Motorised Bike Handle for Wheelchair

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Abstract: ***This paper involves the design of a motorized hand bike that can be attached to a manual wheelchair for greater mobility on roads without strain. The hand bike consists of an electric motor, powered by a rechargeable battery, a motor controller, electric throttle and mechanical brakes for driving controls.***

Keywords: Manual wheelchair, Hand bike, Brushless DC motor

1. Introduction

In general, manual wheelchairs are preferred over a motorized one for a simple reason that they are cheap and easy to maintain. They don't need to be charged before use and can help a person commute without any worries of failure of motors. They also provide physical fitness to the shoulders due to repetitive use. Though it may be an advantage excessive use can cause what is called repetitive strain injury (RSI) due to continuous propulsion of the wheelchair

2. Specification

- **Motor Specifications:**
  Type: BLDC motor
  Capacity: 360W
  Required Voltage: 48V
  Required Current: 7.5A
  Max current rating : 20A

- **Battery Specifications:**
  Voltage: 12v X 4 batteries= 48 V
  Current: 18A

3. Material Required

3.1 Brushless DC Motor

It is also known as a hub motor or a BLDC motor. They are typically brushless motors and contains a number of separate coils and an electronic circuit. The circuits switches the power ON and OFF in the coils and this creates force in each of them, thus making the motor spin. The electric motor is powered by a rechargeable lithium ion battery.

3.2 Motor Controller

The main purpose of the motor controller includes hall sensor communication, motor speed measurement, PWM output to the motor, protection from over-voltage, over current and thermal protection.

3.3 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 first and the second connections are given from the motor controller while the analog output is connected to the analog input of the microcontroller. The analog output varies from 1V to 4V. The mechanical brake is fixed to the hub motor.

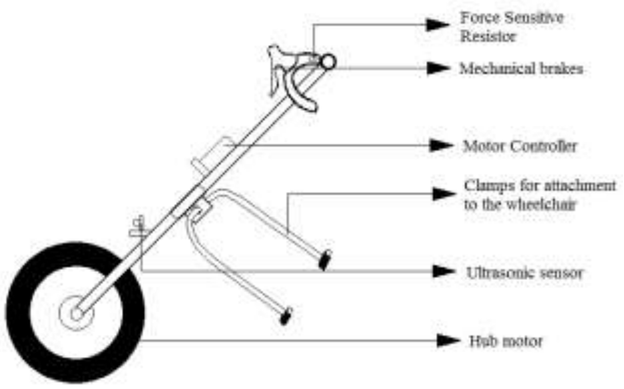


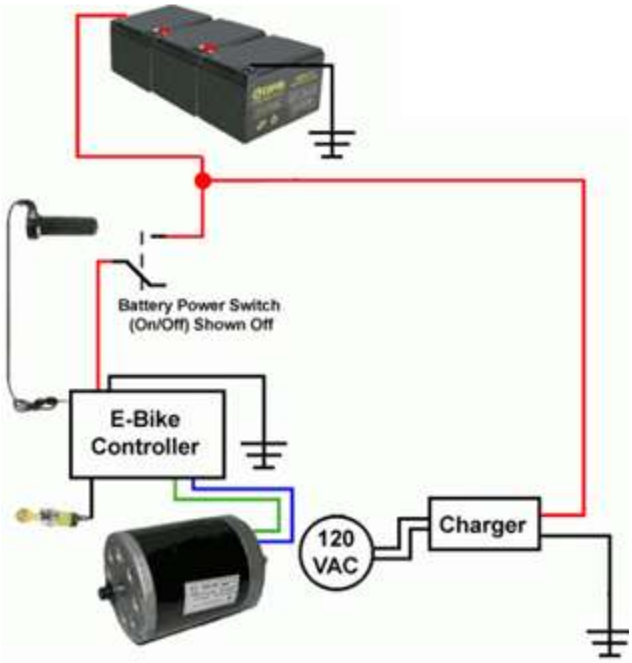
Figure 1: Basic Model of a Motorized bike handle.

4. Methodology

In this model, the batteries are used to to run the DC motor connected to the wheel of the motorized handle. A hub controller is connected to the hub which will regulate the power sent to the wheels. The batteries used are rechargeable. The clamps used in this model are detachable so its can be accessed easily by the person using it. Conventional brakes are used in this model which stops the wheelchair from moving forward.

