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SOLAR POWERED TRICYCLE WHEELCHAIR FOR THE DISABLED

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Abstract : In the era of rapid technological progress, advancements have benefited many, but people with disabilities, still depend on others for mobility. In India, over 20,000 individuals suffer from paraplegia, a number that increases by 10,000 each year. Traditional wheelchairs can be bulky, costly, and hinder independence. Our innovative solution integrates electric components into wheelchairs, creating electrically powered vehicles. This advancement empowers mobility-challenged individuals with newfound independence. By eliminating the need for manual balance, it significantly improves their quality of life and enhances their participation in society**.**

IndexTerms **- Wheelchair Automator, Electric wheelchair, Disabled person, Manual.**

I. INTRODUCTION

Wheelchairs are very essential mobility aids for those with physical disabilities allowing them to move on their own. Nevertheless, traditional wheelchairs which have existed for long periods of time have limitations that slow down the movement of users. However, the need to enhance mobility and autonomy among wheelchair users has seen immense technological improvement resulting in inventions such as electric hand cycles. These devices blend effortlessly into the existing wheelchair frames enabling new abilities and avenues of discovery for the user. Handcycles combine manual propulsion convenience with electric power efficiency thus bridging the gap left by traditional and full-electric models. Electric handcycles are beneficial because they extend the range and capabilities that standard wheelchairs offer its users. Previously difficult terrains and long distances can now be easily navigated by users overcoming earlier challenges posed by barriers along such routes. Moreover, they are able to remove and attach this device at will therefore a user should adopt his or her personal preferences concerning mobility solutions. Furthermore, electric handcycles are a cheaper alternative to fully electrical wheelchairs thereby making the advanced mobility technology more accessible to many users. Moreover, the integration of solar panels to charge the battery adds an environmentally friendly dimension to electric hand cycles, reducing reliance on external power sources and promoting sustainability. Handcycles provide an excellent opportunity for seamless integration between traditional wheelchairs and electric mobility choices thus enabling autonomous and inclusive approaches towards means of moving around. It is crucial that there be ongoing studies as well as potential exploration on electric hand cycles in order to realize the maximum impact thereof and ensure an equitable future where individuals whose locomotion is impaired is concerned.

II. LITERATURE REVIEW

This literature review delves into the current state of research and technological advancements, laying the groundwork for understanding the importance of our innovative project in the broader context of assistive technology. The history of wheelchairs reveals a fascinating journey of invention and progress spanning centuries. From rudimentary designs in ancient China inspired by wheeled furniture to self-propelled models introduced in 17th century Germany, and later innovations like the folding wheelchair by Harry Jennings in the 20th century, the evolution has been remarkable. Wheelchairs have been instrumental in transforming the lives of individuals with disabilities, providing them with mobility, independence, and the ability to engage in everyday activities. These devices not only facilitate movement but also empower users to make decisions about their daily routines, fostering a sense of autonomy and inclusion. Additionally, wheelchairs serve therapeutic purposes, offering a stable platform for physical rehabilitation and exercise. Over time, modifications and enhancements have been made to wheelchairs to improve user comfort and freedom. These adaptations range from customized seating options to integration of technology for communication and environmental control, ensuring that users have access to tailored solutions that meet their individual needs. Standards and regulations, overseen by organizations like the Bureau of Indian Standards (BIS), play a crucial role in ensuring the safety and usability of wheelchairs, thereby enhancing accessibility and quality of life for people with disabilities. Our project builds upon this rich history and existing advancements, aiming to further enhance mobility and quality of life for individuals with disabilities. Through ongoing research and innovation, we strive to create solutions that address the diverse needs of users, promising a brighter future for individuals with disabilities worldwide.

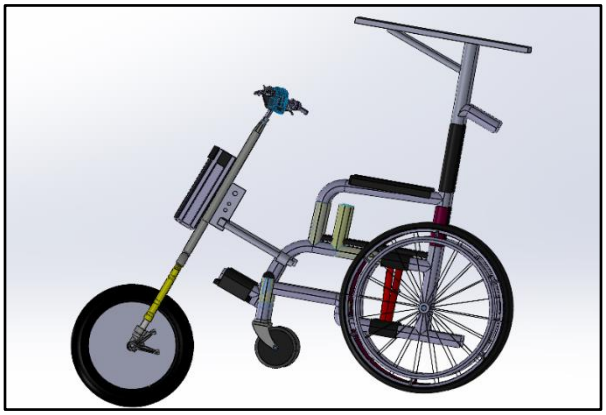
III. METHODOLOGY

A. Proposed System:

This section of the report deals with the mechanical design of the system and the various parts used in the system integration.

B. Automator:

The main objective of the project was to fabricate an attachable frame that physically disabled people can use to move their wheelchairs on their own. The frame is easily attachable and has a detachable mechanism. It is a device which is portable and can be connected to any wheelchair to make it a powered tricycle. It is powered by the BLDC hub motor. Below a cad model of the same is provided.



Parts:

i. Handle: For the user to maneuver and operate throttle, brake as and when required.
ii. Fork: It holds the hub motor.
iii. Carrier: It houses and holds the other parts like Battery and Motor Controller.
iv. Throttle: It is used to accelerate the wheelchair the one used by us is a digital 24V Throttle which also displays the Battery Status and remaining capacity
v. Brakes: E-Brakes are provided, additionally a Disk type of brake can be attached for enhanced braking power.
vi. Frame Fixture: The Frame enables us to attach and detach the Automator to a wheelchair.

