specially to carry people begin too ccur in Chinese art.

Fig: 2.2.1.1: Second wheelchair.

2.2.2 The “Bath” Chair

Developed in Bath, England. Invented by John Dawson in 1783.It had 2 large rear wheels and one small front wheel.

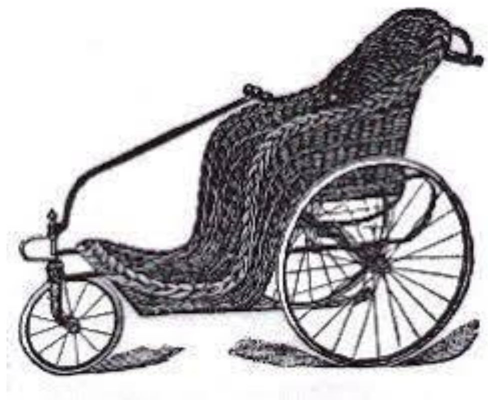

Fig: 2.2.2.1: The “Bath” chair.

2.2.3The Bicycle

1790, de Sirvac introduced the “swift walker”; a wooden bicycle propelled by the user by pushing feet to the ground. In 1865 cranks and pedals were added and it was re-named the “boneshaker”. Like the wheelchair, the bike is also propelled by user.

Figure: 2.2.3.1: The Bicycle

2.2.4 First Portable Wheelchairs

Harry Jennings and his friend Herbert Everest, both mechanical engineers, invented thefirst lightweight, steel, collapsible wheelchair in 1933.The two saw the business potential of the invention and went on to become the first mass manufacturers of wheelchairs; Everest and Jennings. Their “x-brae” design is still in common use.

Fig: 2.2.3.2: First Portable Wheelchairs

2.2.5 Advantages

- An electric wheelchair, in particular, provides increased independence due to it’s ease-of-use and the ability to travel without experiencing fatigue. An ultrasonic sensor, cheaper and less demanding of hardware than other types of sensors presently used.
- Even a manual wheelchair provides additional flexibility for the user and their career. For someone with limited mobility who may not be able to walk unaided, a wheelchair can reduce the risk and fear of falling in the home or outdoors allowing you to move around with confidence.
- The ultrasonic based distance measurement sensor can calculate the distance of object and make alert sound.
- As it charges the battery through solar power, it will save electricity.
- It has very easy speed control system which ensures safety.
- Cost effective.

2.2.6 Disadvantage

- Battery cannot be charged without sunlight.
- System becomes more complex and installation is bit difficult.

2.2.7Cost estimation

Name	Quantity	Unit Price	Total Price
Arduino Nano	1	1500	1500
Ultrasonic Sensor	1	500	500
12V 8A Battery	2	1500	3000
Joystick	1	500	1000
Motor Speed Controller	1	700	1400
DC Geared Motor	2	3000	6000
Manual Wheel Chair	1	8000	8000
40W Solar panel	1	4000	4000
Relay Module	1	500	500
Others		1000	1000
Total Taka			26,900

Chapter III

Components

3.1 Electric Circuit Wiring Diagram

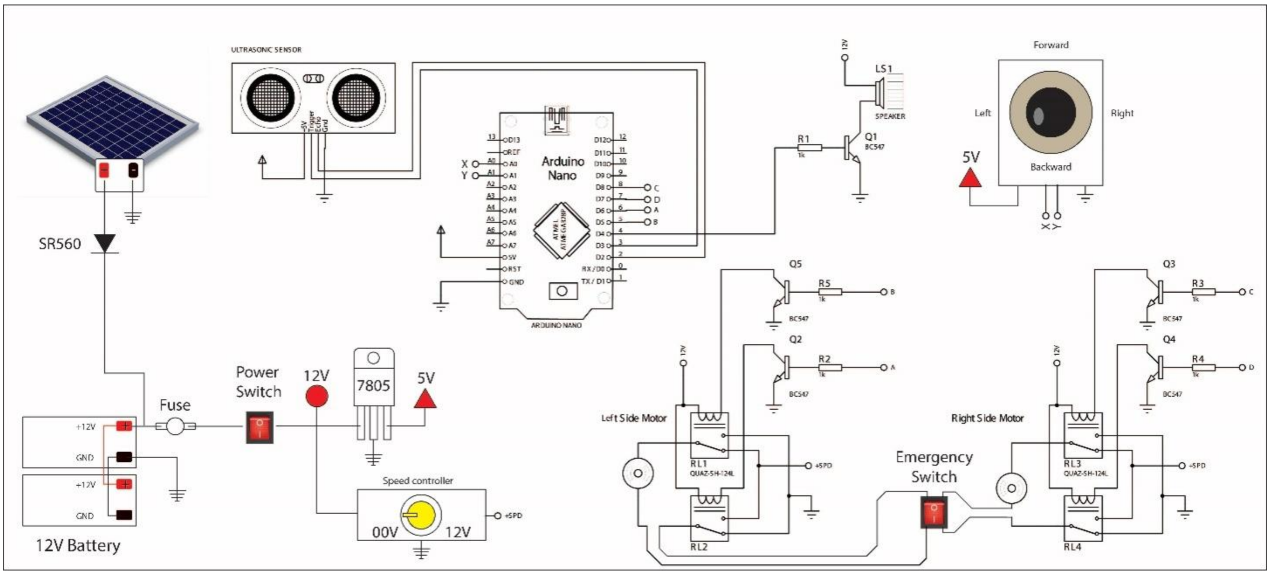

Figure :3.1.1.1: Circuit wiring diagram

From the above figure 3.1.1 is showing the complete circuit wiring diagram of the electric wheelchair system which we have implemented for a disable people. As we can see the main component is the microcontroller Arduino Nano with Atmega328P microcontroller IC, which is a 28 pin SMD microcontroller. The sensors we have used in this project are Ultrasonic sensor. The ultrasonic sensor is a kind of sensor which can detect almost all type of obstacle by receiving echo from it. We connect this sensor with pin no D2, D3 of Arduino Nano to detect the signal in front of the wheelchair. We used joystick for control the wheelchair forward, backward, left, right and stop. The joystick is connected to the microcontroller pin A0 and A1 analog pin. The four relay connected with the microcontroller pin D5, D6, D7, D8 for control the 12V Dc geared motor. The 12V DC buzzer operates from microcontroller using transistor BC547. The Emergency switch is connected with the two motor power line. Two lead acid cell battery 12V 8A are connected using parallel connection for boost the battery ampere 8A+8A=16A, 12V. The power switch controlled the all-electric line of the system. The 40W solar panel charges the 12v battery.

