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Design and Fabrication of Electric and Mechanically powered Hybrid Vehicle

A Manibharathi[1], k Giridharan[2], M Umersherief[3], C.M. Vivek[4]

[1,2,3] Final Year Students, Department of Mechanical Engineering, Periyar Maniammai Institute of science and Technology.

4 Assistant Professor, Department of Mechanical Engineering, Periyar Maniammai Institute of science and Technology.

Corresponding author- vivekintense@gmail.com

Abstract

The demand for personal transport has been immense due the technological developments. Each and every person are seeking personal transport rather considering public transport for day-to-day activities for better comfort. Personal vehicles have negative influence on the surroundings since the amount of emission adversely affects the environment. To overcome this problems transport device with zero emissions can be explicated. This paper proposes the concept of hybrid vehicle powered electrically and mechanically for better environmental sustainability by focusing on zero emissions. The Vehicle is electrically powered with 24v 14 AMPS sealed lead acid battery and 500W DC brushed permanent magnet motor. For mechanical a slider crank mechanism is been employed for converting the reciprocating energy to rotating energy is been employed. The Hybrid vehicle is tested with varying loads and varying environments.

Keywords: Hybrid Vehicle, Environmental Sustainability, Electric motor. Emission less vehicle

Introduction

The main issue of urban areas it has a greater number of vehicles in peak hours and roads are congested by heavy traffic. Vehicles emits lot of toxic gases into the atmosphere impacts human health and day today routine in negative manner. The transportation is needed everyone life and people are more likely willing to drive personal vehicles because of technological advancement and for their comfort. Our generation faces lot of issues related with pollution and government has taken more initiatives in controlling the pollution. The main ideas behind this project to develop a portable eco-friendly automobile which can be carried and handled by all peoples of different genders, sex and ages.

Studies from previous work suggested Failsafe Segway using Gyro unit resulting in zero pollution. Their project cost worth is up to 10,000. They have used a hub motor with a capacity

of 48 v and the speed capacity is 60km/hr. The motor is powered with the help of four batteries. battery voltage 12v and its capacity is 40 amps/hr. Scooter wheels are used for the purpose of running the vehicle. A Special braking unit is attached so that right wheel gets locked while turning left and the Left wheel gets locked while turning right. The cost value can be increased up to 25,000. The weight bearing capacity is not mentioned.[1]

In another work named Design and fabrication of self-balancing vehicle, Chalmers Institute Sweden, their motive was to construct a Fail proof Segway at a low cost. Wooden chassis is used for construction. A DC motor with a configuration of 12v and 60 rpm is used. A 12v rechargeable battery with a capacity of 7.5 amps/hr that takes 7hrs for running and takes 2-3 hrs for getting charged. Additionally, a special braking setup arranged, in which locking of alternate wheel occurs i.e., the left wheel gets arrested while turning left and similarly the right gets locked while turning right. The weight bearing capacity will remain maximum to a level of 80 kg and the cost estimation is not mentioned.[2]

In Segway Personal transporter report by Partik axelson, the people mentioned in this journal made use of wooden chassis to construct the upgraded Segway that has a motor (Configuration: voltage -24v, speed-2750 rpm amps-19A, power-350w). They used wheels of a scooter for the purpose of running. In this Segway, the Gyroscopic action that was expected by them is carried out with sensors. The expenditure will be within 20,000 to 25,000 and the weight up to 75kg can be carried out.[3].

It is mentioned in the journal Edgar, Mechanical Segway a self-Balancing scooter vehicles by M.A.Clark that the project workers made use of gyroscopic sensors, accelerator, brake, steer for constructing a Segway resulting in zero pollution while in running condition. They made use of a country wood to make chassis and they used 12 v DC motor for running purpose. They used Four 12v batteries as power source. Power transmitting chains (Bush roller type) are used for power transmission. No cost value is mentioned. The rider of the vehicle should weigh less than 80 kg.[4]

Boniface, Keith, et al has stressed for the safety standards in Segway to prevent trauma and accidents associated with it. [5]. Work done by Wael Younis and Mohammed Abdelati studied the stabilization theory of inverted pendulum for designing the Segway. [6] Studies done by Sawatzky, Bonita focuss on how Segway fairs with wheel chair, how Segway can be designed for mobility of people with disability.[7] Momin, Zia, and Farooq Khan, developed a four-wheel electric scooter for better comfort and stability for the riders. [8]

The proposed design is done based on the above studies. The objective of the project is to Design a hybrid electric vehicle which is capable of utilizing both electric energies stored in battery and utilize the mechanical power by transmitting the power from electric power and provides adequate control of steering and braking. The proposed vehicle should be compact in size and less in weight. Based on these objectives the parameters such as weight, material type used, motor rating, battery capacity, steering system, braking system etc. are chosen.

