A journal on "Refurbishment of Internal combustion engine to an electric vehicle"

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Abstract - *This study offers the relatively new notion of IC engine reconditioning for electric scooters. These internal combustion engines run on fossil fuels, producing very harmful fumes and noise. An electric scooter could be a viable answer to this issue. Existing Internal combustion engine scooters, on the other hand, will face depreciation and disposal issues. As a result, switching these internal combustion engines to electric engines could be a terrific method to solve a lot of difficulties. Automobiles have certain drawbacks in the present day, such as high fuel costs compared to mileage, pollution, and inefficiency. An electric scooter is a type of alternative fuel vehicle that uses electric motors and motor controllers instead.of an.internal combustion.engine.. Power is obtained via battery packs rather than carbon-based fuel. This not only saves money, but it also has a less negative influence on the environment. It also has a variety of advantages over typical internal combustion engines, including less local pollution and higher energy efficiency.*

Key Words: **Refurbishment, I.C Engine,Electric Vehicle, Motor, Battery, mileage, pollution, simulation, development.**

1. INTRODUCTION

India is the world's largest market for two-wheelers with roughly 360 million internal combustion engine 2-wheelers on road. Electric vehicles have gained significant traction in India's 2 wheeler and 3 wheeler space[1]. However adding more EVs to the existing vehicle load in the name of reducing carbon emissions is not an ideal solution as it will make the roads even more congested. To make clean mobility accessible to everyone, India requires a comprehensive scrapping policy that includes provisions for converting internal combustion engines to electric vehicles[2].

The decision about which conversion is better for a particular vehicle depends on the condition of the vehicle body, chassis and the IC engine.If the engine isseized with the body and the chassis in good condition it can be converted to a completely electric vehicle[3]. In addition a conversion kit consists of a power controller to regulate the flow of energy and a recharging system to allow the flow of electricity to the Li-ion batteries. The conversion process also requires tweaks to the wiring and other electronic functions[4].

2. METHODOLOGY

2.1 Design

Several calculations and research were done on the vehicle chassis to understand the incorporation of the hub motor into the vehicle. The strength and durability of the chassis had to be taken into account to determine the factor of safety and feasibility of thevehicle [5].

It was understood that certain changes to the vehicle chassis have to be made in order for the successful incorporation of the hub motor into the vehicle. We found that it makes sense to make a 3-dimensional sketch of the chassis and then made changes to it to make the idea possible. We made use of Autodesk Fusion 360 software to do this. The modulation of the chassis using the software made it possible to fabricate the new chassis without any errors on the first attempt [6].

Fig 1: Side view of Scooter Chassis

Fig 2:Iso metric view of scooter chassis

Fig 3: Initial Chassis condition

Fig 4: Fixing the new suspension system

Fig 5: Fixing Battery Compartment

Fig 6: Chassis after Modulation

Fig 3 shows the initial condition of the vehicle chassis. The chassis used was altered to incorporate the design changes that were needed. Further as shown in Fig 5 fabrication of a battery box and welding of an extra compartment for accommodating the controller was done. The battery box was fixed in such a way as to not affect the performance and electrical circuitry. Fig 4 shows the modification of vehicle suspension which was originally a single suspension system which was not able to withstand the load which was applied on the chassis for these reason these system was upgraded to dual suspension system which was able to withstand the applied load and also they provided comfort and also safety for the vehicle. Fig shows the final chassis condition after modulation of the suspension system and battery box.

2.2 SIMULATION AND ANALYSIS

Fusion 360 Simulation is a validation tool that allows you to see how a design operates under different scenarios. A highly skilled specialist could devote a significant amount of time to doing a thorough Analysis in order to acquire exact results under real-world conditions[7].

However, the trends and behavioral information obtained from a basic or fundamental study can often be used to predict and improve a design. You may significantly improve the whole engineering process by performing this basic analysis early in the design phase.Use the analyses in the Simulation workspace to determine how loads lead to deformation and failure, so you can understand if and how a part will fail. Or you can determine natural vibration frequencies to avoid resonance. You can identify temperature distributions and thermally induced stresses[8].