3.2Methodology

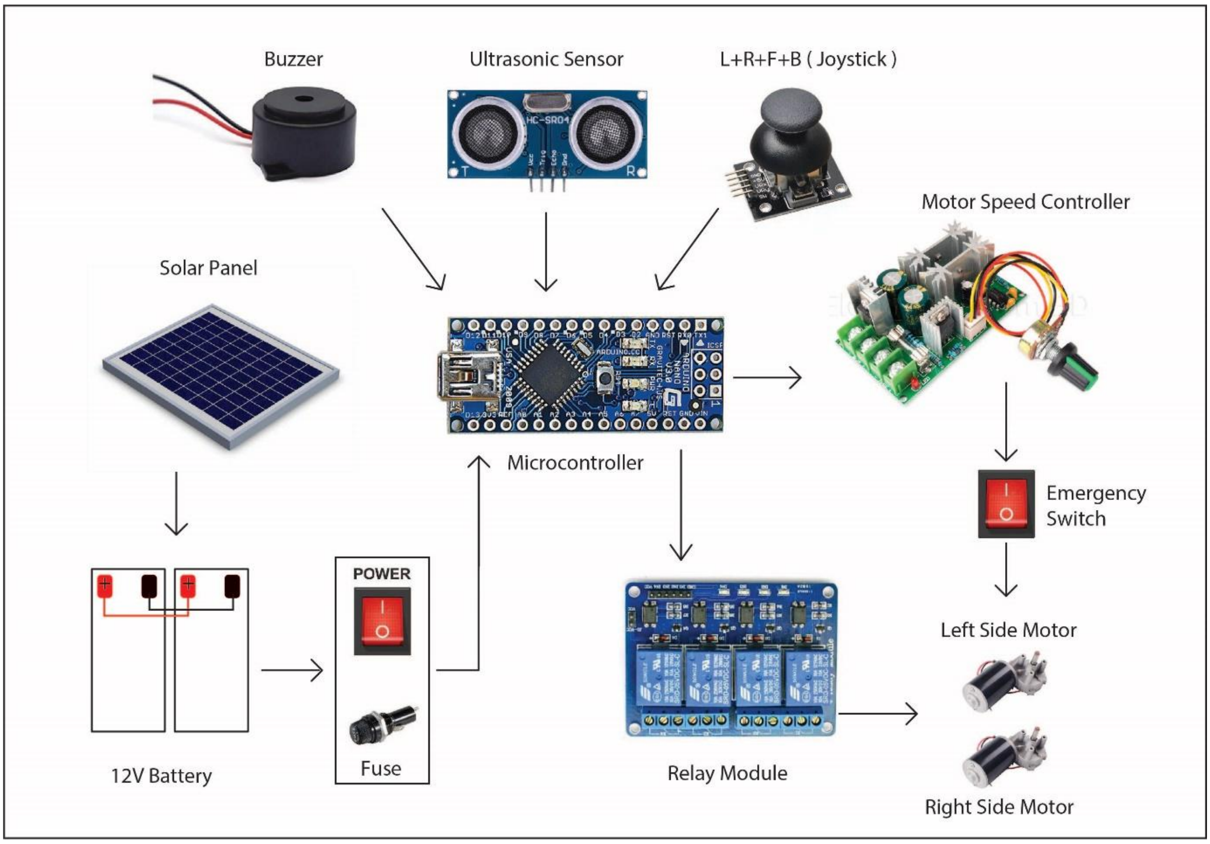

Figure :3.2.1.1: Block diagram of project

Working Principle of Arduino Nano

The central heart of the project is the Arduino Nano microcontroller module. This microcontroller module connects with all the input and output modules of a project like the 12v Buzzer, Ultrasonic sensor module, joystick, and relay module. This microcontroller board is a programmable device. Its have one programming port to connect the computer. A microcontroller can make the decision when the ultrasonic sensor senses the object. The microcontroller module turned to stop the wheelchair using the relay module.

Solar Panel

A solar cell panel, solar electric panel, photo-voltaic (PV) module or solar panel is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of PV panels is called an array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

The solar based charging system is cost effective and free of energy. the 12v solar panel is provided the 2.2A current for a 12v 16 Amp battery. This panel can fully charge to battery 14volt within 3 Hour sun power.

Ultrasonic Senor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

The main lore of this project is the ultrasonic sensor. This sensor can sense any object in front of the wheelchair and send the distance data to the microcontroller module. (0 to 40Cm) Wheelchair stop mode and (41 to 100Cm) Buzzer alert mode is in belt of function.

3.3 Manual Wheelchair

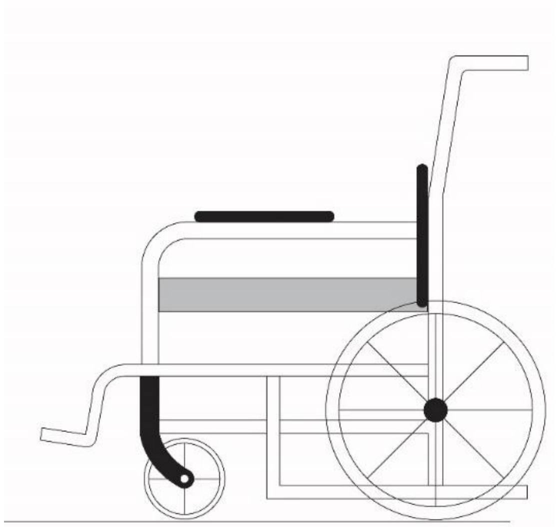

Figure: 2.2.4.2: 2D design of a manual wheelchair.