5. Circuit Diagram

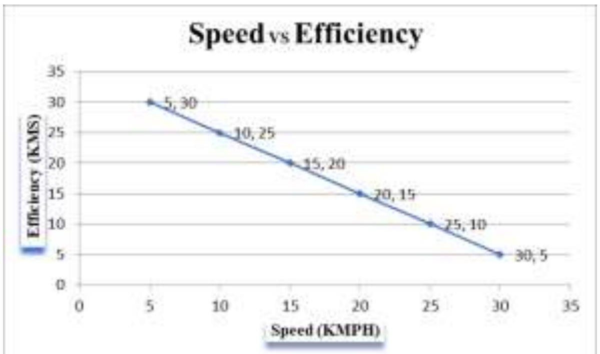
Here the batteries are connected in series. The two ends of the batteries have to be connected to the ends of the hub controller. The hub controller are also attached to the throttle and the electric hub. When the connection from the battery is connected to the controller. The electric motor starts to run.



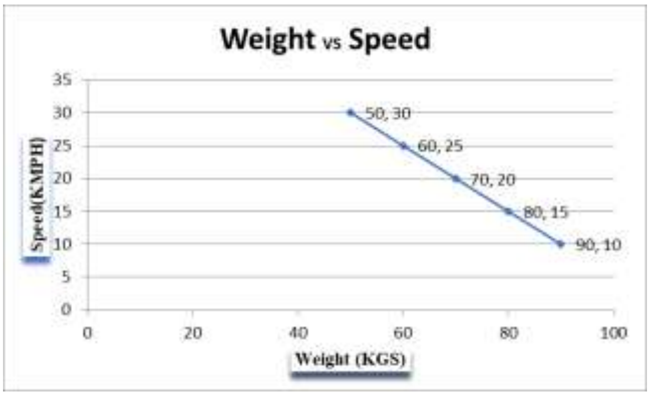
6. Calculations

For the selection of suspension
For calculation of Accelerating Force
Force = $^{Power}/_{Velocity}$
F = $^{360}/_{8.33}$
F = 43.2N
F = m x a
43.2 = 125kg x a
Therefore, a = $^{43.2}/_{125}$
Acceleration = 0.345 m/s^2.
Braking force (BF) = m x a x g
Where m = mass in kg
a = deacceleration in m/s^2.
g = acceleration due to gravity (9.81 m/s^2).
BF = 94 x 0.345 x 9.81= 318.13 N
To select a DC Motor, the following are the calculations for selection
Calculating the Horse Power of the BLDC Motor at 30KMPH (taking FOS 1.5)
HP = $\frac{V\,x\,I\,x\,e}{746}$
Where
V = voltage from the DC motor&I = Current
e = Efficiency of the BLDC Motor (85 – 95%)
Assuming the efficiency to be around 95%
HP = $\frac{48\,x\,7.5\,x\,0.95}{746}$= 0.46
Calculating the RPM
30kmph = 8.33 mps
C = πD
For D = 0.125m
C = π0.125m
C = 0.3927m
For RPM = $\frac{V}{C}$
RPM = 122.23 rpm
Torque = Force x Radius
Torque = 43.2 * 0.0625
T = 2.808 N-m

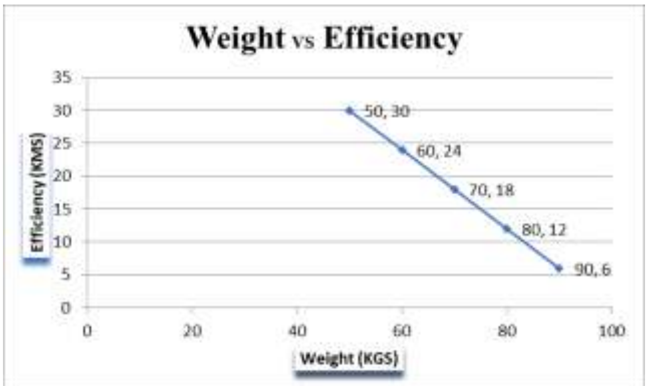
7. Graphs



From the above graph we can see that as speed of the bike increases the efficiency of the bike decreases and vice versa.As the speed of the bike increases the stability of the bike comes down.



From the above graph we can see that as the weight of the person sitting on the bike increases the speed of the bike comes down and vice versa.



From the above graph we can see that as the weight of the person sitting on the bike increases the efficiency of the bike comes down and vice versa.

8. Design of the Completed Model

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