International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

DESIGN DEVELOPMENT OF MECHANICAL VARIABLE TRANSMISSION SYSTEM WITH HIGH STARTING TORQUE FOR ELECTRICAL VEHICLES

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Abstract - *Mechanical variable drive system is specific transmission gear system to get high torque and relatively high speed. This system is generally applicable in Electric vehicle for high acceleration and to achieve high speed. In this project we are going to design and develop a variable gear transmission system to replace the fixed gear drive which is conventionally used in electric vehicle. Mechanical transmission system will help in reducing sudden load on Electric motor. This conversion is feasible and can be implemented by replacing the IC engine with a pre-assembled electric motor kit, as maximum parts are consciously chosen from the survey of market arability in INDIA*

Key Words: ***BLDC Motor, Hub motor, Belt drive, mid-drive, Swing arm, IC Engine.***

1. INTRODUCTION

This hub is a solid attachment in between the wheel and the driveshaft. Hub holds the wheel and driveshaft together to make a connection between them and assure movement without lag, it also assures the axial alignment in rotary motion. This design also has an attachment for the driven pulley, which is further connected to a driving pulley. And also provides a drum for drum brake attachment. This hub is placed between the brake shoe case and another hub which is fastened with the driven pulley. Design universal for any type of scooter which has wheel size 90/100-10 E.g., Honda, Suzuki, Hero, TVS, etc. The whole effort is to replace the use of hub motor in electric drive to provide more power out of small BLDC motors

1.1 PROBLEM DEFINATION

While converting an existing scooter into a pure electric-powered vehicle the main issue is that scooter engines are a design mixture of the swingarm, suspension mound, center stands mounding and driving wheel attachment, the brake drum, and brake shoe hub are also an integral part of IC engine casing. All these attachments and supports are gone as we remove the IC Engine.

Even the wheel is no more attached to the vehicle, as in the case of two-wheeler bikes having an independent swing arm, wheel hub, driven chain sprocket arrangement.

1.2 SCOPE OF THESIS WORK

This hub Design of mid-drive can be used to support the wheel, give the wheel an attachment with a driven pulley, a drum brake system, scooter main stand can be fastened to the swingarm and this assembly together replace the IC engine completely getting all the necessary function back to work.

1.3 Objective of the project

- Any old scooter (wheel size 90/100-10) can be converted to pure electric.
- Any type of mid-drive motor can be connected as the motor mound is universal.
- No power lag issue compared to hub motor in same wattage range.
- Rpm and power can be manipulated by just varying pulley size.
- Easy manufacturing and component availability in the INDIAN market.
- Low unsprung mass as compared to the hub motor.
- Direct shocks on the motor are reduced.

2. MATERIAL SELECTION

Here aluminum alloy is preferred conceding the fact that Aluminum alloy's main feature for its popularity is its low weight, this reduces the weight of the hub as well as in the vehicle. Aluminum alloy has a good machinability property compared with grey cast iron. Two aluminum alloys that are mainly used in manufacturing, are 319 and A356.

319 aluminum alloy Contains:

85.8 - 91.5 % of aluminum,
5.5 - 6.5 % of silicon,
3 - 4 % of copper,
0.35% of nickel,

0.25% of titanium,
0.5% of manganese,
1% of iron,
0.1% of magnesium,
1% of zinc.

Characteristics:

This alloy has good casting features, corrosion resistance, and good thermal conductivity. Under the heat treatment of the T5 process, it generates high strength and rigidity for the engine block.

A356 aluminum alloy contains:

91.1 - 93.3 % of aluminum,
6.5 - 7.5 % of silicon,
0.25 - 0.45 % of magnesium,
0.2% of copper,
0.2% of titanium,
0.2% of iron,
0.1% of zinc.

Although the mechanical properties are similar to 319, when it is under the heat treatment process T6 it gains higher strength than 319. But it has a lower modulus of elasticity (72.4 GPa) than 319 with a modulus of elasticity of 74 GPa.