3.4 2D Design of modified electric wheel chair

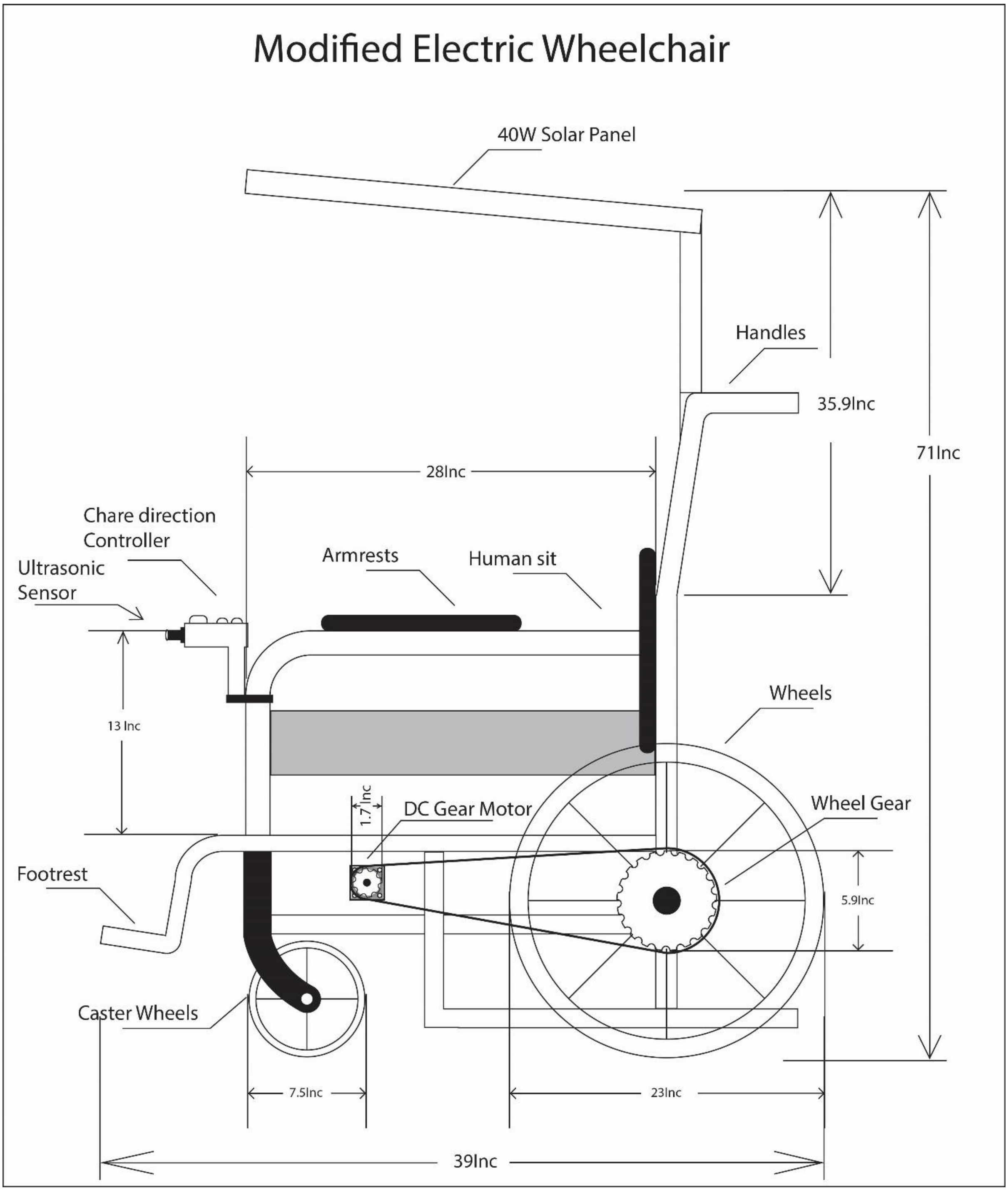

Figure :2.2.5.1: 2D design of modified electric wheel chair

3.5 Assembling Parts

Manual wheelchair buys from local market.

Figure:3.5.1:Manual wheelchair

3.6Add Motor Stand

Add motor mount stand with manual wheelchair.

Figure:3.6.1:Add motor mount stand wheelchair

3.7Add Motor with Wheelchair

Add 12V DC gear motor and Chain Sprocket with motor mount stand.

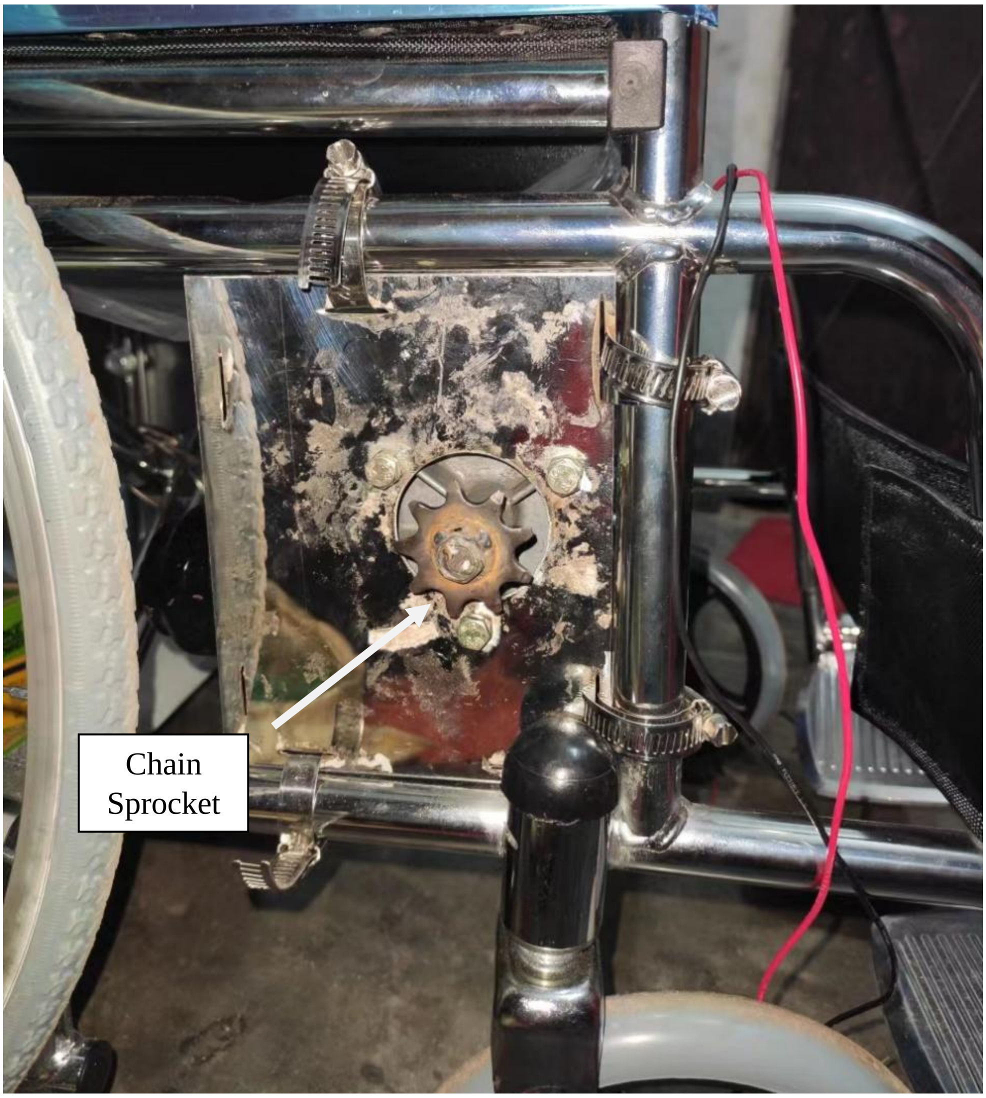

Figure:3.7.2: 12V Gear motor.

3.8Chain with Sprocket

Chain connects with motor and wheel sprocket.

Figure:2.2.8.1: Chain with Sprocket

Torque required for the motor

f_R= Frictional Force

F_{Max}= Maximum Force

N = Normal Contact Force

a = acceleration

u = coefficient of friction

m = Mass of the person

g = gravitational acceleration (9.8 m/s2)

External Weight = Weight of battery + weight of electronic box + weight of chair + weight of motors

External Weight = 7.2+ 0.7 + 21.5+3

External Weight = 32.4 kg

For weight = 85 Kg

Total Weight = Weight of person + External weight

Total Weight = 85 + 32.4

Total Weight =117.4 kg

Since there are two motors attached so weight exerted by each motor will be the halve value of the total weight since there are two main reaction forces on Rear Wheel. The caster wheel will have very low impact on the wheel chair since they are for supporting the wheel chair so the reaction forces of those caster wheel are not making into consideration.

So, Weight exerted by motor 1 = 117.4/2

Weight exerted by motor 1 =58.7 kg

Now Maximum force exerted by the wheel chair will be

Calculated

F_{Max}-f_R= m x a (1)

Now, for the ideal condition normal wheel chair accelerate sat 4.0 m/s2 and coefficient of friction (u) for rough surface is0.3. By these values Maximum force is calculated.