C. Motor Selection:

The major consideration in selection of motor was the torque required during the motion of the vehicle. which are the main criteria to calculate the motor specifications. There are several factors that need to be considered to determine the maximum torque required to propel the vehicle. These factors are:

1. Rolling resistance (RR)
2. Grade resistance (GR)
3. Acceleration force (F_a)

Total tractive effort (N) = RR(N) + GR(N) + F_a (N)
= 63.56 + 36.97 + 8.1
=108.63 N

Where,

1. Rolling resistance (RR): Rolling resistance is the force that opposes the motion of a rolling object as it moves across a surface.

$RR = (W_{GV} * C_{rr}) = (((18+90) * 9.81) * 0.06)$
$RR = 63.56\ N$

Where,
W_{GV} = gross vehicle weight (N)
C_{rr} = coefficient of rolling resistance

Table 1: Values for coefficient of rolling resistance.

Contact Surface	C_{rr}
Concrete(good/fair/poor)	0.010/0.015/0.020
Asphalt(good/fair/poor)	0.012/0.017/0.022
Macadam(good/fair/poor)	0.015/0.022/0.037
Snow(2 inch/4 inch)	0.025/0.037
Dirt(smooth/sandy)	0.025/0.037
Mud(firm/medium/soft)	0.037/0.090/0.150
Grass(firm/soft)	0.055/0.075
Sand(firm/soft/dune)	0.060/0.150/0.300

2. Grade resistance (GR): Grade resistance refers to the force opposing the movement of an object up or down an incline, caused by the gravitational pull on the object's mass.

$GR = W_{GV} * sin(\theta) = ((108*9.81) * sin(2)) = 36.97$
Where,
W_{GV} = gross vehicle weight (N)
θ = maximum incline angle [degrees].

3. Acceleration force (F_a): It is the force required to bring a vehicle from rest to maximum speed in desired time.

$F_a = [(W_{GV} * V_{max}) / (g * T_a)]$
$F_a = [((108*9.81) * 1.5) / (9.81 * 20)]$
$F_a = 8.1N$

Where,
W_{GV} = gross vehicle weight (N)
G = acceleration due to gravity
V_{max} = maximum speed [m/s]
T_a = time required to achieve maximum speed [s].
$Torque (\tau) = TTE * r_w * R_f$
$=108.63 * 0.081 * 1.15 = 10.12 N-m$
Where,
TTE = Total tractive effort
r_w = radius of wheel (m)
R_f = friction factor that accounts for frictional losses between bearings, axles etc.
Angular velocity (ω) = (v/r_W) = (1.5/0.081) = 18.51 rad/sec

Calculation of motor power:
Power = ($\tau * \omega$) = (10.12*18.51) = 187.40W
Based on the calculations a BLDC hub motor of the following specifications is selected.

Sr No	Particular	Values
1	Rated Power	250W or 0.33Hp
2	Rated Voltage	36V
3	Rated peak current	13.4A
4	Rated continuous current	6.94A
5	Rated load rpm	400
6	Rated Torque	32Nm

Table 2: Specifications of Motor

D. Battery:
For our application we have selected a Li-Ion Battery of 24V and 15Ah rating due to the advantages that it offers like high energy density, which means they can store a lot of energy in a small space. They are also relatively lightweight and have a long lifespan.

E. Solar Panel:
Solar panels are photovoltaic (PV) devices that convert sunlight directly into electricity. They are made up of many individual solar cells, which are typically made of silicon. When sunlight strikes a solar cell, it excites electrons, causing them to move from their normal position. This movement of electrons creates an electrical current. For our application we have selected a 90W 24V solar panel which acts as a secondary power source to charge the battery.

F. Charge controller.
The charge controller is a piece of electronic equipment that regulates the voltage and current transferred from the solar panel to the battery. This prevents the battery from being overcharged.

IV. Result And Discussion

The construction of our solar-powered tricycle wheelchair was successfully accomplished within the designated resources. We meticulously chose and designed essential components such as the handle, fork, carrier, throttle, brakes, frame fixture, battery, charge controller, motor, and solar panel to ensure optimal functionality and user convenience. Our project marks a significant advancement in mobility assistance technology, offering an affordable and user-friendly solution for individuals with disabilities. Through the use of locally-available materials and innovative design approaches, we have surpassed the limitations of conventional wheelchairs by providing increased range and adaptability. The adaptable nature of our design allows it to be compatible with various wheelchair models, thereby expanding accessibility and usability for a broader user base. Additionally, the incorporation of solar power addresses environmental concerns and decreases reliance on external power sources, aligning with sustainability goals. Our achievement signifies a noteworthy advancement in granting individuals with disabilities greater autonomy and satisfaction. Through the utilization of nearby resources and inventive design approaches, we've not just developed a functional mobility solution but also promoted inclusivity and empowerment within the community. Looking ahead, we anticipate refining and broadening our design to accommodate the varied requirements of users globally, thereby fostering accessibility and sustainability in mobility assistance technology.

V. Conclusion

The "Solar Powered Tricycle Wheelchair for the Disabled" project is a great example of using new ideas to help people who need it, especially those with paraplegia. It's all about making it easier for them to move around on their own. By using solar power, the project not only helps the environment but also offers a long-lasting solution. The project focuses on making a special attachment for wheelchairs that works with different types of wheelchairs. Safety is a big concern, so they've made sure it's safe to use with good brakes and easy controls. They've tested it well to make sure it works in different places, showing they really understand what people with disabilities need. In the end, this project is about making the world more equal for everyone, no matter what challenges they face. It's a step towards a future where everyone can move around freely and feel independent, all while taking care of our planet.

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