Design and Manufacturing of Hybrid Bicycle

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***Abstract*- Since the fuel prices increasing not only in India but throughout the world day by day. Thus, there is tremendous need to modify or to reuse the output energy of engine fuel by using electrical energy source. A gasoline-electric hybrid bicycle which roles not only on internal combustion engine but also batteries and motors which is the generate electric energy to drive the wheels. It has a great advantage over previously used gasoline engine that drives the power from gasoline only. It effects the environment into great extend, so it is very essential to make use of gasoline electric hybrid bicycle. Method to upgrade conventional bicycle into a combination of mechanical and electrical bicycle by using two stroke engine and by using motor and batteries to increase the overall efficiency and performance of bicycle within minimum cost. The combination of both powers makes the bicycle dynamic in nature, it provides advantage in fuel economy and environment impact over conventional bicycle. Initially the designing of bicycle in cad, simulations of inventor and other models are done equipment and their cost analysis is done. It deals with fabrication of the vehicle**.

***Keyword*- Hybrid Bicycle, Environment, Fuel Economy, Cost Analysis, Design Analysis.**

1. INTRODUCTION

During selection of project topic, it became necessary to design and fabricate the hybrid bicycle with mechanical and electrical combination because the major problems are arising like increasing pollution, fuel cost so it is necessary to have an alternative solution for this and hence a hybrid bicycle uses two or more distinct type of power sources, such as internal combustion engine to drive an electric generator that powers an electric motor[1-4]. The basic principle with hybrid bicycle is that the different motors work better at different speeds. The electric motor is more efficient at producing torque, power and then combustion engine is better for maintaining high speed better than typical electric motor. Switching from one to the other at the proper time while speeding up yields a win in terms of energy efficiency[5-7], as such that translate into greater fuel efficiency. In today's world, now a day the problem facing of dwindling fuel resources for vehicles. There is no doubt that the emission of carbon dioxide from an automobile exhaust is a concern for the increasing rate of global warming [8]. So, one of the optimistic solutions for such problem is the hybridization of the bicycle. The hybridization of a conventional combustion engine with an advanced electric motor drive may greatly enhance the overall efficiency and achieves better utilization fuel with reduced emissions[9-10]. This include assembly of IC engine and it component. The next phase consists of implementing the electric power drive and designing the controllers. The final stage would consist of increasing efficiency of the vehicle in economic ways.

2. METHODOLOGY

The hybrid vehicle consists of following components: Two Stroke engine, hub motor, lead- acid battery, controller, accelerator, bicycle, dynamo etc.

Two-stroke engine:A two engine is a type of internal combustion engine which complete a power cycle with two stroke (up and down movement) of the piston during only one crankshaft revolution. The two stroke engine be the end of combustion stroke & beginning of the compression stroke happen simultaneously with the intake & exhaust function occurring at the same time.

Two stroke engines often have a high power to weight ratio, power being available in a narrow range of rotational speeds called the "power band". (Refer fig.1.) Compared to four stroke engines, two stroke engines have a greatly reduced no of moving parts & so can be more compact & significantly lighter.

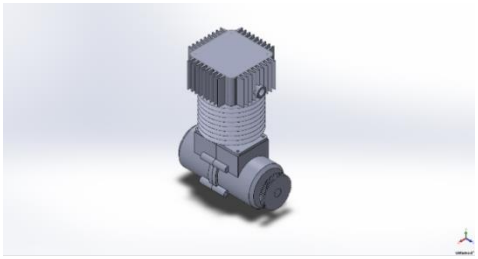


Fig.1 Two Stroke Petrol Engine

Hub Motor:Hub motor is typically brushless motor, (Ref fig.2) which replace the commutator and brushes with half dozen or more. Separate coils and an electronic circuit. The circuit switches the power on & off in the coil in turn creating forces in each

one that make the motor spin.it generate high torque at low speed, & also doesn't need sprockets, brackets & drive chain. It is highly efficient. The main feature of hub motor is that they can be controlled to give wide constant power speed ranges.