N= m x g (2)

f_R= u. N (3)

f_R= 0.3 x 58.7 x 9.8

F_{Max}= f_R+ m x a (4)

F_{Max}= 172.5 + (58.7 x 4.27)

F_{Max} = 423.2 N

Wheel Diameter = 0.6m

Torque = F_{Max}×Diameter/2 (5)

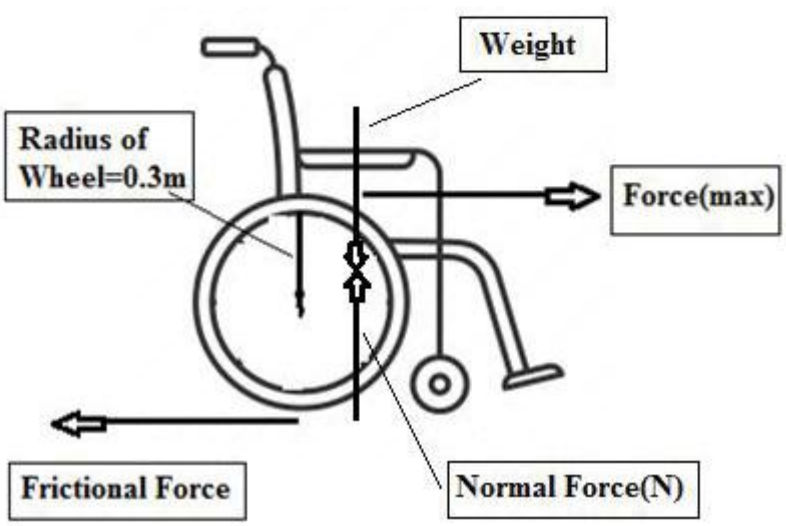

Figure: 2.2.9.1: Free Body Diagram (Wheel Chair)

Torque = 423.2 x 0.3

Torque = 126.9 Nm.

Gear Ratio= Driven Sprocket teeth/drive sprocket teeth (6)

Gear Ratio= 32/22= 2.9

Torque of Motor= Torque of Rear wheel/Gear ratio (7)

Torque = 126.9Nm./2.9

New Torque =43.7 Nm.

3.9 Add Electronic Control Circuit

Add electronics control circuit Microcontroller board arduino nano joystick ultrasonic sensor and motor speed controller.

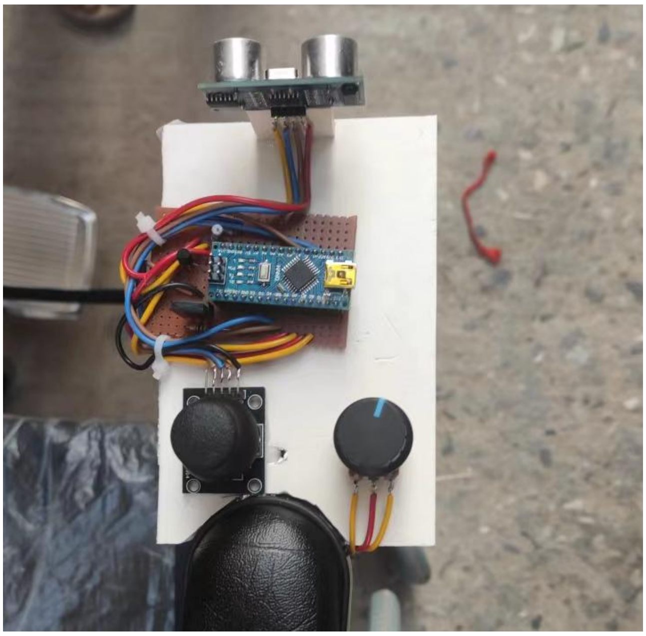

Figure:2.2.9.2: Electronics control circuit

3.10 Power Circuit and Battery

12V 16A Battery and power control switch fuse and motor control relay board.

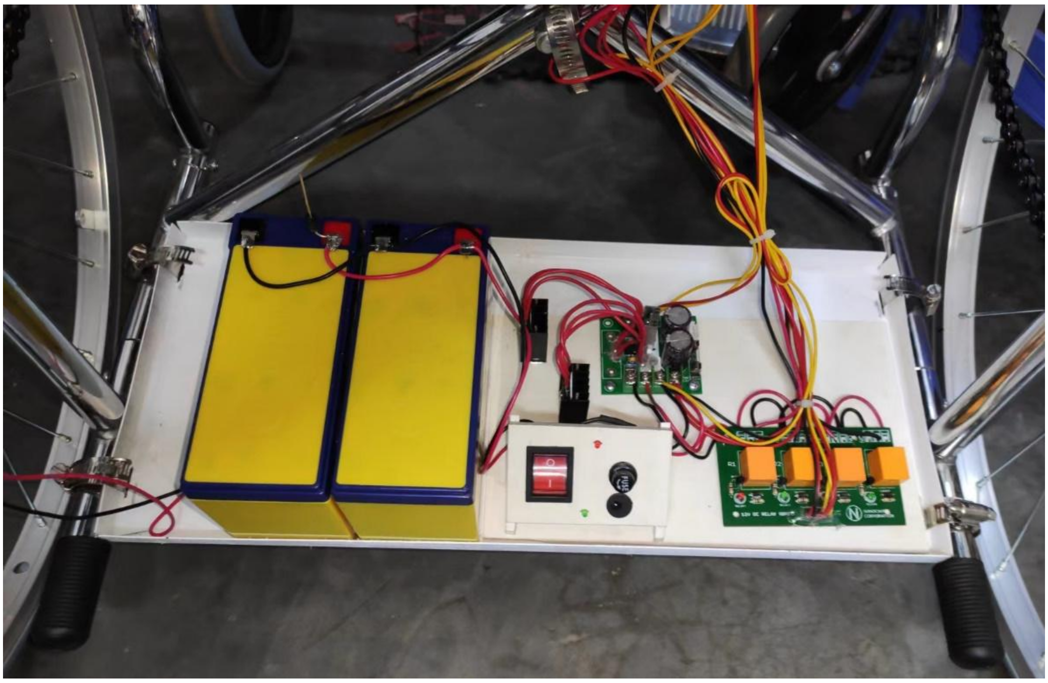

Figure:2.2.10.1: All Power module

3.11 DC Geared Motor Mount

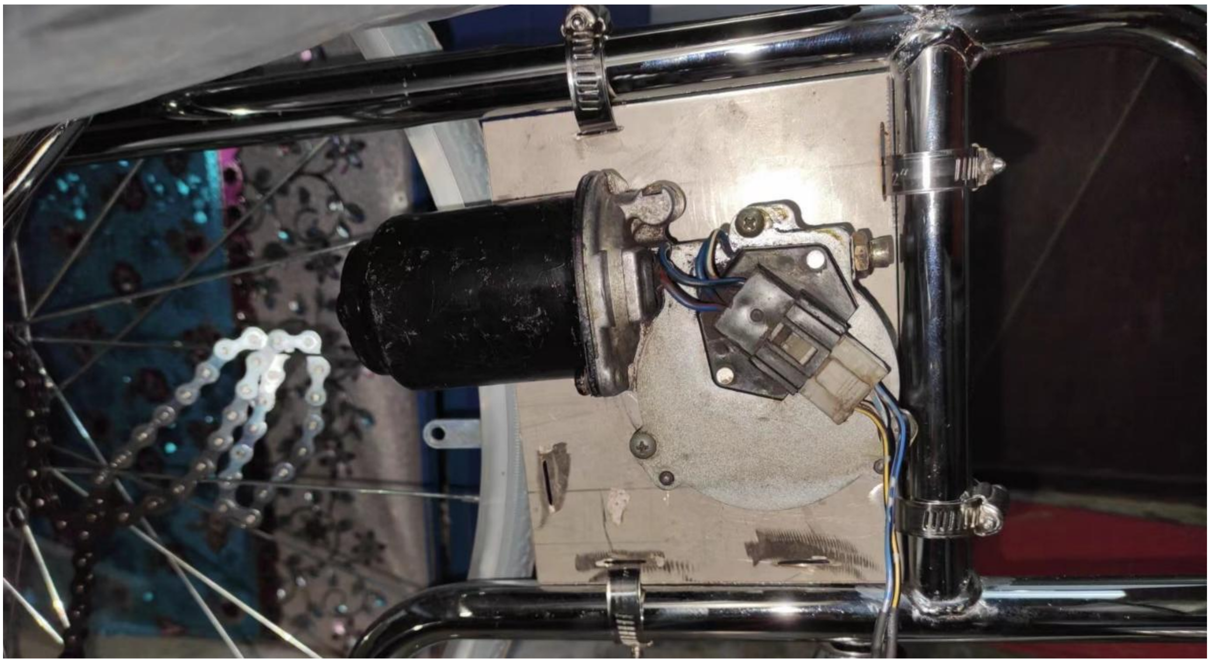

Figure:2.2.11.1: DC geared motor.

