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Solar Smart Hybrid Electrical Wheelchair for Physically Disable People

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ABSTRACT

To improve the quality of life is a part of encouraging the active life is providing the link between physical activities and quality of life and it should be well established among the physically disable people. Wheel-chair is important aspect that allows physically handicap person to be an active element of society by giving his contribution to growth of society.one of the best invention for physically handicap patients was wheelchair and we have taken another foot forward. Our research paper has discussed about the latest advancement in the wheel-chair design and facilities. The vehicle available in the market are based on indoor and outdoor uses. Due to the recent advances in the technology allows us to construct a robust, smart and efficient wheelchairs. There are mainly two types of wheelchairs available in the market one is normal wheelchair and another one is the powered wheelchair. Normal wheelchair is less in cost but also less in functionalities that they offer. Wheelchair is the utility that makes the life easy for physically handicap people. Power wheelchair are consisting of electrical energy to drive the wheelchair. There are lot of wheelchairs available with the different configuration at different price point. The wheelchair that come with the latest technology are modern but also price excessively high hence they are not affordable to each and every individual person with some kind of the disability. Based on the use of the wheelchair they are categorised into indoor and outdoor wheelchair. Outdoor wheelchair is used to task like going to office, family function.to drive a wheelchair outdoor on the road one has to deal with the lot of the problems one of them is protection from the weather.

KEYWORDS: -: ***wheelchair, disable people, solar, interface, sensor***

1. INTRODUCTION

As per the report over a 1 billion people in the world are estimated to have the physical disabilities. I f we talk about in the percentage nearly 15% of the world population has some kind of disabilities. Up to 190 million people age 15 or greater have significant disabilities in the functioning often require external health to perform any action. Over a 700 million people are aged people in the world. While India is home for 1.36 billion people out of them 2.3% of this population have severe mental and heath disabilities. As per the population survey of 2011.

[12] there are nearly 103 million people with age greater than the 60. That include 53 million females and 50 million males. [5] As per the report of the HelpAge India suggested that number of elderly people expected to grow to 173 million by 2026. So, the market for the wheelchair is extensible. The user requirement of the

wheelchair product is in bulk amount. There is vital role of the wheelchair in the induvial mobility and having an active lifecycle is essential part of life. The reports are shown that this lower limb disability, diseases can cause the hypertension and other serious diseases.

2. Literature Review

[1] One of the first concept implementation of project of an automatic wheelchair for handicap physicist was proposed by Madarasz (Madarasz, 1986). He presented a wheelchair equipped with a digital camera and ultrasonic scanner and a microcomputer. [2] Worlds first self-propelled wheelchair was manufacture in year 1655 by paraplegic clock-maker of Nuremberg, Germany by Stephen Farfler.After that lot of advance take place in the technology that change the life of the handicap and aged person. [2] The first patent of motorized wheelchair or powered wheelchair was built in 1900, but the need of the wheelchair does not arrive until second world war. [3] An electrically propelled tricycle was developed by the R. A. Harding company in England in year 1930. [4] Sam Duke received the patent for a releasable add on power drive applied to a wheelchair in 1950.

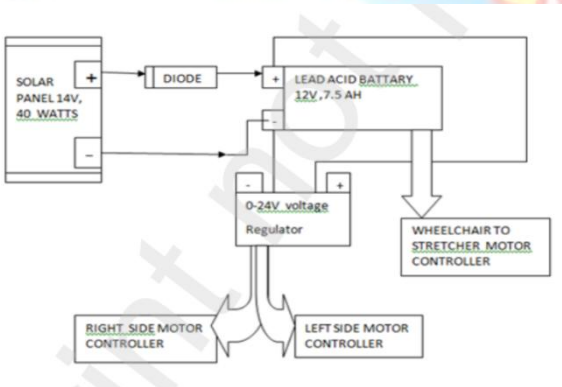

Fig. Block Diagram

3. System Development

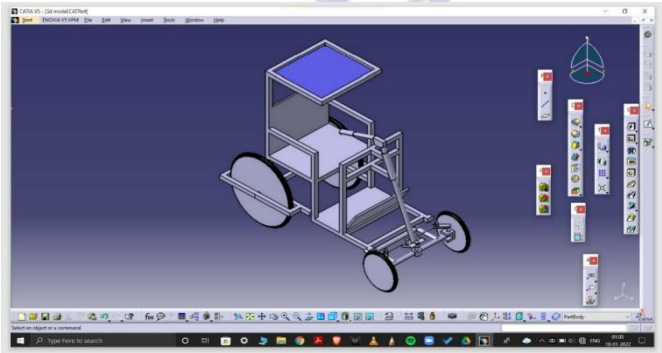

Fig.CATIA design of Solar powered smart electrical wheelchair.

