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Design and Development of Replaceable Electric Powertrain Unit for Motor Scooter

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***Abstract*— In light of volatile market prices and the possibility of dwindling fuel supplies, electric vehicles have gotten a lot of coverage. Electric vehicles have become an appealing option, particularly for short-distance commuting, thanks to advancements in battery technology and substantial improvements in electrical motor performance. Because of their high efficiency and durability, BLDC motors are becoming more popular in electric vehicles. Electric motor scooters face new design problems for scooter manufacturers all over the world. The most cutting-edge design solutions are first put to the test in the competition environment. The current study looked at the initial design of rear swing arms for an electric motor scooter, as well as the iterative method of improving them. All of the pieces are planned to be made of mild steel.**

Keywords*— *Electric Vehicle, Swing arm, Battery, BLDC Motor.

I. INTRODUCTION

A. Backround

The basic idea of a battery electric car is straightforward. An electric battery for energy storage, an electric motor, and a controller make up the engine. The battery is usually charged from the mains through a plug and a battery charging device, which can be brought onboard or installed at the charging point. In forward and reverse, the controller would usually control the power supplied to the motor, and thus the vehicle speed. This is often referred to as a forwards and backwards 2-quadrant controller. Regenerative braking is normally preferred as a means of recouping energy and as a frictionless braking method. The 4-quadrant controller is described as one that allows regenerative braking in both forward and reverse directions.

B. The Problem

Automobile emissions are one of the most significant contributors to global warming. Cars, trucks, and motorcycles release carbon dioxide and other greenhouse gases, accounting for one-fifth of total global warming emissions in the United States. Greenhouse gases trap heat in the atmosphere, resulting in rising global temperatures. The Earth would be covered in ice if greenhouse gases were not present, but excessive use of fossil fuels, such as gasoline and diesel, has resulted in a 0.6°C (1°F) increase in global temperatures since pre-industrial times, and this trend will continue in the coming decades. Farming, biodiversity, sea levels, and the natural world are all affected by rising global temperatures.

C. The Proposed Solution

We have seen the issues and difficulties that it has caused. As a result, using electric cars and selling or scrapping traditional vehicles is a viable option. However, due to the high cost and lack of confidence in electric cars, it appears to be impractical. So, what if the consumer has the option of converting their old scooter to an electric one? To make it possible, we created a retrofit package for the Honda Dio. According to our observations, the frame and other components of Honda motor scooters are identical.

II. PROBLEM STATEMETN

A. Units

- Design a motor scooter with a retrofitted electric powertrain as an alternative to the current IC powertrain.
- Due to the high energy density of petrol, existing motor scooters use traditional IC engines. Electric scooters, on the other hand, lack the output power and hence are not favored. The powertrain would be replaced, providing a cost-effective alternative to the IC engine.
- The powertrain unit will be redesigned with an electric motor to achieve this. Weight reduction for increased performance. The unit swing arm will be optimized to accomplish this.

III. OBJECTIVES

- The Integration of an electric drivetrain and battery system into the body of a motor scooter, resulting in a weight reduction and a range of 60 kilometres. For everyday usage, the vehicle should be able to sustain its original torque of 8 Nm and top speed of 60 kmph.
- The unit swing arm was reverse engineered for improved strength and space use.
- Keeping the vehicle as original as possible with minimal permanent modifications to enable the user to go back to an IC engine unit if necessary.

IV. SCOPE OF PROJECT

- The combination of batteries and controller as a modular device is used in the design of electrical systems.
- The frame is designed as a load-bearing sub-chassis assembly that includes a drive unit and a belt-driven wheel that pivots around a fixed axis.
- The intermediate shaft and brake assembly are part of the drive-train configuration.
- Static load, axial loads, acceleration load, breaking load, and torsional force are all supported by the design of a cantilever dynamic shaft.

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V. LITERATURE REVIEW

Kunjan Shinde, "Literature Review on Electric Bike" Mechanical Engineering Department, University of Mumbai, India

We discovered the concept of electric bikes in this article. We learned about the components of an electric bike and how to calculate them. We also received some design inspiration for our concept. This paper is extremely helpful in conveying the researcher's point of view.