Chapter IV
Design & Fabrication

Main Components Description:

4.1 Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

Main Features

The classic Nano is the oldest member of the Arduino Nano family boards. It is similar to the Arduino Duemilanove but made for the use of a breadboard and has no dedicated power jack. Successors of the classic Nano are for example the Nano 33 IoT featuring a WiFi module or the Nano 33 BLE Sense featuring Bluetooth® Low Energy and several environment sensors.

Made for breadboard

The Nano is made for breadboard use and features soldered headers for all pins, allowing attaching the board easily on any breadboard.

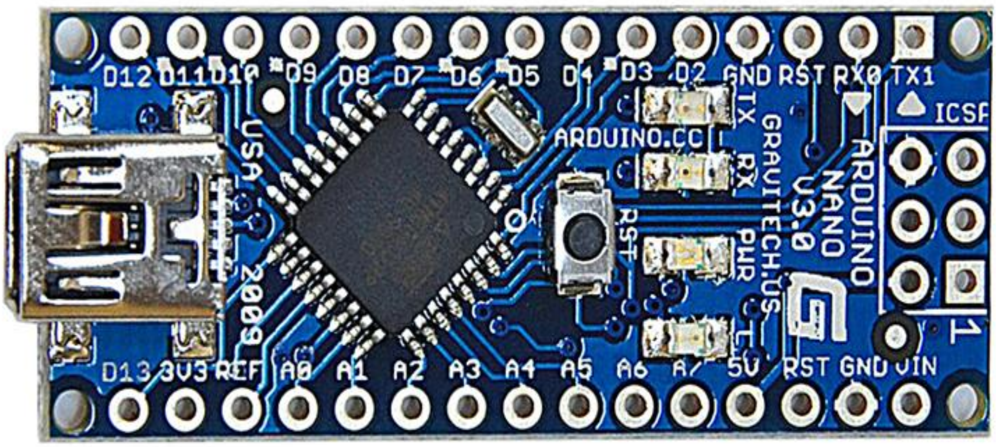

Fig: 2.2.11.2: Arduino Nano

ATmega328 microcontroller

The ATMega328 CPU runs with 16 MHz and features 32 KB of Flash Memory (of which 2 KB used by boot loader).

Tiny footprint

With a length of 45 mm and a width of 18 mm the Nano is Arduino's smallest board and weighs only 7 grams.

Technical Specs:

Board	**Name**	Arduino® Nano
	SKU	A000005
Microcontroller	ATmega328	
USB connector	Mini-B USB	
Pins	**Built-in LED Pin**	13
	Digital I/O Pins	14
	Analog input pins	8
	PWM pins	6
Communication	**UART**	RX/TX
	I2C	A4 (SDA), A5 (SCL)
	SPI	D11 (COPI), D12 (CIPO), D13 (SCK). Use any GPIO for Chip Select (CS).
Power	**I/O Voltage**	5V
	Input voltage (nominal)	7-12V
	DC Current per	20 mA

	I/O Pin	
Clock speed	**Processor**	ATmega328 16 MHz
Memory	**ATmega328P**	2KB SRAM, 32KB flash 1KB EEPROM
Dimensions	**Weight**	5gr
	Width	18 mm
	Length	45 mm

Table:2.1: Technical Specs of Arduino Nano

4.2 12V DC Motor Speed Controller

Product details of DC 10-60V Motor Speed Control Regulator PWM Motor Speed Controller Switch 20A.

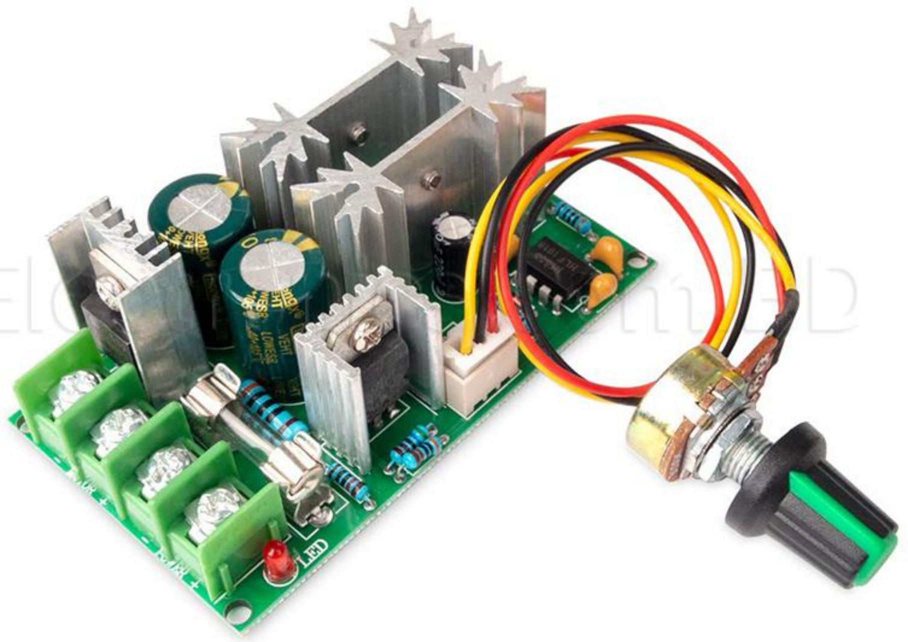

Figure: 2.2.12.1: Motor Speed control module.

Specification:

- 100% New and High Quality PWM DC Regulator, Motor Speed Controller
- Operating voltage: DC 10V-60V
- Output Current: 0 to 20A.
- Frequency: 25 KHz.
- Continuous power: Max 1200W
- Speed range: Motor zero speed to maximum motor speed
- The maximum current up to 20A (required fan to radiate heat)
- Material: Plastic, metal
- Size (L*W*H): 76mm x 44mm x 26mm

4.3 Joystick

Joystick is one of the main inputs for this project. The outputs of the two variable resistor of the joystick are connected with the two channels of ADC. Arduino joystick is a device that can be used to measure the X-axis, Y-axis and Z-axis direction. It is also called the game console. It can be considered as a combination of a potentiometer and one button.

Figure: 2.2.13.1 : Joystick

Connection

- Connection to Arduino and joystick.
- Connect Vcc of joystick pin to the 5v of Arduino Nano.
- Connect Gnd of joystick pin to the Gnd of Arduino Nano.
- Connect I Rx of joystick pin to the 0 of Arduino Nano.
- Connect I RY Vcc of joystick pin to the 1 of Arduino Nano.
- Connect SW of joystick pin to the 2 of Arduino Nano.