The component of the wheelchair are as follows:

1.Motor

The motor used for the wheelchair is permanent magnet dc motor. The motor is rated for 24V (Volt) and 350W (Watt). It is able to generate the stating torque of 11Nm(Newton. Meter). We have used the motor with the chain sprocket assembly to couple the motor to the rear wheels of the wheelchair.

Fig. Motor for the wheelchair

2.battery

[10] Forthe supply of 24 volt to the motor we have use thepair of batteries in series connection. The rating of each battery is 12 volt and 40 Ampere to get the 24 volt and 40 Ampere supply for the motor. The weight of the motor is 10 kilograms.

Fig. Battery of wheelchair

3.controller

The controller we have used is from SunRobotics rated for the 24 volt and 350 watts. The controller has charging slots for the batteries. It also supports the regenerative breaking of the motor. The lightning switch is for the starting of the motor. The controller

also comes with headlight useful for the travelling at the night. With throttle for the speed control. The speed can be varied with the throttlewhich is built-in into the handle so that the easily speed can be varied. The controller also has slot for the IOT related connection to the motor.

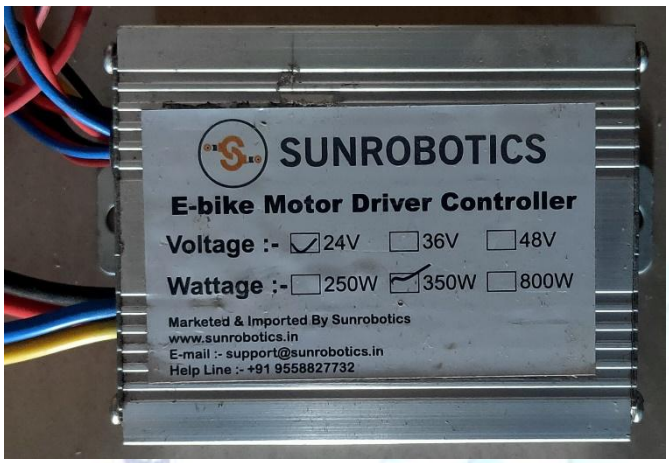

Fig. Controller of motor

4.sensors

To make the wheelchair modern and offer the latest technological advances we have built this wheelchair with the integration of IOT.[13] Wheelchair comes with the collision detection sensor that works on ultrasonic waves. We have also provided the push button that will ring the emergency buzzer if user presses that button.

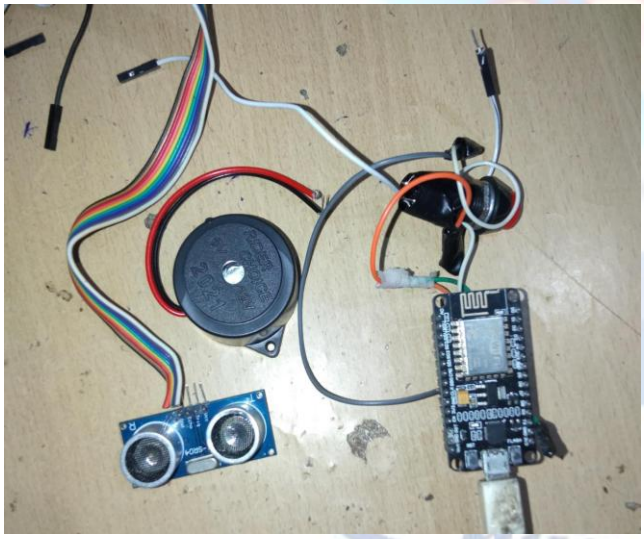

Fig. IOT Sensors

If user feeling uncomfortable, he can give the alarm through the push button. Wheelchair also offer the Global positioning system for tracking the actual location of the wheelchair to relative can be always in track with the position of physically disable people so that outage can be avoided.

5.solar panel

The normal wheelchair's runtime is often fix due to limited capacity of the battery up to 2 hours.

[11] Increase in the rating of the battery also comes with cost of the increase of the weight. The solar panel used for the wheelchair is rated for the 12 Volt.[6] Solar panel gives the output in DC hence battery can be charged with the help of the solar panel. This also increases the runtime of the wheelchair by half an hour.

