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Design and Development of Solar Powered Electric Cart for on Campus Application

M.Surendra[1], M.Gowtham[2], V.Nithin[3] , G.Bhanu[4] , N.Sai Kumar[5], Dr.V.Sridhar Patnaik.[6]

[1,2,3,4,5] *B. Tech Final Year Students, Dept of Mechanical Engineering, Visakha Institute of Engineering and Technology.*

[6] Professor, Dept of Mechanical Engineering, Visakha Institute of Engineering and Technology.

Abstract - Electric vehicles (EVs) are becoming increasingly popular due to their eco-friendliness and low operational costs. However, the use of fossil fuels to generate electricity to charge these EVs undermines their sustainability goals. Combining solar energy with EV charging can create a sustainable and clean transportation system, which can reduce our dependency on non-renewable energy sources. The overall objective of the project is to design an efficient solar powered electric cart that can be used on campus in transporting and carrying Stationery loads. This is accomplished through the design of subsystems such as the frame, drivetrain, power, suspension, Brakes and steering, and integrated into a master assembly model using soft wares namely SolidWorks, a computer aided design (CAD), and finite element method (FEM). The FEM analysis is carried out to study the stress and displacements of the cart in order to ensure the safety. The basic performance of cart is evaluated in terms of its range, acceleration and maximum achievable speed. The cart is designed for 250kg load carrying capacity, acceleration of 1.2 m/s2 and maximum achievable speed of 15km/h with a power rating of about 1.5kW. Secondary support software such as Excel, and solar analyzing software were used to assist in the planning of the various subsystems as well as data collection and assortment.

Keywords : Solar / electric cart, electronic differential speed control, Lithium-ion battery, transportation, photovoltaic.

1.INTRODUCTION

The issues of climate change or global warming have been rigorously discussed by many governments since the early 21st century. A great number of relevant reports have revealed the negative impact of climate changes dominantly driven by human activities. With the globally increasing civilisation and industrialisation, a large number of fossil fuel burnings in industries have led to the acute problem of air pollution (Wee, 2010). Simultaneously, the exhaust emissions from automotive vehicles cannot be ignored. Vehicle emissions, which mainly include CO2, CO, NOx and particulate matters (PM10 and PM2.5), have been considered as the major contributors to the effect of greenhouse gases, also leading to the increase in different forms of cancers and otherserious diseases (Fenton and Hodkinson, 2001; Fajri and Asaei, 2008).

The ever rapidly growing transportation sector consumes about 49% of oil resources. Following the current trends of oil consumption and crude oil sources, the world's oil resources are predicted to be depleted by 2038 (Ehsani et al., 2010). Therefore, replacing the non-renewable energy resources with renewable energy sources and use of suitable energy-saving technologies seems to be mandatory. Electric Vehicles (EVs) as a potentialsolution for alleviating the traffic-related environmental problems have been investigated and studied extensively (Clement et al., 2009; Hajimiragha et al., 2010; Stephan and Sullivan, 2008). Compared to ICEV, the attractive features of EVs mainly are the power source and drive system.

2.0 SYSTEM OF SOLAR CART VEHICLE

2.1 CHASSIS

Chassis is a major component of a vehicle system. It consists of part of the vehicle which consists of frame and running gear like motor, transmission system, suspension system etc. This type of chassis used for electric vehicle it consists of internal framework that supports man-made object. Design and analysis of the chassis is done through a advanced CAD (fusion 360, & Analysis software). The design and analysis of the chassis is done for stress distribution criteria .This type of chassis is mostly used in light weight vehicles like electric vehicles. It provides a good beam resistance because of its continuous rail from front to rear. As a result chassis has been designed in a way to reduce vibration, increase strength and optimize the weight of the chassis

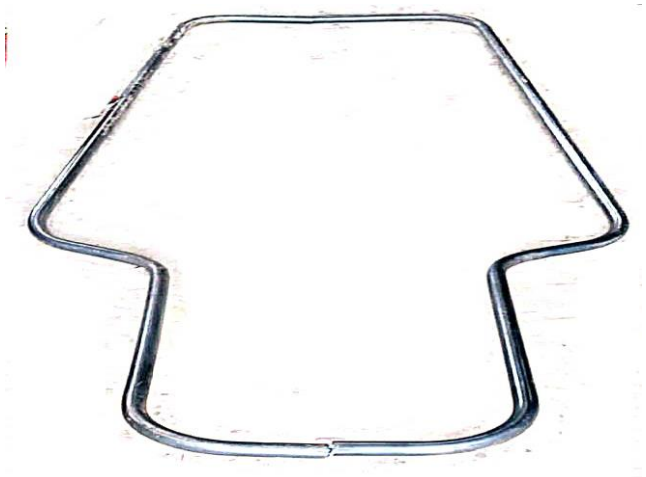

Fig2.1:Chassis

Chassis, also known as 'Frame', is the foundation structure of any car that supports it from underneath. The purpose of the chassis is to bear the weight of the car in its idle and dynamic states. Given that, most people don't get to choose the chassis of their car and many may not really care about them as much.