4.4 Ultrasonic sensor

Ultrasonic Sensor HC-SR04 is a sensor that can measure distance. It emits an ultrasound at 40 000 Hz (40 kHz) which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. The configuration pin of HC-SR04 is VCC (1), TRIG (2), ECHO (3), and GND (4). The supply voltage of VCC is +5V and you can attach TRIG and ECHO pin to any Digital I/O in your Arduino Board.

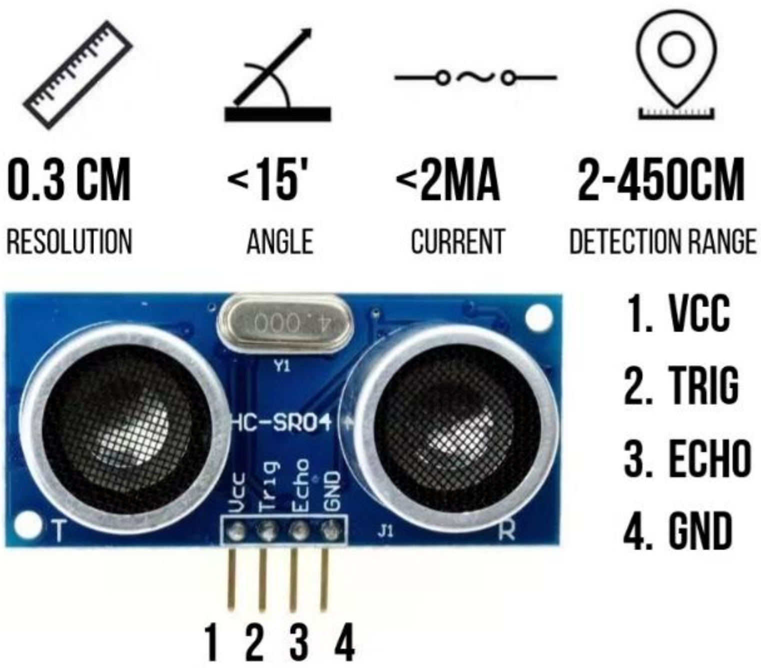

Figure: 2.2.13.2: Ultrasonic Sensor

In order to generate the ultrasound, we need to set the Trigger Pin on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo Pin. The Echo Pin will output the time in microseconds the sound waves traveled.

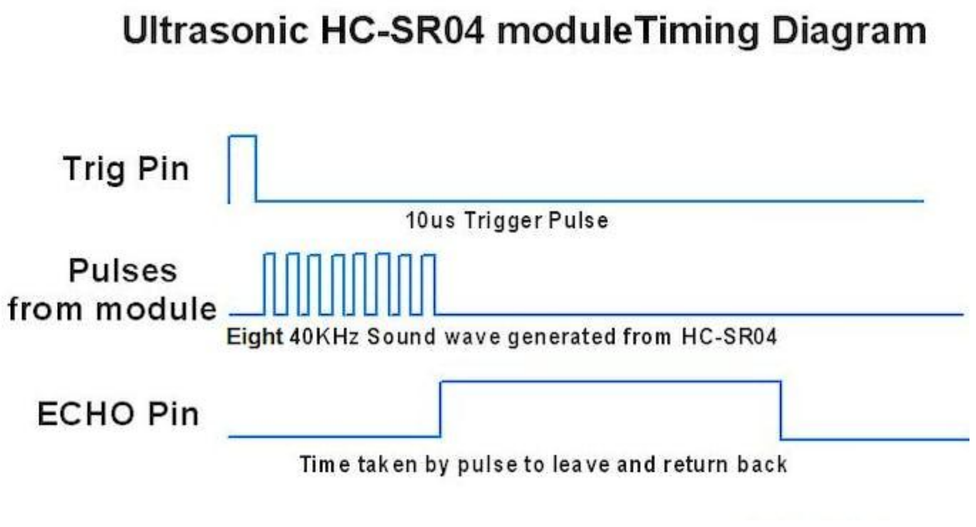

Figure: 2.2.13.3 Ultrasonic HC-SR04 timing diagram

For example, if the object is 20 cm away from the sensor, and the speed of the sound is 340 m/s or 0.034 cm/µs the sound wave will need to travel about 588 microseconds. But what you will get from the Echo pin will be double that number because the sound wave needs to travel forward and bounce backward. So in order to get the distance in cm we need to multiply the received travel time value from the echo pin by 0.034 and divide it by 2.

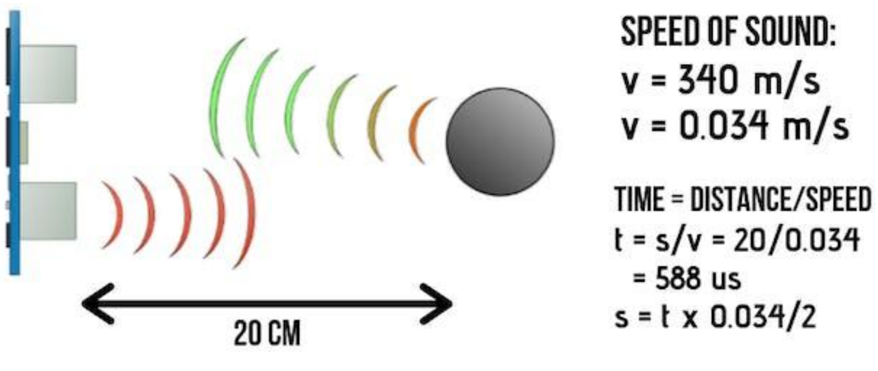

Figure: 2.2.14.1: Distance calculating

For the programming code, first we need to define the Trigger Pin and Echo Pin that connected to Arduino board. In this project Echo Pin is attached to D2 and Trig Pin to D3. Then define variables for the distance (int) and duration (long).

In the loop first you have to make sure that the trig Pin is clear so we have to set that pin on a LOW State for just 2 µs. Now for generating the ultrasound wave we have to set the trig Pin on HIGH State for 10 µs. Using the pulse In function you have to read the travel time and put that value into the variable “duration”. This function has 2 parameters, the first one is the name of the echo pin and for the second one you can write either HIGH or LOW. In this case, HIGH means that the pulse In function will wait for the pin to go HIGH caused by the bounced sound wave and it will start timing, then it will wait for the pin to go LOW when the sound wave will end which will stop the timing. At the end the function will return the length of the pulse in microseconds. For getting the distance we will multiply the duration by 0.034 and divide it by 2 as we explained this equation previously. At the end we will print the value of the distance on the Serial Monitor.

4.5 Relay

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability. Relays are used in a wide variety of applications throughout industry, such as in telephone exchanges, digital computers and automation systems. Highly sophisticated relays are utilized to protect electric power systems against trouble and power blackouts as well as to regulate and control the generation and distribution of power.

Contact Arrangement/Poles

The arrangement of contacts on a relay includes a form factor and a number of poles. Each form factor is explained below.

