

SEMI-AUTOMATIC WHEELCHAIR AUTOMATOR- A REVIEW

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Abstract : Attachable wheelchair automator (AWA) is designed for the benefit of the differently abled people who use wheelchair due to their disability or illness which can be attached to manual wheelchair for better maneuverability. It consists of a rechargeable battery, electric motor, electric throttle, mechanical brakes. Since the power wheelchair is very expensive and not everyone can afford it, hence the attachable wheelchair automator can prove as an affordable solution. Also Since it is detachable so it gives the user flexibility to use it as per requirement and also saves up space when needed. It is user friendly and will run on electricity.

Keywords: Attachable wheelchair automator, rechargeable battery, electric motor, mechanical brake, electric throttle, AWA

I. INTRODUCTION

Wheelchairs are used by ones who have difficulty in walking and moving around due to various neuromusculoskeletal impairments. In general manual wheelchairs are mostly preferred than motorized wheelchairs by disabled people. Besides the fact that manual wheelchairs weigh lighter than motorized ones, have less maintenance, costs less and have greater portability; they have an added advantage of promoting physical fitness in the upper extremity of the disabled person. In spite of providing exercise, this repetitive motion of propelling the wheelchair may cause injury in the shoulder due to overuse. There are various complaints of shoulder pain registered and most of them are of rotor cuff muscles. Therefore the only disadvantage of using a manual wheelchair is the possibility of contracting an upper body repetitive strain injury (RSI) due to the continuous propulsion of the hand rim wheelchair [2]. These injuries can be overcome by reducing the human effort by introducing electric power to the wheelchair.

The most common wheelchair found are either hand powered or electric powered. But they both have one thing in common that is the size and the wheels. The wheels at the front are smaller than the wheels at the back which is not a problem in flat surfaces but in rough terrain, it results in locking of the front wheel which can cause the person to fall. That is why they are designed for indoor use only.

There is also another kind of wheelchair that have 4 wheels and a large seat and electrically powered, but the problem with them is they are heavier which results in portability and are unpractical for indoor use.

The electric wheelchairs have become more efficient, quieter and lower-maintenance in general. They also grant users more freedom with less assistance including in the control, styles, range or travel distance, maneuverability, seating, and other user options. But this disparity in performance is reflected in a difference in cost: electric wheelchairs typically range between ₹ 50,000 and ₹ 1, 50,000 (1), while the basic manual wheelchairs cost around ₹ 5000 to ₹ 15,000 (1).

After researching various existing motors, we noticed that a standard bike could be converted into an electric bike by installing an attachable automator which consists of a wheel connected to a motor which is powered by a dc battery. The conversion is very convenient and allows a much greater range of travel. Also, cars' windshield wiper motors can also be used to provide as much torque as the hub motors with a more competitive cost. Therefore, a manual wheelchair can be possibly converted into an electric wheelchair by adding the suitable motors.

The design also includes an option to disable the AWA, which allows the user to switch between manual and electric modes to offer more flexibility to end-users. This feature can greatly benefit the more active users. Those users still maintain most of their extremity control and they can exercise their arm with converting the wheel chair to manual. The electric wheelchair option provides them with more freedom to travel a longer distance and require less assistance.

II. LITERATURE REVIEW

Many methods and products have been suggested and developed to overcome this prevalent disadvantage in the manual wheelchair by various authors.

Amar Nishant Singh developed a tricycle that can be driven by either an electric motor or a hand crank [3]. The hand crank drives the front wheel and operates independently from the motor.

Richard Simpson developed a power assist wheelchair with obstacle detection, to aid a disabled person with visual impairments [4].

Sruthi Ramachandran et al designed a motorized hand bike that can be attached to a manual wheelchair with a force sensitive resistor (FSR) sensor. Depending on the force applied on the FSR, the microcontroller reduces the PWM duty cycle to the motor. An ultrasonic sensor mounted on the bike reduces the PWM duty cycle rapidly on detecting an obstacle.

Yu Munakata et al made an external motorize system for driving a manual (hand propelled) wheelchair with an active-caster. In spite of a single drive wheel, 2DOF of the wheelchair with an active-caster drive system can be controlled independently without any constraint [5].

