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EV SCOOTER

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1.ABSTRACT

This paper focuses on the design and development of an electric vehicle (EV) scooter to offer a sustainable and cost-effective solution to urban transportation. The proposed scooter integrates a BLDC hub motor, rechargeable lead-acid batteries, and essential EV components using a streamlined design to enhance efficiency and minimize maintenance. Key design phases include conceptualization, CAD modeling, material selection, and assembly. Performance testing showed promising results in range and operational cost. The project aims to promote cleaner mobility and reduce dependence on fossil fuels.

KEYWORDS:

Electric Vehicle, BLDC Motor, Sustainable Mobility, Green Transport, Battery Powered Scooter, Urban Transportation.

2.INTRODUCTION

Concerns over global warming and fossil fuel consumption have accelerated interest in electric transportation. E-scooters are compact, energy-efficient, and ideal for urban use. Our objective was to build a single-seater electric scooter that is lightweight and functional, using a modular design approach from scratch.

Electric scooters are rapidly gaining popularity due to their affordability, low maintenance costs, and contribution to reducing air and noise pollution. India, being one of the largest two-wheeler markets globally, presents a significant opportunity for electric vehicle adoption, especially in urban areas with high traffic congestion.

Market Relevance:

The Indian government's FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) policy supports electric vehicle innovation and subsidies. This has led to increased R&D efforts, local manufacturing initiatives, and awareness among consumers.

Environmental Impact:

Traditional petrol-powered two-wheelers emit carbon monoxide, nitrogen oxides, and hydrocarbons, contributing to air pollution and climate change. EVs, on the other hand, produce zero tailpipe emissions and can be powered by renewable energy sources, making them an eco-friendly choice.

Technological Advancements:

The integration of Brushless DC (BLDC) motors ensures smoother acceleration, better torque control, and longer lifespan compared to brushed motors. Battery technology, especially lithium-ion, is improving in terms of energy density, charge cycles, and weight, though this project utilizes more cost-effective lead-acid batteries for prototyping.

3.METHODOLOGY

The basic idea is to attach a motor to the cycle for its motion. A motor that is powered by a battery and that can be switched on during difficult terrains and switched off and pedal to get the battery re-charged during motion in a flat terrain. The idea came into our mind as different stages of project planning, firstly we wanted to implement a simple moving system so the projection of cycle as a system came into our mind, and second stage was adding a necessarily useful component into it that can be beneficial in the future and for common people, falling into the current trend was that of hybrid system so we ended up planning to assemble a motor unit into the cycle drive. There were many issues that came up while making such a system major one of them being the power of the motor to be used, since no such previous systems were made, we could not predict the type of motor which we should go for. Second thing being the weight factor, the addition of extra weight on to the system, which can cause discomfort to the rider while normal pedaling. Third was the type of battery to be used, we should go for a battery that has longer life, economically viable, and also has less maintenance issues. Fourth issue was that self-recharging a battery with a motor alternator unit that too with the simple cranking motion of the cycle was not viable, we had to utilize a mechanism that can come in handy here and that was by using the flywheel rotation technique.

DESIGN ANALYSIS

Generally, the design of this system depends primarily on the ratings of the DC permanent magnets which produce the DC and the required output power. The output power to be produced affects the dimensioning as well as the input parameters like torque, speed, etc. In light of the above constraints, the following design considerations and assumptions have been made for this project design.

4.OBJECTIVES

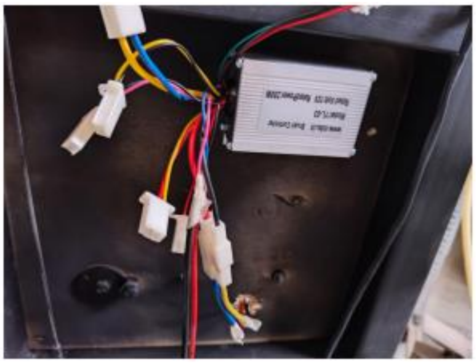
1. Design a cost-effective electric scooter.
2. Reduce pollution and dependence on petrol-powered two-wheelers.
3. Evaluate scooter range and performance.
4. Optimize for urban and last-mile connectivity.