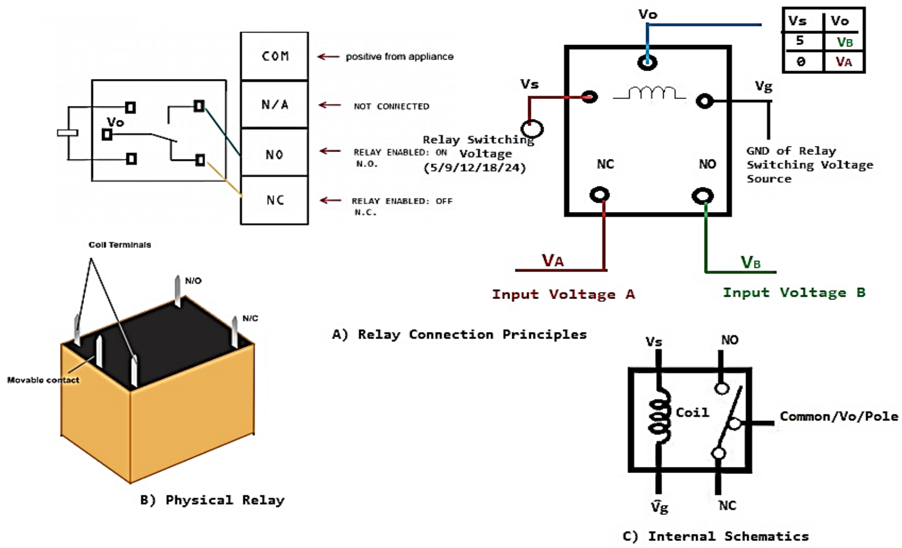

Figure: 2.2.15.1 Relay operation

Form A is a contact that is Normally Open (NO), or “make” contact. It is open when the coil is de-energized and closes when the coil is energized. Form A contacts are useful in applications that must switch a single power source of high current from a remote location. An example of this is a car horn, which cannot have a high current applied directly to the steering wheel. A Form A relay can be used to switch the high current to the horn. Form B is a contact that is Normally Closed (NC), or “break” contact. It is closed in the de-energized position and opens when the coil is energized.

Form B contacts are useful in applications that require the circuit to remain closed, and when the relay is activated, the circuit is shut off. An example of this is a machine’s motor that needs to run at all times, but when the motor must be stopped, the operator can do so by activating a Form B relay and breaking the circuit.

Form C is a combination of Form A and B arrangement, sharing the same movable contact in the switching circuit. Form C contact are useful in applications that require one circuit to remain open; when the relay is activated, the first circuit is shut off, and another circuit is turned on. An example of this is on a piece of equipment that runs continually: when the relay is activated, it stops that piece of equipment and opens a second circuit to another piece of equipment.

Make-before-break Contact: a contact arrangement in which part of the switching section is shared between both a Form A and a Form B contact. When the relay operates or releases, the contact that closes the circuit operates before the contact that opens the circuit releases. Thus both contact are closed momentarily at the same time. The inverse of a Make-before break contact is a Break-before-make contact. Poles are the number of separate switching circuits within the relay. The most common versions are Single Pole, Double Pole and Four Pole.

4.6 DC Geared Motor

A gear motor (or geared motor) is a small electric motor (AC induction, permanent magnet DC, or brushless DC) designed with an integral (non-separable) gear reducer (gear head) attached. The end shield on the drive end of the motor (light blue, below) is designed to provide a dual function. The side facing the motor provides the armature/rotor bearing support and a sealing provision through which the integral rotor or armature shaft pinion passes. The other side of the motor end shield provides multiple bearing supports for the gearing itself, and a sealing and fastening provision for the gear housing (orange, below). This construction offers many benefits for a user and eliminates the guesswork of sizing a motor and gear reducer on your own.

Figure: 2.2.16.1: DC Geared Motor

In general, gear motors function as torque multipliers and speed reducers, requiring less motor power to drive a given load. The gear housing design, the gearing type, gear lubrication, and the specific mode of integration all affect the gear motor performance.

Features:

- Motor Operation Voltage:12V
- Speed: 55 Rpm
- No load current: 2A
- Stall current: 10A
- Stall Torque: 45 kg-cm
- Motor Power: 120W
- Shaft diameter: 10mm
- Shaft dimension: 29mm
- Weight:1280gr

4.7 Discussion

In this chapter of this project paper, we have already discussed the circuit testing and error rectification of this system, the advantages, and limitations of our developed system. This system was very reliable since AVR is a reliable platform for electronics development works. The Ultrasonic and Joystick was also very low cost and reliable component, primarily used in automation systems. In the end we could say this project was a very intelligent and lucrative. With the growing time and technology, the use of bikes will increase as well as the theft prevention systems soon.

Chapter V
Result and Discussion

5.1 Result

We have designed a prototype of an electric wheelchair system, which consists of some precise and sensitive sensors like an ultrasonic sensor. the main challenge was to control the high power DC motor and control the wheelchair left, right, forward backward and stop. When the ultrasonic sensor distance 60cm to 100cm for an object then the buzzer makes a sound and if the object is too close to the car by 0 to 60cm then the buzzer makes more sounds and wheelchair will be stopped .We used a joystick to control the wheelchair movement and used 40W solar power to recharge the 12v battery. The battery can full charge using solar power and need to charge for 3h 30m. So calculating all this thing we have fixed the programming by doing several experiments while developing the things, and at last we have finalized the operation as we wanted.

No	Components	Output Data
01	Ultrasonic Sensor Working Distance	(0 to 40Cm) Wheelchair stop mode. (41 to 100Cm) Buzzer alert.
02	Battery Charging	Full Charge 14Volt Low Charge 11Volt
03	Joystick Left Joystick Right Joystick Forward Joystick Backward	Care move to Left Car move to Right Car move to Forward Car move to Backward

Table: 3.1: Output result

Chapter VI
Conclusion

6.1 Conclusion

So we could conclude that physically disabled and elderly people can move quickly using our electric wheelchairs. They no need to depend on others' help anymore to move from one place to another. They also do not need any extra skills to operate this intelligent wheelchair because it can be operated just by a joystick command.

Also, we wanted to know about the Joystick Ultrasonic Sensor and its working in detail and to develop a fast and real time project that could help other people. These conditions made Electric Wheel Chair a suitable project for us.

Completing this project needed sheer determination, as many things could go wrong. As the electrical design meant a lot in this project, creating an electronic circuit proved to be a difficult task for a mechanical student. Though some difficulties arose and much remodeling was needed, and the chair had some limitations, which we learned while building it, at last, the Electric Wheel Chair was created very close to the adapted design philosophy. We were very happy throughout this project because we had done good work with the guidance of our supervisor Saikat Biswas Lecturer ME Department of Mechanical Engineering. We get a chance to implement our knowledge in design, drilling, and more throughout this project. We would like to thank our supervisor Saikat Biswas, for completing our project.