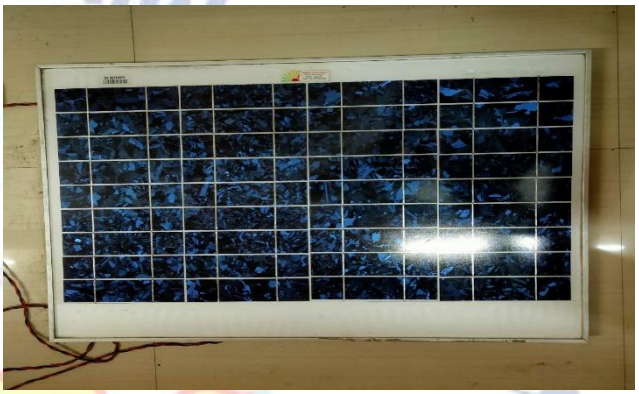

Fig.12V(Volt) solar panel

4. METHODOLOGY

The smart electrical wheelchair has PMDC Motor, Handle for manual control, [7] Application for digital control. We have use pair of PMDC Motor to provide better propulsion. To rotate wheel chair in right or left only one wheel rotate while other is stationary. When the rocker switch pushed forward the wheel connected to it will also rotates in the forward direction due to which the rack is pushed forward here both the ends of rack are connected to rods, the rod which is connected to backside of rack is connected to backside of chair while the front sided rod of rack is connected to legside of chair. Motor has handled through which the direction of the motor can be changed. Supply will be given to the controller through which the motor is connected. The shaft of the motor is connected to the shaft of rear wheels of the wheelchair by chain and sprocket assembly.

5. CALCULATIONS

[8] For designing the wheelchair by loading up to the 160 kg and top speed of 20 kmph.

We have considered that the weight of the wheelchair to be 70kg and loading is 90 kg.

Let,

Force required to overcome

1.Rolling Resistance

2.Gradient Resistance

3.Aerodynamic Resistance

Total force = Force at rolling + Force of gradient + Aerodynamic drag force.

Force of Rolling

Fr=Cr*M*a.

Fr= 0.004*160*9.81

Fr=6.27 N

Cr=Coefficient of rolling Resistance

M=gross mass of the wheelchair +Driver

a=acceleration due to gravity

Force for gradient resistance

Fg=M.a. Sinθ

Θ=angle of banking.

Mostly the road is flat hence θ is 0 degree hence Sinθ=sin (0) =0

Hence,

Fg=0 N.

Aerodynamic resistance

Fad=0.5*P*V*V*Ca*Af N

Fad=0.5*1.23*5.55*5.55*0.89*0.84

Fad=14.16 N. (Newton)

P = Density of Aerodynamic

V = Velocity of air resistance

Ca= Coefficient of air resistance

Hence Ftotal=6.27 N + 0 N +14.16 N

Ftotal=20.43 N (Newton)

For the motor calculations,

Radius of wheel =0.333m

Let V=4,

V=U+at,

Hence acceleration =0.4,

Force = Mass*acceleration

= 160*0.4

= 64 N

Torque = Force * Radius of wheel

= (64+20.43) *0.33

= 26.54 Nm

Power = Torque*Angular speed

= 26.54*2*pi*N/60

= 26.54*2*3.142*(115/60)

= 319.65 Watt.

This should be power rating for the motor to carry this much load.so we selected 350W(Watt) motor.

6. Performance Analysis

TABLE I: PERFORMANCE ANALSIS

Actual speed	4 Kmph
Runtime without solar	1 hour 20 minutes
Loading Capacity	80 kilograms
Runtime with solar	1 hour 40 minutes

From the table of performance analysis:

1) The expected speed was 5 Kilometers per hour. But in actual scenario we are getting the speed of approximately 4 kilometers per hour.
2) The runtime of the motor is about 1 hour and 20 minutes minutes without using the solar panel for the charging the battery. With the integration of solar we were able to squeeze the runtime of an hour and 40 minutes.With the solar, wheelchair could run 20 minutes extra.
3) Estimated weight that wheelchair structure was able to handle is 80 Kg (Kilogram).

TABLE II: COST ANALYSIS

Frame construction	4,000
DC motor	6,000
Battery	6,000
IOT component	3,000
Transparent sheet	2,600
Motor controller	2,500
Frontal glass	900
Total cost	25,000

7. Future Extensions

If the cost is not an issue, then one more motor can be added so that the wheelchair will get uniform torque from both the side and speed will also increase. [9] The weight of wheelchair is nearly 80kg because we have use robust iron rod that can be replace by the fiber material which will be strong and lightweight. Wheelchair can handle the more load if weight of wheelchair itself is low. The Joystick can be used to change the direction of the wheelchair for the easy control but the joystick controllers are expensive

8. ACKNOWLEDGMENT

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Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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