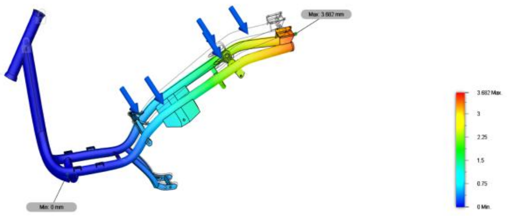

Fig 7: Total deformation of chassis using fusion 360 software

Fig 8: Stress analysis on chassis using fusion 360 software

PROPERTY	VALUE
Density	7.87 g/cc
Ultimate Tensile Strength	440 MPa
Yield Strength	370 MPa
Modulus of elasticity	205 GPa

Table 1. Material Mechanical Properties

TYPE	Equivalent (von-Mises)Stress	Maximum Principal Elastic Strain	Total Deformati on
Minimum	5.5761e-013 MPa	9.4996e-004 mm/mm	0. mm
Maximum	1811. MPa	8.7592e-003 mm/mm	143.62 mm

Table 2: Result Table

3. COMPONENT SELECTION

3.1 Frame

The frame is the E-supporting bike's member and is subjected to both static and dynamic loads. It also accepts a variety of loads, including vertical, cornering, side thrust, acceleration, and braking dip. Various types of accessories and components are strewn throughout the frame[10]. A frame should be strong enough to withstand all of the mentioned loads. The Existing frame of the I.C. The engine scooter was chosen because it meets all of the criteria and was created by professionals for improved safety and efficiency. To fit the motor, battery, and brakes, some changes are made [11].

3.2 Batteries

It takes a steady power supply that is readily available and can be reused to operate the motor at full speed and cover the maximum range at the required speed. To give power, we've chosen lead acid batteries[12]. The voltage supplied should beequal to or greater than the motor's input voltage, which is 48V DC. To reach the required voltage, we selected four 12V batteries and linked them in series. The batteries are simple to recharge and do not require any maintenance[13].

Selected batteries specifications are

Current rating: 28 Ah Voltage:12 V

Total number of batteries : 4

Combination Of batteries: Series

Combined Voltage: 48V

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3.3 Motor

A motor with a capacity of up to 250watts is required to drive the vehicle at a speed of 35 kmph and deliver a rated torque of roughly 6.2 N-m. We used a Brushless DC.motor, which costs less than 8000 dollars and is ideal for low-cost applications [14].

Specifying the chosen motor -

Type : Brushless D.C Motor

Power : 2000 Watt

3.4 Motor Controller

The motor used the current from the batteries to supply it in response to the throttle input. The controller gets information from the throttle connector and adjusts the power supply to the motor. We chose a controller that was appropriate for our motor in order to satisfy our existing needs.[15].

operating parameters are :

Operating current: 60A

Operating Voltage: 48V DC

Phase angle: 120^0

4 DYNAMIC CALCULATIONS

4.1 Load calculation:

Considering the weight of the vehicle and its accessories is used to calculate the total load applied to the BLDC motor. Vehicle weight = 95kg

Rider = 70kg

Total load = 165 kg.

4.2 Force calculation:

The force required to pull the calculated

The force required is given by the formula

F = Crr * M * g

Where

F= force in Newton

Crr=coefficient of rolling resistance = 0.01

g =acceleration due to gravity = 9.81 m/s^2

M= mass of the vehicle(total load)

F = 0.01* 165 * 9.81 F
=16.18 N

4.3 Power calculation:

The formula is used to calculate the amount of power required to pull the rated weight at a maximum speed of 30 km/hr.

P=F*(V / (3600))

Where.,

P= Power in watts

V= Velocity

30 Km/h = 30000m/h

P =16.18 * (30000 / 3600)

P=134.83 watts

4.4 Battery selection

The battery's watt–hour is calculated as follows:

Ah * V = wh

Where,

Ah = Ampere hour

V = Voltage

Wh = Watt--hour

(I) 48 V 13A battery

=48 * 13

=624 wh

We may utilize this battery because it produces 480 watts, which is greater than the required voltage[16].

4.5 Distance Calculation

The distance that this battery may travel is determined by

d=wh/F

=624/16.18

d=38.56 kms

We can compute the distance that can be traveled with a weight that is double that of the actual load because the road conditions may not be uniform along the route.

d=wh/F

=624/20

=31.2kms

4.6 Charging Time Calculation

The charging time of a Lithium-ion battery varies depending on the charger used to charge it. The time it takes for a lead acid battery to charge is determined by

T =Ah/A

Where

Ah=Ampere hour rating of battery

A = Current in amps (charger)

T=13/5

= 2.6hours

In the future, a rapid charging mechanism could be employed to charge the battery faster [17].For a full charge, you'll need the following units of current.

The watt hour is estimated below using a 48v 13ah lithium ion battery.