4. HUB DESIGN

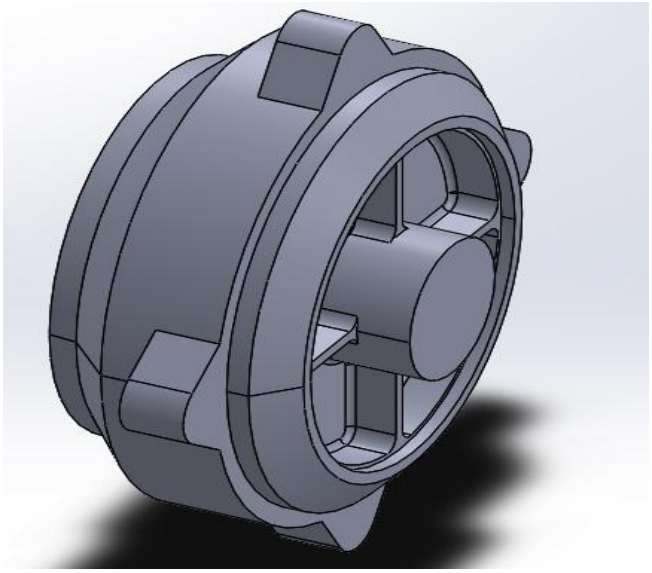
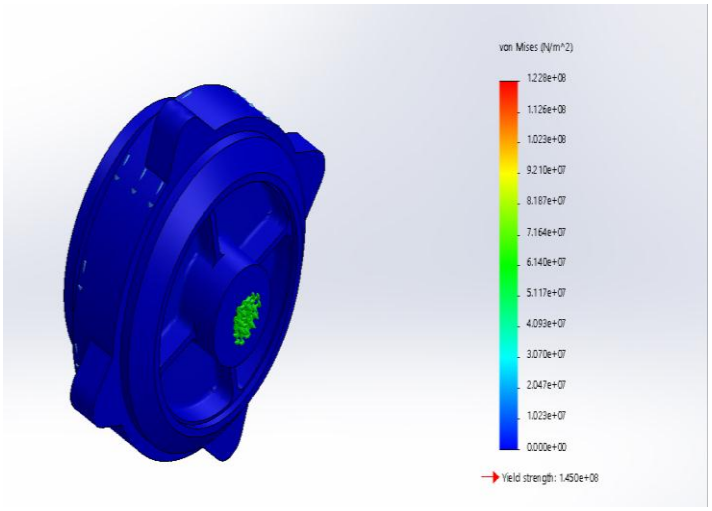