Fig.2 Hub Motor

Lead Acid Battery: Lead acid batteries are very common in our day to day life. This is illustrated in (fig.3.)Batteries use a chemical reaction to do work on charge and produce a voltage between their output terminals. The sulphuric acid electrolyte produces a voltage. The supplying of energy to and external resistance discharge the battery. The discharge reaction can be reversed by applying a voltage from a charging source. Thus this project demand for a battery with long life with longer running hour's lighter wright with respect to its high output voltage & higher energy density among all the available battery types the most suitable on to be selected.

Fig.3.Lead Acid Battery

Controller: A motor controller is an important element of the hybrid bicycle. It serves as a brain of bicycle. shown in (fig.4.) It controls the amount to power supplied to the hub motor & also to the lights, horn, etc. the motor controller is connected to a power source. Such as a battery pack & control circuitry in the form of analog or digital input signals. The motor controller performs the fun of conversion of DC voltage from battery to an alternating voltage with variable amplitude & frequency that drive the hub motor at different speed.

Fig.4 Controller

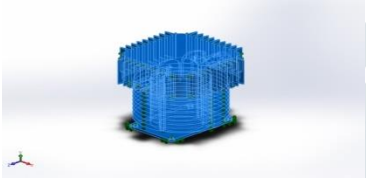
The design of hybrid bicycle model is look like figure.5

Fig.5. Design Model of Hybrid Bicycle

3. RESULT AND ANALYSIS

The following Result are obtained by using solid works which shows the material properties and name of component as shown below

TABLE.1 Properties of Material

Model Reference	Properties		Components
	Name: Model type: Default failure criterion: Thermal conductivity: Specific heat: Mass density:	Gray Cast Iron Linear Elastic Isotropic Unknown 45 W/(m.K) 510 J/(kg.K) 7200 kg/m^3	Solid Body 1(Engine Block.IGS)(Engine Block)

Parameter
Mass:14.9425 kg
Volume:0.00207535 m^3
Density:7199.99 kg/m^3
Weight:146.437 N
Temprature:900°C

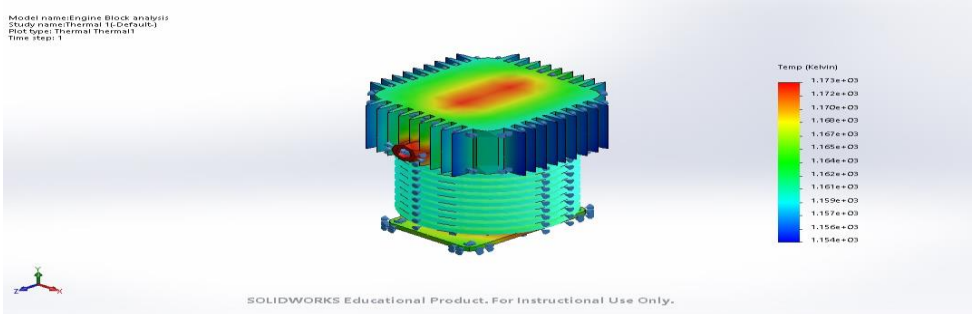
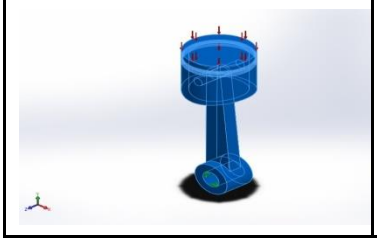


Fig.6. Cylinder Block Analysis

TABLE.2 Properties of Material

Model Reference	Properties	Components
	Name: **AISI 4130 Steel, annealed at 865C** Model type: **Linear Elastic Isotropic** Default failure criterion: **Max von Mises Stress** Yield strength: **4.6e+08 N/m^2** Tensile strength: **5.6e+08 N/m^2** Elastic modulus: **2.05e+11 N/m^2** Poisson's ratio: **0.285** Mass density: **7850 kg/m^3** Shear modulus: **8e+10 N/m^2**	**SolidBody 1(Boss-Extrude2)(Piston Arm-1), SolidBody 1(Cut-Revolve1)(Piston Head-1)**

Volumetric parameter:
Mass:0.611549 kg
Volume:7.79006e-05 m^3
Density:7850.38 kg/m^3
Weight:5.99318 N.