Dafne Zuleima Morgado Ramirez and Catherine Holloway studied both physical and non-physical barriers that a wheelchair user faces while operating it. On interviewing many wheelchair users they found that users who propel their wheelchair by themselves are prone to upper limb injuries which resulting in upper limb joint pain and reducing muscular strength. Various previous power assist devices were suffering more fatigue failure due to the placement of the power assist at the hub of the wheel which was too heavy and fragile for daily use. In order to compete this they introduce power assist. The system was installed below the seat and the batteries were placed on each side to distribute weight. Also, they installed a battery status indication unit at the leg of the wheelchair.

California Polytechnic State University, San Luis Obispo and Hochschule München, School of Applied Sciences jointly designed and build a working portable and detachable, hand powered, rear wheel drive wheelchair. They took local resident points over previous generation wheelchairs and designed a new electrically powered wheelchair but in their case, the power is supplied to rear wheels. They studied various old wheelchair designs and proposed their final design. But at the end there were various flaws in the design, the weight of the wheelchair was more than the proposed one.

III. OBJECTIVE

The Primary aim of AWA is to convert manual wheelchair to an electric wheelchair under a small budget. As mentioned earlier the price difference between the manual and automatic wheelchair is around RS 40000 or more for the lowest model of a power wheelchair. Our project cost has to be less than the difference. Our secondary aim is to provide flexibility to the user so that the user can easily attach or detach the AWA to make the wheelchair powered or manual as per the requirement. It will greatly benefit the users with a higher mobility level. And finally AWA system is designed to be user-friendly, hence easily controlled by the user. Moreover, it is eco-friendly too since it will run on electricity. Hence our project is the hybrid version of the indoor and outdoor wheelchair.

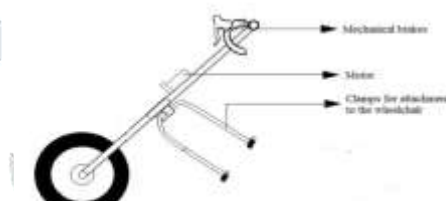


fig 1

IV. RESEARCH METHODOLOGY

The basic model of the hand bike is as shown in Figure 1. The design of the automator consists of a PMDC motor powered by a rechargeable battery. The hand bike has clamps for attaching itself to the frame of the footrest in a manual wheelchair. Therefore it can be detached easily from the wheelchair when it is not needed and it can be folded for portability. It has controls for moving in the forward direction, a rotatable handle for making turns and mechanical hand brakes. The basic design of the automator consists of PMDC motor, 12volts DC battery, steel frame, wheel, sprocket and roller chain.

Fig 2 and 3 show the actual design of the front part of the AWA designed using Solid Works.



fig 2



fig 3

The AWA contains

Permanent magnetic DC motor: In a **PMDC motor**, permanent magnets (located in stator) provide the magnetic field, instead of a stator winding. The stator is usually made from steel in cylindrical form. Permanent magnets are usually made from rare earth materials or neodymium. The rotor is slotted armature which carries armature winding.

Electric Throttle and Brake: The electric throttle has three connections – a 5V supply, a ground wire and an analog output which varies depending upon the degree to which the throttle is rotated. The analog output varies from 1V to 4V. The mechanical brake is fixed to the hub motor.

Rechargeable Battery: Lithium-ion battery is used as the power source since it is lightweight and easily portable. A 12 v dc battery is used to power the motor.

The motor will be attached to the wheel sprocket through a roller chain. The motor will be kept on a motor box which will be placed on the front side of the hand bike. The permanent magnet DC motor will be attached to rechargeable 12volt DC battery which will provide power to the motor.

The arm extending through the hand bike will be clamped to the footrest of the wheelchair firmly so as to provide a smooth movement. These arms will be connected to the main frame with a hinge mechanism so that the wheel is free to move in any direction without any restriction.

V. CONCLUSION

Design of a motorized attachable automator for the manual wheelchair is presented in this paper. It aids the differently abled by providing them a smoother and faster ride on a manual wheelchair with minimum effort and reduced strain on their shoulder and also provides them flexibility in its usage and is environment-friendly too. Moreover, it will be affordable for those people who cannot buy an electric wheelchair.

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