5. COMPONENTS & SPECIFICATION

GEAR MOTOR:

Specifications – Motor Type: Gear motor – Rated Output Power: 350 Watts – Voltage: 24V – Rated Speed: 250–450 RPM (post gear reduction) – No-load Speed: 300–600 RPM – Torque: 12–25 Nm (gear-dependent) – Gearbox Type: Planetary or Worm Gear – Gear Ratio: 5:1 to 20:1 – Efficiency: 75–85% – Shaft Diameter: 10–12 mm

CONTROLLER:



Specifications – Compatible Motor: Gear Motor – Body Material: Aluminum – Cable Length: 15 cm – Current Limit: 15 A – Rated Voltage: 31 to 36 V – Rated Power: 350 W – Weight: 211 g – Length: 90 mm – Width: 50 mm – Height: 30 mm

LEAD-ACID BATTERY:

How they work

• Discharging: During discharge, the lead dioxide and lead react with the sulfuric acid electrolyte to produce lead sulfate, water, and electricity.

• Charging: When recharged, the lead sulfate is converted back into lead dioxide and lead, and the sulfuric acid electrolyte is regenerated.

THROTTLE:

The throttle mode works similarly to that of a motorbike or scooter. You can propel the bike forward without pedaling by pressing the throttle. You can control how much power is produced with most throttles. Electric bikes have a variety of throttle options, ranging from thumb throttle to full twist throttle.

DISC BRAKES:

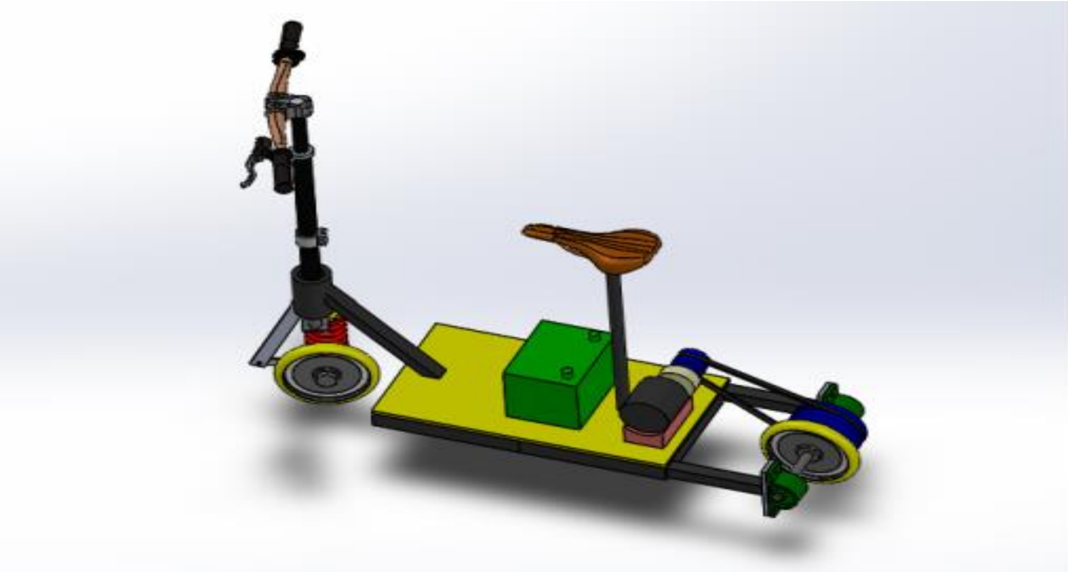
A disc brake is a type of brake that uses the calipers to squeeze pairs of pads against a disc (sometimes called a [brake] rotor) to create friction. There are two basic types of brake pad friction mechanisms: abrasive friction and adherent friction. This action slows the rotation of a shaft, such as a vehicle axle, either to reduce its rotational speed or to hold it stationary. The energy of motion is converted into heat, which must be dissipated to the environment. Hydraulically actuated disc brakes are the most commonly used mechanical device for slowing motor vehicles. The principles of a disc brake apply to almost any rotating shaft. The components include the disc, master cylinder, and caliper, which contain at least one cylinder and two brake pads on both sides of the rotating disc

MINI SUSPENSION:

Mini suspensions for electric scooters (e-scooters) are compact suspension systems designed to absorb shocks and improve ride comfort, especially on uneven or rough terrain.

