

Power Assist Wheelchair for Physically Challenged Person

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Abstract: A physically challenged people face many problems in their day to day life, they need to seek help from others to perform their routine tasks such as for going hospital, malls or market etc. Mobility of the Physically Challenged people is a great concern of the society. Considering these in mind, the present work is focused on the history of wheel chairs, market surveys, and physically challenged people requirements. On the basis of gathered information the design of the power assist wheelchair which has low cost and approachable for poor and middle class population. Power assist is the attachment made to fit any standard wheelchair. The designed wheelchair can be used manually or can be used as electric wheelchair based on the requirement of the user.

Index Terms – Wheelchair, Power assist, Batteries, Controller, Hub Motor, Clamps.

I. INTRODUCTION

Physically challenged people face difficulties to perform their daily activities. Transportation of disabled people is one of the important factor, they need to take help from others to move from one place to other or sometimes they self-propel a wheelchair. Self-propulsion of wheelchair causes repetitive stress in shoulders, upper limb and spinal cord injuries. To overcome the difficulties faced by the manual wheelchair users we have come up with a assistive technology made to fit manual wheelchair with respect to compatibility to the user, cost, and availability to cope up the present requirements of the people who are using it. Power Assist is an add-on power device designed to increase the ability of manual wheelchair. The power assist attachment is made to fit any standard manual wheelchair. Power-assist device has the potential to combine the best features of both power and manual wheelchairs. It provides the wheelchair user with additional power to ascend inclines and go over rough terrain. It is a front mounted unit which is driven by a single drive wheel. The attachment is light in weight and can be easily transported. Power assist is cost effective and gives the disabled people to be independent. It aids the disabled people to easily ride on roads and reduces the strain on their shoulder.

II. LITERATURE SURVEY

Edward Peizer and Donald W. Wright, have summarized the development and evolution of wheelchairs. They studied the changes that are made to the wheelchairs over the years and discussed them in brief.

Shelby L Walford, Philip S Requejo, Sara J Mulroy, Richard R Neptune, have investigated the development of shoulder pain in manual wheelchair users. Their study shows the development of pain is due to biomechanical variables. Manual wheelchair users rely on their upper limbs to provide independent mobility. The existing problems faced by the manual wheelchair users are known.

Lockton D, discusses the attachment of electric power into manual wheelchairs. He categorized and described the existing products and configurations which include the drives, controlling devices and steering position. Various configurations such, Single-wheeled drive, rear-mounted, as Twin-wheeled drive, rear-mounted, with differential steering with steering ahead of the wheel, single-wheeled drive, rear-mounted, with steering above the wheel, Single-wheeled drive, rear-mounted, with nutation steering and Single-wheeled drive, front-mounted, with handlebar/articulated steering are evaluated. The motors, mechanics, control technology and usability are investigated for the above mentioned combinations.

Murray, provided details of evolution of mobility in wheelchairs, efficient gadgets used for the propulsion of wheelchair users and discussed the relative importance of developments in assistive mobility mechanisms, wheels and stairs. These are some of the related work mobility scooters, clustered wheel concept, track based stair climbers and caterpillar wheel based devices. The effect of external factors like safety, operational efficiency, weight, aesthetics, range of operation, cost, comfort is evaluated.

III. MAIN COMPONENTS OF POWER ASSIST

HUB MOTOR

Hub motors are used in modern E-bikes. There are 'brushed' hub motor and 'brushless' hub motor. We are using a brushless Hub motors because they are more durable than the brushed hub motor, there is no physical contact from any parts inside the motor, therefore there is no wear and tear possibilities. Hence the maintenance cost is less. The hub motor used here has a rated voltage of 24V and rated power of 350W

at the speed of 800 RPM. The diameter of the Hub motor is 10 inch (254mm with tire) and E-bike Hub motor has a motor weight of 4.4 Kg, load bearing capacity of 80-150 Kg. It provides a speed of 12-28Km/h. This Hub motor comes with drum brake. There for this Hub motor is quite powerful and have required torque, which is very suitable for our project.



Fig-1 Hub Motor

BATTERY

Lithium ion batteries are more popular in electric vehicles and technologies. These batteries are rechargeable batteries and they weigh less than other rechargeable batteries of similar size. You can recharge the battery without completely discharging the battery and they are able to handle many charge and discharge cycles. The battery use here is 36v, 7.5 ah Lithium ion rechargeable battery with hard case.



Fig-2 Battery

CONTROLLER

The controller is one of the main parts of a power assist wheelchair. It is used to control the speed of the hub motor, start, stop. It is connected to all other parts such as battery, throttle, motor, etc. The controller use here is brushless motor controller. The rated working voltage is 24V and rated power is 350W. This controller can provide steady speed and sensitive control for breaking and direction change.



