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EV Bike

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Abstract: ***The E-bike is trial for converting a machine powered vehicle to an electrically powered vehicle. In this case, a bike is considered. It focuses on converting a readily available machine powered moped in the request and also streaking the machine drive and introducing an electric drive for propulsion. The new electric drive comprises of BLDC motor, battery pack, ECM. The body design and frame will remain same as the manufacturer has handed. The design and implementation of electric drive is the purpose. The purpose of E-Bike is to introduce an electric and affordable interpretation of bike which has no adverse effect on nature and doesn't use any carbon- grounded energy. The ideal is to achieve same specification as those are observed in machine driven vehicle.***
Keywords: Electric motorcycle, BLDC motor, renewable energy, E-Bike, Conversion into EV.

I. INTRODUCTION

As the automobile market is slowly shifting from carbon-based fuel powered vehicle to electrically powered vehicle, there has been developing huge scope in the electric vehicles (EV) field. There has a need aroused for more research in the above mentioned field. The usage of field has not been controlled from the last 50 years and now the reserves of such fuel are depleted completely. Still the energy needs are not reduced. So, the electric power can also be seen as a feasible source. The electric cars, electric bikes, electric bicycles, electric trucks, etc. are some counterparts of different types of vehicles are developed like-wise. Various types of electric systems are proposed by different manufacturers such as the idea of integrating an external electric drive to vehicles which are readily available in market. Some are working on battery size and its life and the charging cycles. Some are finding different ways of store electric energy by using super capacitors, etc. Also using DC or AC motor is an idea. There are many manufacturers developing electric version of bikes. Bikes are most preferred medium to travel as they are cheap and can transport two people from one place to another, which is the best way to travel in urban cities having less space, small roads. There are numerous products available in the market. In India, the companies like Bajaj, Yamaha, Revolt and Hero are proposing new electric bikes to market. Also new manufacturers like Vida EV, Simple Energy, Ultraviolette Automotive, Okinawa, Miracle E- Bike, etc. are coming up fast as it is the new fast-growing market.

II. OBJECTIVES

1) To make a low budget, efficient, durable e-bike.
2) To make an optimum speed e-bike.
3) To find an optimum capacity battery to full-fill the needs of the conventional bike users.
4) To find out a better solution for the problem involved in current e-bikes.
5) To make the awareness of consumer about the electric bikes.

III. PROPOSED METHODOLOGY

1) For reducing cost of the design alternate hand corridor are bought motorcycle factors like wheel, shock absorber, etc. from scrap.
2) Opting optimum quality, optimum speed, and optimum cargo carrying capacity motor.
3) Opting stylish standing, durable, low conservation battery.

IV. LITERATURE REVIEW

Kunal D Topiwala, Mr. Chitan Patel, Sufiyan Ansari & Himanshu Patel, they're converting old conventional bike to electric bike. The main reason to identify the need of finding and modifying E-Bike is to overcome the issue of the pollution because of vehicles in metro municipalities & civic zones is swelling uninterruptedly as per them.

Akash Anil Vaidya, Prof. T. S. Sargar, Saket P. Joshi, in this paper they bandy about various problems in an I.C. engine vehicle such as, These I.C. engines use fossil fuels to operate resulting in highly toxic gases and noise, a conventional I.C. engine bikes is expensive and also damage the terrain, also I.C. machine bikes bear regular conservation and operating cost is comparatively high. They aim to mitigate the problems by designing and converting an I.C. engine bike to an E-bike which will be driven by an electric motor with simplified mechanical chain drive system eliminating gear mechanism.

Shrinivas Mutyala, he considered the problems faced by society to afford EV so, he tried to overcome the problems by creating an affordable version of EV and also addressing the environmental concerns. Objective of his paper was to explore the acceleration an electrically powered motorbike under Practical condition. Electric motorbike which can cruise up to 55 km/h using transmission rate via chain drive. The main purpose of his research is to review the current situation and effectiveness of electric motorbike researched by various researchers.