6.DESIGN AND CAD MODELING:

ASSEMBLY OF EV SCOOTER



Isometric view:

7.CALCULATION:

1.Battery and Controller Compatibility

- Battery: 12 V
- Controller: 12 V, 250W
- Motor: 24 V, 350W

Charging Time (h) = 12 2 × 1 0.9
= 6.67 hours

2. Gear Ratio and Wheel Speed

- Motor RPM: 2750
- Desired Wheel RPM: 300

Gear Ratio = Motor RPM /Wheel RPM
= 2750/ 300 ≈ 9.2 4.

3.Torque Calculation

Let's calculate motor torque at max power: Power = 2π × Torque × RPM /60

Rearranging:

Torque = P × 60 2π × RPM
= 350 × 60 2π × 2750 ≈ 1.22 Nm

4.Wheel RPM and Speed

Assuming a belt with a pulley reduction to bring motor RPM down to a usable wheel speed.

Reduction Ratio: 5:1

Wheel RPM = 2750/ 5
= 550

5. Speed:

v = RPM × C /60
= 550 × 0.628 60 ≈ 5.75 m/s
= 20.7 km/h

6. Range Estimation (Battery)

Using two 12V batteries in series:

Total voltage = 24 V

Assume battery capacity = 12 Ah

Energy = 24 × 12 = 288Wh

Motor Power Consumption: 350W

Run Time = 288/ 350 ≈ 0.82 hours ≈ 49 minutes

Range = Speed × Time = 20.7 × 0.82 ≈ 17 km

7.Torque on Rear Wheel

Motor Torque: 1.22 Nm

Reduction ratio (belt): 5:1

Output torque on wheel = Motor Torque × Reduction Ratio

Rear wheel torque = 1.22 × 5 = 6.1 Nm

So, the rear wheel receives about 6.1 Nm of torque.

8. Torque on Front Wheel

If no motor is attached to the front wheel and it's used only for steering:

Front wheel torque = 0 Nm (driven only by rolling friction)

8.CONCLUSION

Due to the many problems of congestion, pollution and urban mobility, new modes of transportation (electric scooter) transportation devices, increasingly seem to be an alternative to widespread automobile use. The ergonomic evaluation also demonstrated that power scooter is easy to use in normal use situations, including situations involving obstacles, for a broad cross section of users. The devices also compare favorably with other types of vehicles, particularly in terms of stability, where they seem superior to other vehicles such as bicycles and mopeds. However, electric scooter is designed for a broader segment of the population and is meant to meet a wider variety of mobility requirements in urban transfers to alternative forms of mobility and use for short distances. The performance studies carried out in a closed environment also demonstrated that power scooter is easy to use in normal use situations as well as to get around obstacles.

9.FUTURE SCOPE

• With some of India's biggest automobile makers getting involved into electric vehicles segments, E-bikes, Scooters & bikes are going mainstream. Indigenous start-ups like Ather energy, Torque motorcycles, Efflux, Ultra Violette automotives, Orca energies and Yulu adding to influx, backed by the government 'Make in India' initiative.

• Government of India has fixed a target of taking electric vehicles production up to 30% of two-wheelers and cars by 2030, from the current stand of less than 1%. The sector holds immense scope since middle and lower-income groups are often hit by the hike in fuel prices and hence are most likely to make the 'Big Switch' from petrol & diesel-run automobiles to EV's.

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