Design

For design calculation the factor of safety is taken as 1:3, hence the load, torque required are considered in ratio of 1:3. The vehicle is designed for a person weighting around 70-80 kg. Considering the weight of vehicle around 15-20 kg so total of 100 kg is consider of actual load.

Actual Load = 100kg

Factor of safety = 1:3

Velocity = 30km/hr

Maximum Load = 300kg

= 30 x 33/100 = 39.3km/hr

Maximum Load = 300kg Max Velocity = 40km/hr

= 40 x 1000 / 3600

= 11.111m/sec

Time = 30sec

Force required = Mass x Acceleration

To Find Acceleration

Linear Motion Equation

$V = u + a\,t$

$11.111 = 0 + a\,(30)$

$11.111 = 30a$

$a = 11.111 / 30$

$= 0.3703666 m/sec^2$

Force required = 300 x 0.3703666

= 111.10998N

Power = Force x Velocity

= 111.10998 x 11.111

= 1234.5443211Watt

= 1.235Kw

Power = 2πNT / 60

1234.544321 = 2 x 3.14 x 3000 x T / 60

1234.544321 = 18840T / 60

3.9316698124 = T

T = 3.932Nm

Electrically Powered

Based on the design calculation, for electric power part the following components were be preferred for fabrication.

Motor

The specification of motor is shown in table no.1. As per design calculation the torque requirement is 3.932Nm, hence motor torque of 3.9 Nm is selected.

Parameter	Specification
Type	Dc motor – Brushed permanent magnet
Voltage	24
RPM	2800
Rated current	27.4A
Torque	3.9Nm

Table.no 1 Motor Specification

Battery

The motor is powered with set of 12v 14A sealed lead acid battery. The weight of battery is around 3.5 which is comparatively low considering the previously fabricated models.

Speed Controller

Speed controller are used to govern the performance of the electric motor. The speed controller used is DOL type which is used to control throttle and also used for controlling functions such as LED indication, charge light, speed variation etc.

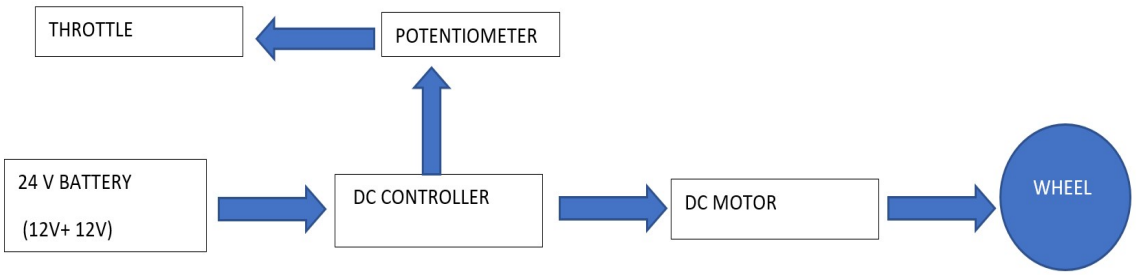

Fig.1 Arrangement of ECS

Mechanically Powered

The mechanical powered part is more like a step walking process as used by Slider-crank mechanism to convert the reciprocating motion to rotational motion. The Process of stepping initiates the reciprocating motion transferred to the wheels by the slider crank mechanism. The slider crank rotates during the step pressing process. these rotational motions translate the power in to wheels then vehicle will move forward. While each body has six degrees of freedom in space, the kinematical conditions lead to one degree of freedom for the whole system.