2.2 BATTERY

Lithium battery provides users with reliable and high-performance batteries. Its energy density, safety, charge retention, long endurance all show excellent performance. It is an ideal choice for two wheel / three wheel electric vehicles, logistics robots, etc.

The lithium iron phosphate battery (LiFePO4 battery) or LFP battery (lithium ferrophosphate) is a typeof lithium-ionbattery using lithium iron phosphate (LiFePO4) as the cathode material, and a graphitic carbon electrode with a metallic backing as the anode. The energydensity of an LFP battery is lower than that of other common lithium ion battery types such as Nickel Manganese Cobalt (NMC) and Nickel Cobalt Aluminum (NCA), and also has a lower operating voltage.

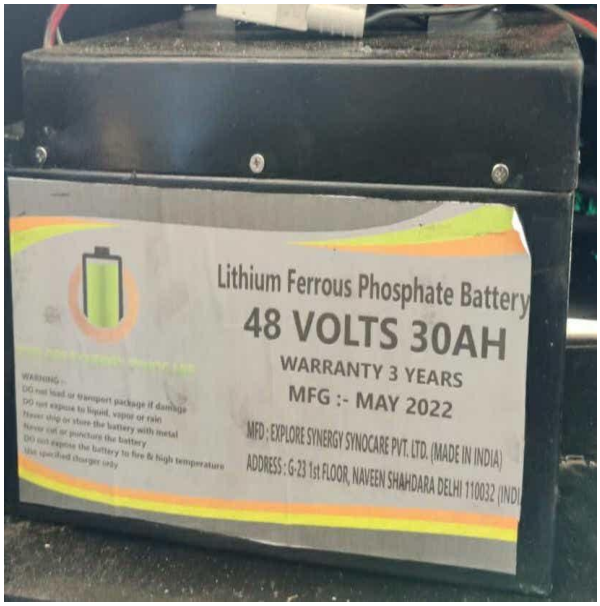

Fig5.2: Battery.

2.2 SOLAR PANELS:

People of the world have to pay attention to renewable energy resources due to the limitation and impact of non-renewable energy resources. Due to global warming, greenhouse gas emissions, fluctuating oil prices, and rising electricity demand in developing countries have to consider new solutions .
So renewable energy is affected by the current energy structure and direction of energy development as an essential part. Solar energy is a type of renewable energy resource which has been extensive – scale development and full applications due to energy transmission limitations .

Usually, solar energy has many advantages than fossil-based coal and oil due to reduce carbon emissions, clean the air, and can generate again within our lifetimes . In the present scenario of the world, the consumption of electricity has been increased. Therefore researchers have focused on developing solar energy technologies to obtain a high-efficiency level with minimum investment cost and less environmental pollution .

When considering solar energy technology, its intermittent and fluctuating characteristics, utilization, and efficiency are limited. For rural and mountainous areas far away from large power grids, generally, solar hybrid power systems are used.

Due to randomness and fluctuation of solar power cannot provide continuous and stable active power output . In general, this solar power is not adaptable to everywhere due to the distribution of natural resources are dependently on the culture of the individual community.

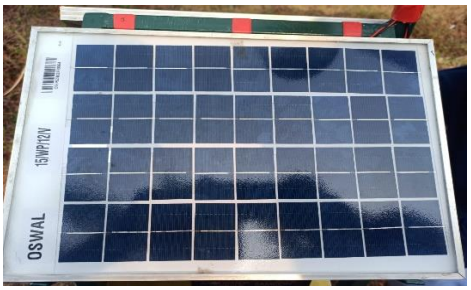

Fig -2.2: Solar cell

2.3 BLDC MOTOR

Brushless DC Motors or BLDC Motors have become a significant contributor of the modern drive technology. Their rapid gain in popularity has seen an increasing range of applications in the fields of Consumer Appliances, Automotive Industry, Industrial Automation, Chemical and Medical, Aerospace and Instrumentation.

A brushless DC motor (known as BLDC) is a permanent magnet synchronous electric motor which is driven by direct current (DC) electricity and it accomplishes electronically controlled commutation system

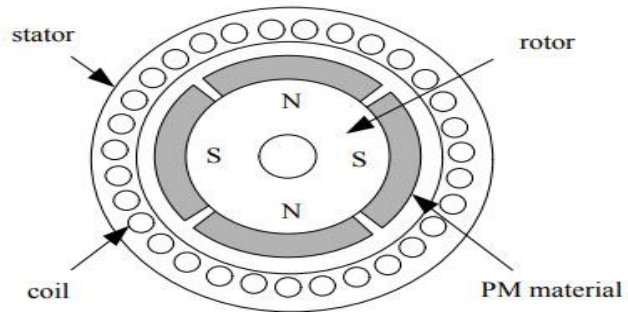

Fig2.3 BLDC motor construction

Fig 2.5: Bracking plate.