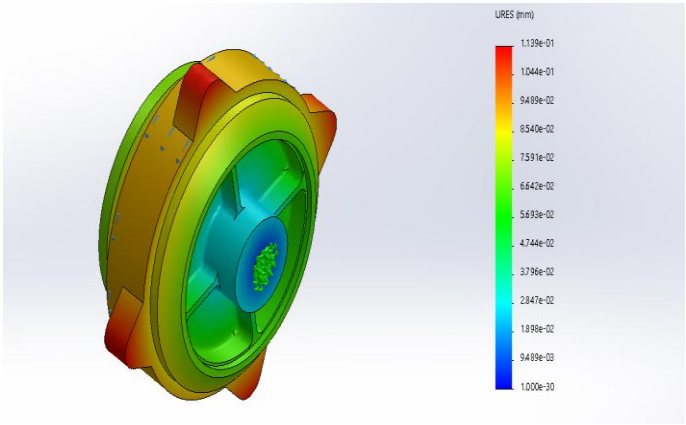
Fig -1: HUB DESIGN

5. SIMULATION AND ANALYSIS

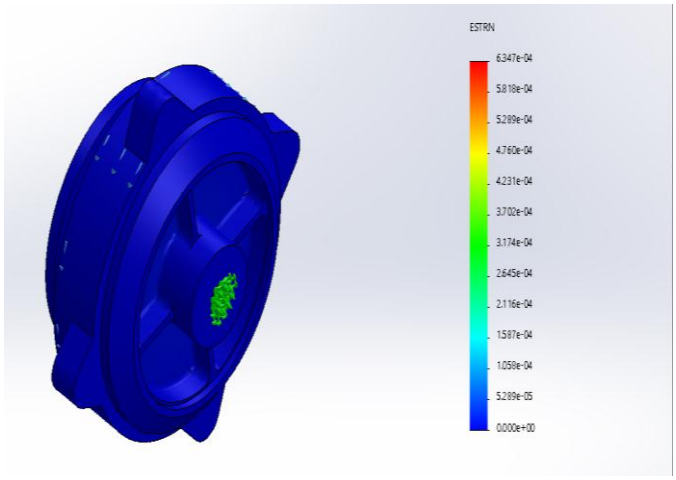
5.1 STRESS ANALYSIS



5.2 DISPLACEMENT ANALYSIS



5.3 STRAIN ANALYSIS



6. APPLICATION

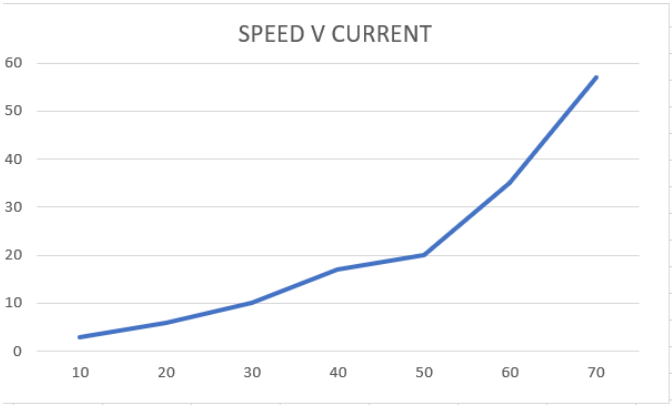
- Old vehicles with good body condition can be reused as pure EV vehicles.
- Batter cooling methods can be provided to cool the motor as the motor is placed away from the wheel.
- Water splash resistance increases.
- Stones and such hard material as a residual on road will not directly impact motor.
- Food delivery scooters can easily convert to EV and fossils fuel can be saved.
- Low acceleration problem is solved compared to the same wattage hub motor.
- Gradeability increases compare to the hub motor

7. RESULT

The fixed reduction is capable of pushing the vehicle to 80 km/h speed but will take more current to reach its nominal power rating.

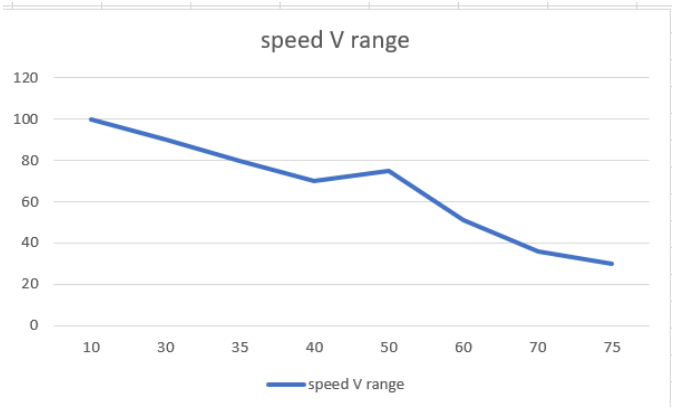
But a CVT or Multiple gearboxes can accelerate the vehicle fast, resulting in low power requirements or high-power requirements for a short time, resulting in saving power which can be used for increasing the range.

Till now we have reached a point where we have developed a fixed drive to obtain the current rating on conjugative speed as shown in the graph[1]



When working on the system we found that when we remove the engine from an old scooter to convert it to pure electric the rear hub is an integral part of the engine as we remove the engine the suspension mounds the wheel hub and the brake assembly are also gone along with the engine.

So, we have suggested a design of a hub and a swing arm that will bring the suspension mound and a wheel hub and brake back into the system. This hub will also have an attachment of synchronous pully. Further, the CVT will be connected to this system as an integral part.



8. CONCLUSIONS

There is an increase in the awareness for the need to cut down on greenhouse and carbon emissions which are usually a result of fuel powered engines. This prompted the need to develop sustainable transportation systems that are free from pollution, in order to protect the environment and dangers of climate change. The use of electric and solar powered vehicles has gradually gained momentum but the biggest challenge to the generality of the populations around the world is affordability. This research focused on analyzing available options for an improved version of a scooter over the conventional one, in terms of several criteria such as efficiency and ease of manufacture and maintenance. The selected design, the continuously variable transmission was analyzed and developed further and is proposed as a sustainable means of transportation. For stability and safety, a tricycle version of the concept is recommended. Although it will cost more than the conventional scooter, the developed electric drive train provides a 'green' and affordable means of human transportation as well as protection of the environment from the dangers of climate change and increased emissions from fuel powered vehicles and factories. Further analysis and improvements can be carried out to enhance the design through the incorporation of controllers and sensors.

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BIOGRAPHIES

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