48×13 = 624wh

1 amps = 1.4 kvah

13 amps=13/1.4

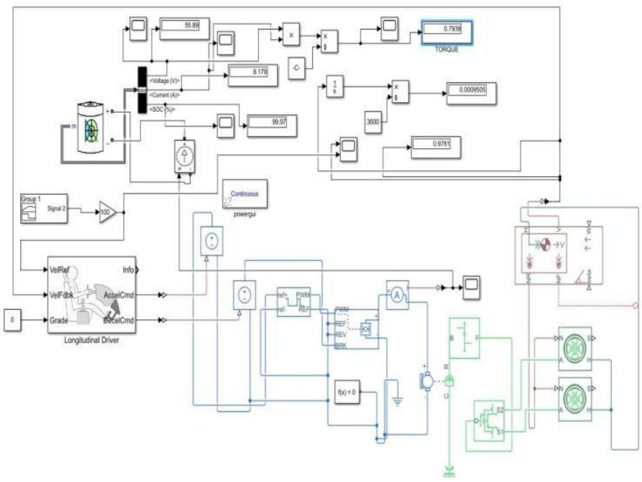
13 amps=9.28 kvah

Kw= kvah × Pf

∴(power factor) Kw=9.28×0.174

Kw =1.61 units is.required.

5. SIMULATION



The simulation of a fundamental electric motor-drive system utilised in this article to study power flow in both motoring and regeneration. The simulation posits that a powerful magnet a motor controller, a DC motor the desirable qualities associated with a PI the electric battery, and the controller. Using this example,be utilised to assess the flow of electric energy efficiency and drive for a given speed and torque load circumstances. Several of the system variables were outlined, while others were idealised in this kind.During the design phase, vehicle driving evaluations and simulations have been completed to help assist in the design process to assess whether the design is appropriate for the intended use. A driving cycle is a series of values for the vehicle's speed that are calculated on a simulated

During the simulation, a vehicle is to be achieved. the demand the goal of a driving cycle is to reduce the amount of expensive on-road tests, while simultaneously cutting down on test duration and the test engineer's weariness. driving cycle path leads to the dynamometer or to the test facility digital simulation[18].

The simulation makes the assumption that the values of torque and speed are known. When speed values are taken into account, torque values can be determined if the wheel dimensions are known as well as the road load values that the vehicle can handle. Rolling resistance, air resistance, and gradient resistances that are known or that can be computed are added together to form the total road load.

Before fabrication and physical testing of the new vehicle, we should have an idea about the parameters that we get for it like the range, state of charge, voltage and current. For this purpose, we use the Math lab software. Based on the values obtained from the calculations on proceeding with the software simulations the torque obtained is 0.7938 N-m. These conditions did not match the required output hence based on the requirement of the vehicle and for smooth function of the vehicle some modifications were made in the parameters obtained[19].

6. INPUT VEHICLE SPECIFICATIONS

Kerb mass of the vehicle	95 kg
Driver mass	70 kg
Gravity (g)	9.81 m/s
Gear ratio	1:1
Efficiency of transmission	0.85
Top speed	40 kmph
Acceleration performance	0-20 kmph in 7.5 seconds

7. RESULTS AND DISCUSSION

Through numerous simulations and physical tests we came to understand the following parameters:

- On a flat road, a top speed of 35 km/h was obtained.
- After a full charge, the scooter's range is 35-45 kilometers[20].
- For increased range and lower weight, a BMS and lithium Ion battery can be installed
- The scooter was successfully tested for light everyday use.
- A complete charge of the battery takes about 7-8 hours[21].

The scooter will go at a speed of 35 km/h for a single charge of the battery if the components meet these parameters. It also covers a greater distance. Our prototype has a higher beginning torque due to the usage of a 250W motor. The vehicle's speed and range can be extended by upgrading the battery capacity and motor parameters. Charging can also be done on board to extend the vehicle's range of operation[22][23][24].

8. CHALLENGES

1. Structural changes had to be made to the chassis.
2. Analysis of the new chassis had to be done.
3. The strength and sustainability of the chassis and to be determined.
4. Gathering the required components was a challenge.
5. Problems were faced during integration of electrical connections to the components.
6. Provisions for heat dissipation and battery management system.
7. Difficulty in fault identifications and implementing safety precautions.

9. CONCLUSION

The electric vehicle has various advantages and benefits over the internal combustion engine, as demonstrated in this study. It is more efficient and cleaner, but it has negatives as well. We also saw how conversion is superior to buying a new electric vehicle in terms of quality and cost. The battery is critical to the electric vehicle's future success. If researchers can develop or find the "super battery," the future of electric vehicles is bright. Currently, each vehicle has a trait that distinguishes it from the others. Only time will tell which vehicle will be the most successful in the future, as will technological improvements.

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