2.4 STEERING SYSTEM

RACK AND PINION STEERING

Rack & pinion is a type of steering with a pair of gears that convert rotary motion into linear motion. These systems consist of a circular gear called a pinion with teeth attached to a linear gear shaft called a rack. The rotary motions applied to the pinions cause it to turn while moving the rack sideways.

RACK AND PINION MECHANISM

A rack and pinion is a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operates to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly.

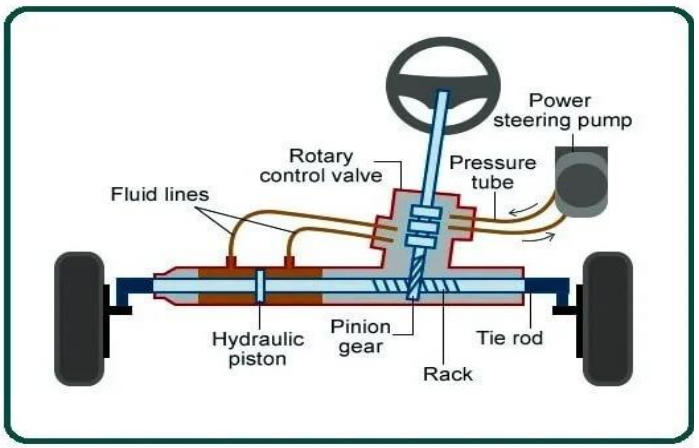

Fig 2.4: Steering Mechanism Process.

2.5 BRAKING PLATE :

The plate, attached to the axle assembly, holds the components of the drum brake assembly. A backing plate, as shown in Figure , is stamped steel and has various holes for springs, parking brake cables, and wheel cylinder attachment, and support pads for the shoes. The labyrinth seal is formed around the outside of the backing plate to keep water from entering the brakeassembly.

2.6 TRANSMISSION SYSTEM

The utility model discloses a transmission system of an electric tricycle. The transmission system of the electric tricycle comprises one rear wheel and a driving motor; and the driving motor drives the one rear wheel respectively through two transmission shafts. The two transmission shafts respectively drive the one rear wheel to rotate to drive the electric tricycle to travel, so as to realize differential steering without a differential mechanism, which can greatly reduce the manufacturing cost of products; pedal-driven flywheels are mounted, so as to realize the diverse functions of motor driving and manual driving; and the transmission system has the advantages of simple structure and wide application range

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Fig 2.6Transmission System

2.7 Wheel cylinder:

When the brakes are applied, hydraulic pressure pushes the two pistons in the Swept area one surface Swept area two surfaces 60 Square Inches 100 Square Inches a brake drum has less surface area than a brake rotor, but there is much more contact area between the brake shoe linings and the drum than there is between the brake pads and rotor. Most larger brake drums have fins along the outside to aid in cooling the drum. The fins

increase the drum's external surface area, which allows for more rapid heat dissipation.

Fig 2.7:Wheel Cylinder.

given from the battery through the controller. The power generation by the solar equipment is sufficient to supply the power to lights and horn. For protecting the kart from atmospheric corrosion paints are applied. The project has succeed to run the vehicle by means of both battery and solar panel.

4 CONCLUSION

"The Design and Fabrication of Hybrid Vehicle" of self designed and self assembled has been carried out by our team with diligent and continuous effort. The design of the chassis and relevant components are designed by using the Fusion 360 software by one of the project teams of our college. Then the fabrication process is started by applying the methods like Pipe bending, Pipe cutting, beveling, welding, reaming and grinding processes. Followed by the completion of fabricating the components of the vehicle the power transmission system is placed my means of motor to the rear wheel through chain mechanism. The connections for the motor and solor panel are given from the battery through the controller. The power generation by the solar equipment is sufficient to supply the power to lights and horn. For protecting the kart from atmospheric corrosion paints are applied. The project has succeed to run the vehicle by means of both battery and solar panel

REFERENCES

1. Nishanth, Kumar Aluri; Salim, A. Channiwala

2. bhinav and Kumar, Sahil and Bangar, Sahibjeet Singh and Iqbal, Tariq (2023)

3. Mohammad Aadil Shaikh

4.Rahaf,Musslem; WajAlmehdar; GhufranDiwan; A.Benseno uci; Saima Munawwar

5. Ahmad F. Tazay1 1Assistnat Professor

6. SMil'shtein1, M Zinaddinov1, D N Asthana1 and J Scheminger

AUTHORS

M. SURENDRA
B.tech Final year
VIET Visakhapatnam

N.SAI KUMAR
B.tech Final year
VIET Visakhapatnam

M.GOWTHAM
B.tech Final year
VIET Visakhapatnam

V.NITHIN
B.tech Final year
VIET Visakhapatnam

G.BHANU PRAKASH
B.tech Final year
VIET Visakhapatnam

DR.V.SRIDHAR PATNAIK
Professor, Principal.
Dept of Mechanical Engg.
Viet, Visakhapatnam.