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Design and Analysis of Retrofitted Two-Wheeler Electric Vehicle

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Abstract: This paper provides an overview of the designing principles of fluid vehicles (15 aged, engine damaged, and going for trash vehicles) into the electric vehicle conversion process. The paper describes the development of an electric vehicle powertrain and the design and analysis of the different parts of vehicles like a transmission system (bush, bearing, and sprocket) battery, geared motor, motor, and controller. It also, explains the design rules and calculations of the powertrain subsystem. Electric vehicles are powered by geared electric motors (DC) which are powered by the battery through the electric converter. Conventional vehicle loses their efficiency after a long duration. Retrofitting gasoline-powered vehicles into an electric vehicle is a cost-effective and beneficial process. During the retrofitting, the powertrain, electrical parts, and vehicle parts (swing arm, bush, and bearing) are required to modify and the remaining subsystems like suspension, steering, and braking will be the same. In the powertrain part, the vehicle consists of a Geared motor, motor controller, battery, and battery management system, and transmission system (chain drive).

Keywords: Fluid vehicles, Electric vehicles, lithium-ion battery, Controller, Geared motor, transmission.

I. INTRODUCTION

One solution is to convert old vehicles, which run on petrol, into electric vehicles (EVs). This paper will research the process of transforming aged, engine-damaged, and scrapped vehicles that would otherwise be discarded into efficient electric versions. Rather than letting old vehicles end up in scrapping repurposing them as electric vehicles offer a sustainable alternative.

The conversion involves modifying the vehicle's engine and adding new electric components, such as a battery, controller, and motor. Electric vehicles operate differently from their petrol counterparts, running on electric motors instead of traditional engines. Converting a gas vehicle into an electric one not only benefits the environment but also proves cost-effective in the long term. It provides a detailed walkthrough of this conversion process, focusing on the design and analysis of essential components like the design of the transmission systems such as bushes, bearings, and swing arms, and the analysis of the battery, controller, and motor.

Ensuring these changes are made correctly guarantees smooth and efficient scooter operation. Our research aims to simplify the process of converting gas scooters into electric ones, making it accessible to a broader audience. It covers the steps involved, from selecting the right parts of the motor and chain to calculating the power requirements for optimal performance. Sharing this knowledge to inspire more individuals to consider electric vehicles as a cleaner mode of transportation.

II. INSTRUMENTATION

Here this section discusses the design and analysis of the main components of the transmission system like the design of frame bushes, bearing, swing arm, and the analysis of battery, controller, and calculations of motor and chain.

i.Design of Frame

The following is the frame design used in making electric bikes,

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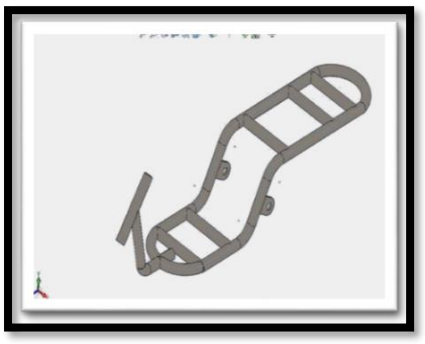

Figure 1- Design of Frame

This Static force includes linear static study type. The mesh generated during this analysis is Tetrahedral mesh. The material selected during analysis is steel due to its properties such as:

a) Strength
b) Toughness
c) Ductility
d) Durability.

Traditionally an alloy of iron and carbon, steel stands as one of the most commonly used metals in the world across industries from construction to blacksmithing to sewing. Early steels had variable carbon content usually added in the forging process with charcoal from 0.07 percent to 0.8 percent, the latter being the threshold at which the alloy can be considered proper steel. Modern steel content usually maxes out at 2 percent, a material often called cast iron.

RESULTS ;-

A. Strain Results

Result component: Total Translation				
Extent	Value	X	Y	Z
Minimum	0 mm	131.380 mm	215.183 mm	-365.221 mm
Maximum	0.0161 mm	0.000 m	433.518 mm	306.114 mm

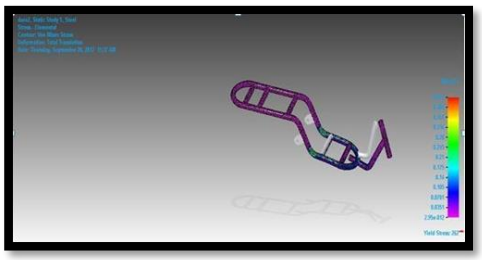

Table 1: Strain Result

ii.Lithium-ion Battery

This is a 24-volt 250-watt battery suitable for the retrofitted kit to convert fluid vehicles to electric vehicles specifications are given below:

GENERAL SPECIFICATION
Model ASHVA-2424
Dimensions (L x W x H): 200mmX165X110mm (Dimensions can be Customized)
Weights: 4kg Approximate
Nominal Packing HS Sleeve or FRP Box

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Cell Type 3.7V NMC Cylindrical
Cell Model 18650

ELECTRICAL SPECIFICATION
Nominal Voltage: 25.9V
Nominal Capacity: 24Ah
Battery Energy: 622Wh
Resistance 30mΩ at: 50%SOC
Efficiency: 99%
Self-Discharge: <5% Per Month

CHARGING PARAMETERS
Recommended Charge Current: 1A – 6A
Maximum Charge Current: 10A
Recommended Charge Voltage: 28.4V – 29.2V
BMS Charge Cut-Off Voltage: 29.75V±0.21V
Over Charge Detection Delay: 400 – 800mSec
Over Charge Release Voltage: 28.35V±0.35V

DISCHARGING PARAMETERS
Recommended Discharge Current: 1A – 20A
Maximum Continuous Discharge Current: 20A

Peak Discharge Current: 40A for 2 Sec
Recommended Discharge Voltage: 20.5V – 21.0 V
BMS Discharge Cut-Off Voltage: 17.5V±0.21V
Over Discharge Detection Delay: 10 – 300mSec
Over Discharge Release Voltage: 19.60V±0.35V

iii.Motor calculation

Figure 2 – Geared Motor

Calculations of motor selection of suitable motor for retrofitted kit:

- The gross weight of the vehicle = 200 Kg
- The system has to achieve a speed of 40 Km/hr.
- V = d/t = 1000/90 = 11.11 m/s
- A = Δv / Δt = (11.11-0) / (90-0) = 0.12
- F = M × A
- = 200 × 0.12
- = 24 N
- T = F × R
- = 24 × 0.2
- = 4.8 N.m.
- Our System Motor Gives

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- Power Of Motor = 250 w
- RPM = 350
- P = 2 π N T / 60
- T = 6 N.m.

So We Used These Motor Which Is Sufficient

iv.length of chain calculation

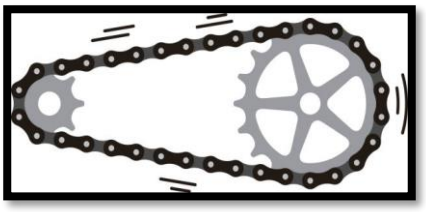

Figure 3 – Chain

- Length Of Chain
- D1 = Diameter of chain wheel= 14cm, R1 = 7cm
- D2 = Diameter of Sprocket = 7cm, R2 =3.5cm
- X = Centre distance of Sprockets=28cm
- L = π (r1+ r2) +2x+ (r1-r2)^2 /x
- = π(7 + 3.5) + 2×28 + (7-3.5)^2 / 28

= 90 cm

v.Controller

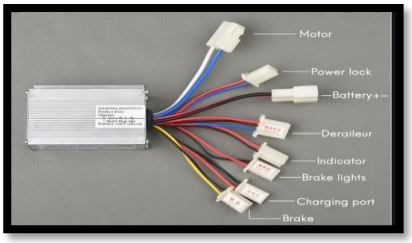

Figure 4 - Controller

This Motor Controller 24V for MY1016 250W includes attachments for the motor, accelerator, brake, battery, battery charging, brake light, and power lock. DC Motors are popularly known as scooter motors or general application motors. It is extremely durable and reliable. It's commonly found in 24V scooters or even small kiddies carts and it's also been a proven motor in robotics.

The E-bike controller is the brain of the e-bikes. It is connected to all the other electronic parts such as the battery, motor, and throttle if it exists. It takes all the inputs from all the other components and determines what should be singled out in return.

This motor brush controller for Electric bicycles & scooters is compatible with the MY1016 250W DC motor.