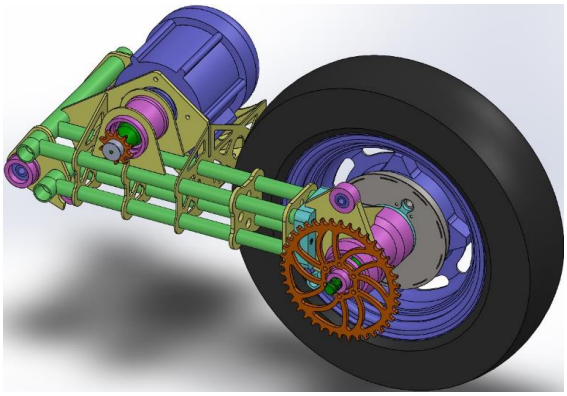
João Diogo da Cal Ramos [2], the paper presents "Rear Swing Arm Design of an Electric Racing Motorcycle"

The swing arm was the subject of this article. The swing arm on the motor scooter is one-sided. As a result, the swing arm's design and manufacture were critical. This paper provided us with some input data, such as design parameters, calculation assumptions, and manufacturing guidelines.

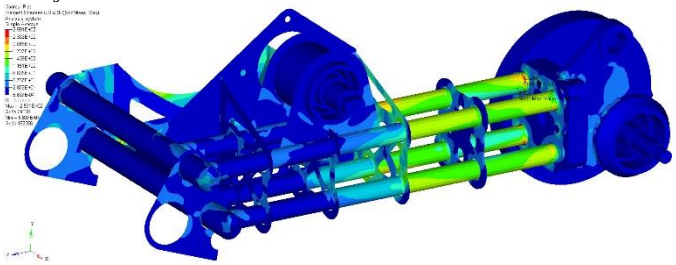
VI. DESIGN AND ANALYSIS

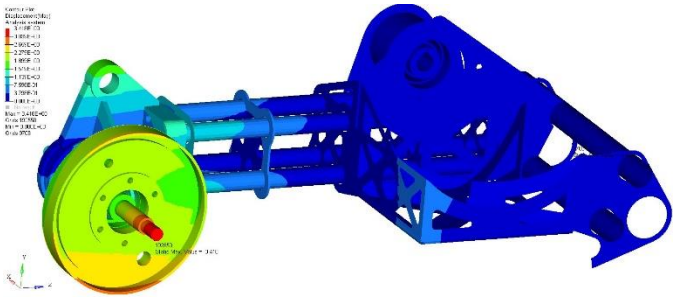
A. Swing Arm

Using a jig, we extracted dimensions from the engine integrated swingarm, such as pivot point position, spring mount location, and wheel axis. The engine, power train, and brakes unit are all part of the new swingarm design. With all of this in mind, we created the model depicted in Figure.



On Altair HyperWorks based on Optistruct, a static structural analysis of this subframe is performed, with boundary conditions such as fixing all DOF except rotation on pivot point, fixing vertical DOF of spring mount, motor dead weight, motor holding torque, drive train holding force, bump load, brake torque, leaning angle load, and acceleration push. The study revealed a maximum von-mises stress of 260MPa and a maximum displacement of 3.42mm. As a result, the safety factor is 1.35.





B. Lithium-ion Battery

Since the lithium-ion battery is the most advanced battery technology, we used it to build our battery pack. They have a 3.7V nominal voltage and a 2Ah power. We required 48V to meet the motor's requirements, so 13 cells were stacked in sequence. To achieve a 1.5kWh power, 16 cells were stacked in parallel. The picture below shows 260 cells with connections.

VII. CONCLUSION

- It has been discovered a practical method for producing the replaceable electric powertrain assembly.
- Top speed of 57.5kmph
- Acceleration of 0-46kmph in 7.65sec within 100m.
- Economy of 5.2km for 1 rupee.
- Range of 55.5km, without rolling and regenerative.

VIII. REFERENCES

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