Appendix

Arduino Nano program coding of this project is:

```
#define joyX A0
#define joyY A1

#define Buzzer 2
#define LEFT1_Wheel 6
#define LEFT2_Wheel 7

#define RIGHT1_Wheel 8
#define RIGHT2_Wheel 9

#define echoPin 4
#define trigPin 5

int Car_Distance = 0;

long duration;
int distance;
int F_OFF=0;

void setup(){

  pinMode(LEFT1_Wheel,OUTPUT);
  pinMode(LEFT2_Wheel,OUTPUT);
  pinMode(RIGHT1_Wheel,OUTPUT);
  pinMode(RIGHT2_Wheel,OUTPUT);

  digitalWrite(LEFT1_Wheel,HIGH);
  digitalWrite(LEFT2_Wheel,LOW);
  digitalWrite(RIGHT1_Wheel,HIGH);
  digitalWrite(RIGHT2_Wheel,LOW);

  Serial.begin(9600);
  pinMode(trigPin,OUTPUT);
  pinMode(echoPin,INPUT);
  pinMode(Buzzer,OUTPUT);
  digitalWrite(Buzzer,LOW);
```

```
 digitalWrite(Buzzer,HIGH);
 delay(50);
 digitalWrite(Buzzer,LOW);
 delay(50);
 digitalWrite(Buzzer,HIGH);
 delay(50);
 digitalWrite(Buzzer,LOW);
 delay(50);

}
void loop(){

//jOYSTIC
int xValue = analogRead(joyX);

int yValue = analogRead(joyY);
 Serial.print("xValue : ");
 Serial.println(xValue);
 Serial.print("yValue : ");
 Serial.println(yValue);

 //Ultrasonic Sensor
 digitalWrite(trigPin,LOW);
 delayMicroseconds(2);
 digitalWrite(trigPin,HIGH);
 delayMicroseconds(10);
 digitalWrite(trigPin,LOW);

 duration=pulseIn(echoPin,HIGH);
 distance=(duration*0.034/2);
 Serial.print("Distance : ");
 Serial.print(distance);
 Serial.println(" cm ");

 if(distance >0 && distance <60 )//Short Distance Controll
 {
   Car_Distance =1;
   digitalWrite(Buzzer,HIGH);
   delay(30);
   digitalWrite(Buzzer,LOW);
   delay(30);
   }
 else if(distance >=60 && distance <100 )//Long Distance Controll
 {
```

```
  digitalWrite(Buzzer,HIGH);
  delay(70);
  digitalWrite(Buzzer,LOW);
  delay(70);
  }


 //________________________________________________



if(Car_Distance == 0)
{

 //Joystic
 if (xValue>0 && yValue<10) //Left
 {
  digitalWrite(LEFT1_Wheel,LOW);
  digitalWrite(LEFT2_Wheel,LOW);
  digitalWrite(RIGHT1_Wheel,HIGH);
  digitalWrite(RIGHT2_Wheel,HIGH);
  Serial.println("Left");
  delay(500);
 }

 else if (xValue<=10 && yValue>=500) //BACKWORD
 {
 digitalWrite(LEFT1_Wheel,LOW);
 digitalWrite(LEFT2_Wheel,LOW);
 digitalWrite(RIGHT1_Wheel,LOW);
 digitalWrite(RIGHT2_Wheel,LOW);
 Serial.println("Backword");
 delay(500);
 }


 else if (xValue>1020 && yValue>500) //FORWORD
 {
 digitalWrite(LEFT1_Wheel,HIGH);
 digitalWrite(LEFT2_Wheel,HIGH);
 digitalWrite(RIGHT1_Wheel,HIGH);
 digitalWrite(RIGHT2_Wheel,HIGH);
 Serial.println("Forword");
 delay(500);
```

```
 }

 else if (xValue>=500 && yValue>=1020) //RIGHT
  {
   digitalWrite(LEFT1_Wheel,HIGH);
   digitalWrite(LEFT2_Wheel,HIGH);
   digitalWrite(RIGHT1_Wheel,LOW);
   digitalWrite(RIGHT2_Wheel,LOW);
   Serial.println("Right");
   delay(500);
  }

 else if (xValue>1020 && yValue>1020) //
   {
   digitalWrite(LEFT1_Wheel,LOW);
   digitalWrite(LEFT2_Wheel,LOW);
   digitalWrite(RIGHT1_Wheel,HIGH);
   digitalWrite(RIGHT2_Wheel,HIGH);
   }
 else //CAR STOP
 {
  digitalWrite(LEFT1_Wheel,HIGH);
  digitalWrite(LEFT2_Wheel,LOW);
  digitalWrite(RIGHT1_Wheel,HIGH);
  digitalWrite(RIGHT2_Wheel,LOW);
   Serial.println("Chare OFF");
   }


 //_____________________________________________________

}
else
 {
  F_OFF=1;
  digitalWrite(LEFT1_Wheel,HIGH);
  digitalWrite(LEFT2_Wheel,LOW);
  digitalWrite(RIGHT1_Wheel,HIGH);
  digitalWrite(RIGHT2_Wheel,LOW);
   Serial.println("Chare OFF");
 }
```

```
if(F_OFF==1)
{

if (xValue>1020 && yValue>500) //BACKWORD
  {

  digitalWrite(Buzzer,HIGH);

  digitalWrite(LEFT1_Wheel,HIGH);
   digitalWrite(LEFT2_Wheel,HIGH);
   digitalWrite(RIGHT1_Wheel,HIGH);
   digitalWrite(RIGHT2_Wheel,HIGH);
  Serial.println("Backword");
  delay(1000);

  digitalWrite(Buzzer,HIGH);
  delay(200);
  digitalWrite(Buzzer,LOW);
  delay(200);
  digitalWrite(Buzzer,HIGH);
  delay(200);
  digitalWrite(Buzzer,LOW);
  delay(200);
  digitalWrite(Buzzer,HIGH);
  delay(200);
  digitalWrite(Buzzer,LOW);
  delay(200);
  digitalWrite(Buzzer,HIGH);
  delay(700);
  digitalWrite(Buzzer,LOW);


  Car_Distance =0; //RESET
  F_OFF=0;

    }

}
} //end
```

References

[1] Ajit A. Mohekar, Savita V. Kendre,Tanmay N. Shah, Prof. P. D. Sonawane, Prof. Dr. S. T. Chavan"design of an innovative retrofitted tricycle for a desiable person "International journal of advance research in science and engineering'' volume no.4, issue 07,july 2015.

[2] Vivek Kaundal, Rajesh Singh, Anant Wadhwa,Shashank Mishra,Aadhar Rastogi, "Low Cost Robotic Wheel Chair for Disabled People in Developing Countries'' Conference on Advances in Communication and Control Systems 2013 (CAC2S 2013).

[3] Rashid Ahmed K., Safar Abdul Razack , Shamil Salam , Vishnu Prasad K.V.,Vishnu C. R. " Design and Fabrication of Pneumatically Powered Wheel Chair-Stretcher Device'' International journal of innovation research in science, engineering and technolog,vol.4,issue 10, October 2015.

[4] K.Kalaiyarasu,G.Leelavathi, M. Suganya, S. Vignesh, N. Santhosh, ''Design and Implementation of Smart Roulettle using Gesture Control''IJSART – Volume 2 Issue 3 –march 2016.

[5] Brigida Monica Faria, Luis Miguel Ferreira, Luis Paulo Reis, Nuno Lau, Marcelo Petry, and Joao Couto Soares, " Manual Control for Driving an Intelligent Wheelchair: A Comparative Study of Joystick Mapping Methods''.

[6] Parris Wellman, Venkat Krovi, Vijay Kumar, and William Harwin, "Design of a Wheelchair with Legs for People with Motor Disabilities'', IEEE transaction on Rehabilitation Engineering, VOL. 3, NO. 4, 43ecember 1995.

[7] Arun Manohar Gurram, P.S.V Ramana Rao, Raghuveer Dontikurti, "Solar Powered Wheel Chair: Mobility For Physically Challenged'', International Journal of Current Engineering and Technology, Vol.2, No.1, March 2012.

[8] Yogesh Mangaonkar, Prof. Ritesh Banapurkar, "Design and Fabrication of SelfGuided Smart Chair System for Library Book Access", IJESC 2016.

[9] Suraj kumar vishwakarma, nitin kumar gupta," Design and Fabrication of an Innovative Planetary Wheel Chair for Ruler Area", IJSER2016