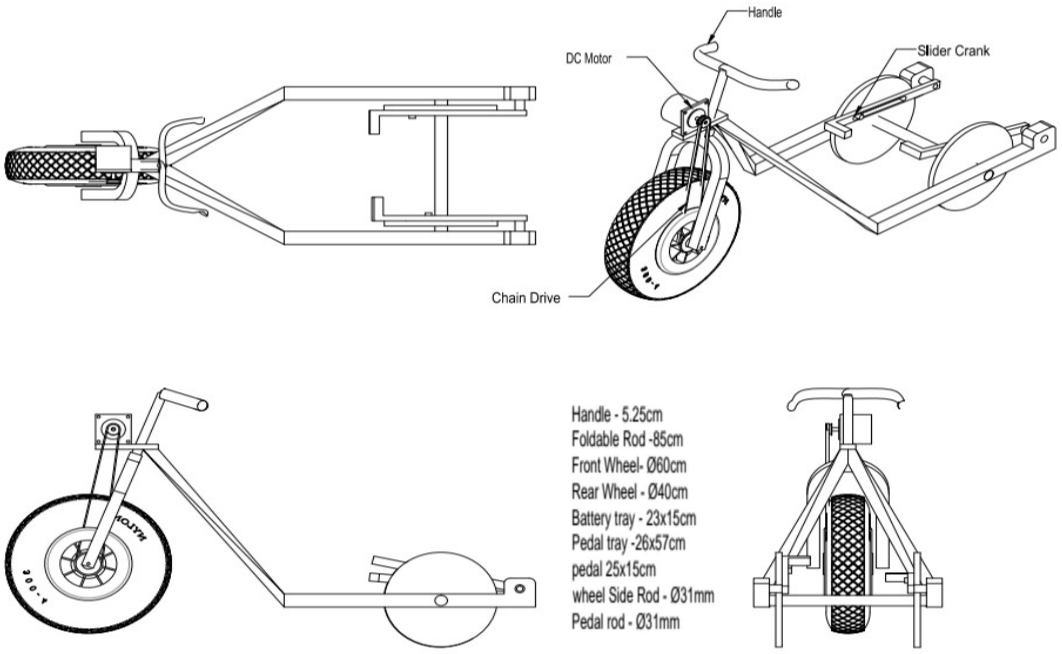

Fig.2 2D Design of Hybrid Vehicle

Fabrication

The frame and chassis are built with square hollow bar of mild steel. The base provides stability for the vehicle. The surface of the vehicle is fabricated with mild steel sheet material. The square bars are welded by arc welding. The vehicle is rear wheel drive when mechanically powered and electrically powered on frond wheel. The speed controller is assembled in bottom of the frame. The motor's RPM is tested for input voltage. The batteries are also place in the base and the motor is place in surface of the vehicle body. The handle bar is attached to the front wheel which is conventional cable to turning in both directions. The wheels used are made up of hard rubber sizing 8 inches. The rear wheels are connected to bearing which enable linear and rotational motion by reducing friction and stress.

Fig.3 Fabricated Model of Hybrid Vehicle

Conclusion

With increasing carbon emissions caused by vehicles powered by fossil fuels leads to global warming and other environmental degradation. For sustainable development, the need for eco-friendly vehicles has to developed. The recent trends have shown the increase in manufacture of electric vehicles and eco friendly vehicles. The proposed model has advantages of being environmental friendly in terms of zero emission and have alternate way of mechanical power to run the vehicle.

Reference

[1] Design and fabrication of a fail safe Segway, By B.Tech students of merits,Udhayagiri.

[2] Chalmers-Design and fabrication of aself balancing vehicle,Chalmers Institute Sweden
[3] Edgar, Mechanical Segway a self Balancing scooter vehicles by M.A.Clark
[4] Segway Personal transporter report by Partik axelson
[5] Boniface, Keith, et al. "Serious injuries related to the Segway® personal transporter: a case series." Annals of emergency medicine 57.4 (2011): 370-374.
[6] Younis, Wael, and Mohammed Abdelati. "Design and implementation of an experimental segway model." AIP Conference Proceedings. Vol. 1107. No. 1. AIP, 2009.
[7] Sawatzky, Bonita, Ian Denison, and Amira Tawashy. "The Segway for people with disabilities: meeting clients' mobility goals." American journal of physical medicine & rehabilitation88.6 (2009): 484-490.
[8] Momin, Zia, and Farooq Khan. "Design, development and fabrication of transmission and steering system for four wheel electric scooter for handicapped for indoor and outdoor use." (2016).