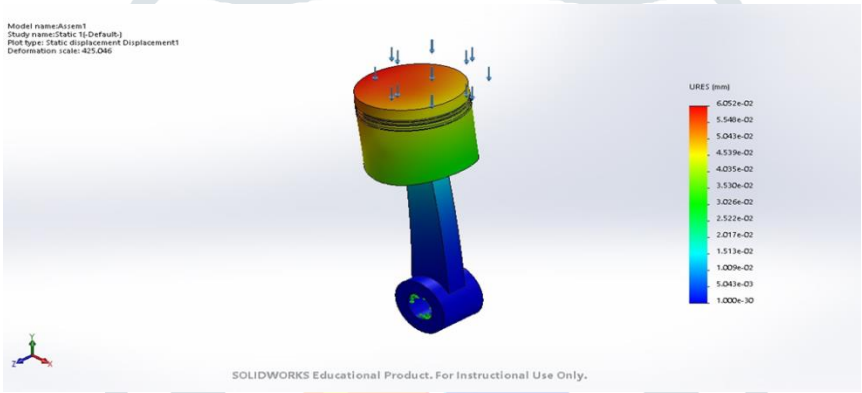


Fig.7 Engine Piston

By considering temperature of 900 degree centigrade, The thermal analysis has been done on Piston and Cylinder Block by using solid-work and the result obtained are shown in fig.6 & fig.7. it has been seen that the static displacement at the connecting rod cap is 1.000e-30 mm and static displacement at connecting rod shaft is 1.009e-02 mm which is under safe condition and the static displacement on piston crown is 6.052e-02 which shown by red region because it comes in directly contact with flame but the overall results obtained for the static displacement on piston is under the safe condition.

TABLE.3 Stress Analysis

Name	Type	Min	Max
Stress 1	VON: von mises stress	1.213e+02 N/m^2 Node: 176515	2.822e+07 N/m^2 Node: 190000

Fig.8 Chassis of Bicycle

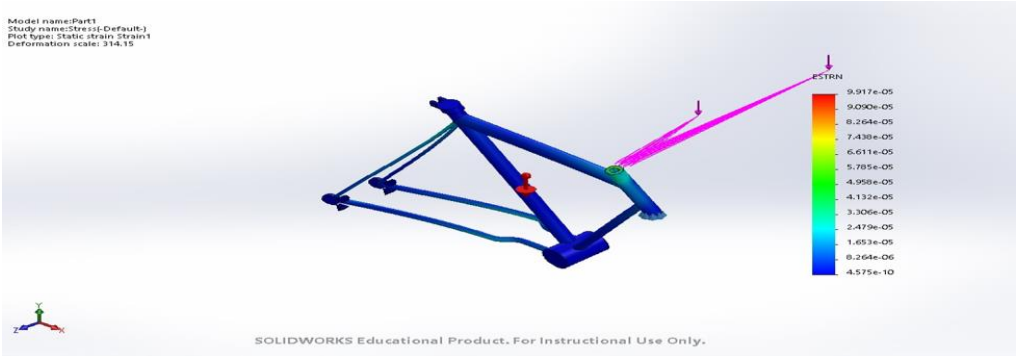


Fig.9 Stress-Strain Analysis

As shown in fig.8 and fig.9 the results obtained by using solid work, Considering Mass: 21.7403 Kg, Volume:0.00282 m^3, density:7703.55kg/m^3 and by applying load (direct transfer) with reference coordinates (400,580,200),(400,500,-200) on the Chassis by considering the center of gravity, It has been seen that the stress obtained on bearing is under fully safe zone which is shown on equivalent strain scale is 4.575e-10 similarly the results obtained on headset are also with safe conditions as shown on equivalent strain scale is 4.958e-05 shown in fig.9.

4. CONCLUSION

It is observed that, the ICE in this built hybrid electric bicycle is utilized for obtaining the propulsion of the bicycle from the rest, as the speed is increased; the electric motor propulsion is combined with the ICE propulsion for total movement of the bicycle. The total torque obtained by both ICE and electric motor are synchronized for respective road gradient by varying suitably the respective controllers utilized. By doing torque distribution accordingly, battery life per total charge can be enhanced in driving the electric motor also minimizing the fuel required for ICE propulsion. The following result are given through this hybrid bicycle are as below:

- Torque calculated of motor 1136 N-mm
- Power of motor is 250watt
- Torque of engine 1733 N-mm

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