Fig-3 Controller

THROTTLE

It is a system that recognizes the driver's desired speed and converts this into a signal to control the speed of the power assist. When the throttle is engaged it provides power to the hub motor and moves the power assist and wheelchair along with the person and lets you change the speed of the vehicle according to the driver's requirements. The throttle used here is a twist throttle, it is attached to a controller where it is used as input to control the hub motor. The inner diameter of the handle is 2.2 cm and the length of the wire is 1.56 m. It consists of three pin/wires red, black and green, where red for positive pole, black for negative pole and green for signal.



Fig-4 Throttle

DC-DC BUCK CONVERTOR

DC-DC Buck convertor is a step down power supply module which converts an output voltage that is lesser than its input. Since we are using a 36v li ion battery and 24v hub motor the DC-DC Buck (step down) converter is used here. The input voltage ranges between 4V to 40V DC (direct current) and the output voltage ranges between 1.23V to 26V.



Fig-5 dc-dc buck convertor

IV. DESIGN AND FABRICATION

The design was perfectly calculated to mount in all the other parts in it without any contact with the road surface after assembly. The design was modernized taking the comforts of the user and safety as well. The clamps used for attachment between power assist and wheelchair was challenging. The below figure shows the 3D design of the power assist wheelchair which was designed using a catia V5 software.



Fig-6 Side view

The fabrication is started soon after the design is finalized, and arc welding was chosen as a method for binding the frame metals. And after the fabrication of the frame we mounted hub motor on to it and also some other parts



Fig-7 Power Assist

As soon as all the parts are fabricated the parts are given a final finish and then the parts finalized for the final assembly. The parts are assembled using graded bolts and the lock nuts to avoid self-unscrewing due to vibration caused by the engine and the vehicle itself.



Fig-8 Assembly

V. WORKING MODEL

The power assist wheelchair is the attachment made for the manual wheelchair that can be used as the attachable electric wheelchair. The power assist consists of head tube frame, handle bar, throttle controller, lithium ion battery, hub motor, handle bar and controller. A Hub motor is a device that converts electrical energy into mechanical energy. The working principle of the motor is the effect of magnetic field on the current force, which makes the motor rotate. A motor is a rotating electric machine that transforms electrical energy into mechanical energy. The power assist wheelchair powered by a battery as an energy source. The battery would kick out a steady electric current, driving the dynamo in reverse so that it spins around in hub motor. As the motor turned, it would rotate the tire and make the power assist wheelchair go along without any help. The power assist is the simplest and user friendly mobility device. The wheelchair attached to it follows the path as the steering is at the power assist and it is the drive mechanism. The power assist attached to wheelchair with the help of clamp. A hollow shaft is made at the footrest of the wheelchair to which power assist is attached and clamped on and off in every less time. The power assist consists of a controller which is the brain of the whole system. It assists the command of speed, brake etc. The battery placed at the front portion of power assist which gives the power to run the wheelchair.

ADVANTAGE

- It is affordable.
- Easy to operate.
- Compared to electric wheelchair cost is less.
- Easily attached and detached
- Can be used outdoors.
- Can be Maintenance is less.
- Used as both manual and powered wheelchair.
- It helps the user to travel inclines.

DISADVANTAGE

- It is used only for short distance travelling.
- After use of 3 and 4 years' battery can be replaceable.

VI. CONCLUSION

The main theme of this project has been to make people aware of this technology, and make it popular among the general mass, so that it helps improving this world by reducing the disability problems. There has always been this willingness in human race to improve the ongoing technology that is prevailing at a particular time, by bringing a more sophisticated and advanced product than that is what presently available today. This act what actually leads into bringing new developments, progress in every aspect of life for better livelihood all around. That is why by the improvements and growth in science and technology in recent decades, we can see similar progress in the field of transportations also. As we know development is a continuous process and until it reaches into a state of complete perfection, there is always room for its improvements, and our study is just to support this idea. We would say that our project has been successful with considering the changes we had to make when compared to the available electric wheelchair. We believe that our project will be effective in providing mobility for disabled people at affordable price. As mobility is the basic need of every disabled person and we have made our project by considering its reliability, efficiency and effectiveness. Its utilization will be very much helpful for the NGOs as availability of automated wheelchair at affordable range of price will be financially and socially helpful. We have tried to analyse the properties of automated wheelchair, especially the role of controller, motor, along with batteries, so that it may help to improvise this technology where it may be necessary. The main objective is just to highlight its importance among common public, and establish it as a more secured and reliable alternative for inside city transportation, homely use, NGOs

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