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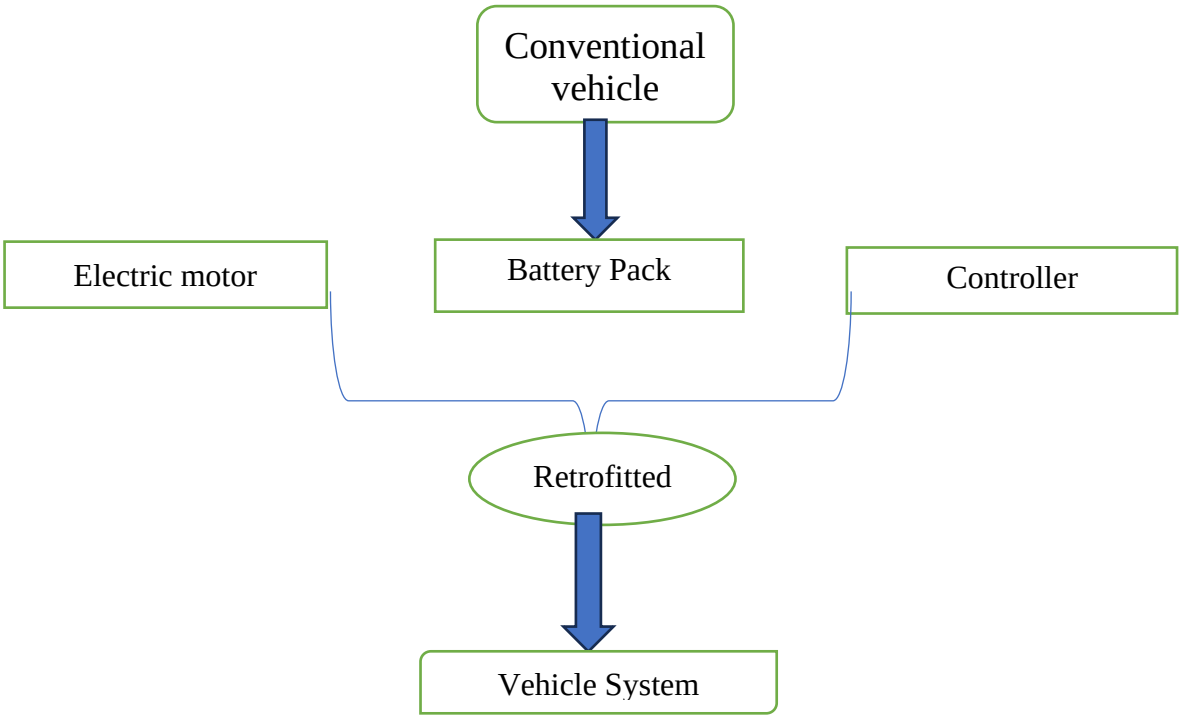
Block Diagram



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vi.WORKING OF MODEL

Petrol vehicles have been the most preferred vehicles in the market for years. Activa, Access, Jupiter & Dio have dominated the market share and continue to be the top-selling scooter brand in India. Millions of petrol vehicles are running on roads as two-wheelers are the most preferred way of traveling in India.

Actual working model And How to convert it :-

If you already own an old petrol vehicle and planning to buy a new electric vehicle then we recommend you convert any vehicle like Honda or Activa to electric as it is more economical than buying a new electric vehicle. This can be achieved by retrofitting where the internal combustion(IC) engine and petrol tanks are replaced by an electric kit and battery respectively in the kit main components are included such as the controller, Battery, Motor, Sprocket, and Chain.

Figure- Design of Model

vii.RESULTS AND DISCUSSIONS

1. Design software can also aid in conducting safety assessments.
2. A generalized solution for all types of vehicles can be achieved by adding some basic components.

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3. Due to analysis, suitable materials are selected for specific components.
4. Design and analysis are essential in the improvement of retrofit kits

viii.FUTURE SCOPE

The future scope of conversion kits is very high because in the future there will be a limited no of Petrol and diesel products for use in IC engine vehicles.
There are other advantages of conversion kits or EV vehicles in the future for the environment of earth, it reduces carbon emissions and global warming problem.
Conversion kit also reduces scrap problems in the future and it has also low-cost products.

CONCLUSION

Retrofitting older, damaged vehicles into electric vehicles offers a cost-effective and beneficial solution. By replacing the conventional engine with an electric powertrain consisting of components like geared motors, motor controllers, batteries, and transmission systems, these vehicles can be revitalized for extended use. This process maintains existing vehicle subsystems like suspension, steering, and braking while enhancing efficiency and sustainability. Electric vehicles powered by geared electric motors and batteries provide a promising alternative to conventional vehicles, reducing reliance on fossil fuels and minimizing environmental impact.

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