Jagdish Keshav Khade, he had first discussed the points why one should prefer EV vehicles over an ICE vehicle and then had detailed thoroughly about battery and motor. He had worked on lithium-ion battery that has less weight, which has quick charge property, requires less storage space as compare to other batteries available in market. The objective of this project is to make a low budget, efficient, durable e-bike, to make an optimum speed e-bike, to find an optimum capacity battery to full-fill the needs of the conventional bike users, to find out a better solution for the problem involved in current e-bikes and to make the awareness of consumer about the electric bikes.

V. E-BIKE COMPONENTS

First of all we studied about the EVs, their batteries, their circuits and even about the ICE bikes.

A. Cumulated Parts

The Vehicle (The Frame), Battery, Motor, Controller, DC-DC Convertor, Instrument Cluster, Throttle, Shock Absorbers, Accessories.

B. Components Selected

1) Frame

Frame is the supporting member of the E-bike and subjected to static and dynamic load. It also takes various load like perpendicular load, cornering load, side thrust, acceleration and brake dip. Various accessories and components are mounted over the frame. A frame should have sufficient strength to stand against all the listed loads. We have selected the existing frame of I.C. engine bike HERO SPLENDOR as it fulfils all the criterion and is designed by experts for better safety and efficiency. Some modifications are made in order to accommodate the motor and batteries.

2) Drive Assembly

The rear tyre is to be driven with a chain and sprocket mechanism. A Chain is used to transmit force from front sprocket on the motor shaft to the rear wheel sprocket. We had used Spur Gears because, no Axial thrust needed, bearings are not required, it has simple compact design that makes them easy to design and install even in limited or restricted spaces, constant speed Driven can be achieved we can increase or decrease According to our needs, even these gears are not going to slip during the operation & they are reliable and durable, with less power loss, we can achieve 90-95% power efficiency and also less expense as compared to the other gears. The sprocket mounted on the Motor is having 14 teeth and the sprocket mounted on the rear wheel is having 28 teeth, so the gear ratio we achieved is 1:2.

3) The Battery

To run the motor at full speed condition and to cover maximum range in at the designated speed motor requires a consistent power supply which is easily available and batteries can be reused. We have selected 3C Lithium Ferro Phosphate Battery cells of FBTECH Company to provide the power. The Chromosome Conformation Capture techniques (frequently shortened to 3C technologies or 3C-based methods) are a set of molecular biology methods used to dissect the spatial association of chromatin in a cell. These methods quantify the number of interactions between genomic loci that are nearby in 3D space voltage provided should be equal to or more than the input voltage of motor i.e. 48V DC. We have made a battery pack of 45 battery cells of 3.2V 6Ah and gave them series and parallel connections to achieve the required voltage and current. Now-a-days the Lithium Ion cells are in great hype then why do we use the Lithium Ferro Phosphate cells? It is because, even though Lithium Ion cells are Compact as compared and even can store more charge and also they have good weight-charge efficiency ratio but, they even have major drawbacks. The biggest one of these is about the heating issues and we can even see the circumstances happening due to it, the biggest example of it is the Ola scooters, also the another major reason for not using this type of battery is that they are way more costlier than the LFP Batteries. The Lithium Ferro Phosphate batteries are widely used by the EV producers in the market. Here are some examples, the Tata motors uses LFP in all of its EV models, the tesla also used it in their previous generations if cars, even the MG also uses the LFP batteries in their EVs and many more…… These batteries are easily rechargeable and maintenance free. Selected battery cells have following specifications:

a) Current rating : 6Ah
b) Voltage : 3.2V
c) No. of battery cells : 45
d) Combination of batteries : 15 Series & 3 Parallel
e) Combined Voltage : 48V
f) Combined Current Rating: 18Ah
g) Wattage: 864W
h) Discharge Rate: 3C
i) BMS Type: Normal Self Balancing BMS.

4) Motor

To drive the vehicle at a speed of 25-30 km/h because, as per Automotive Research Association of India (ARAI) rules an E-Bike exceeding the speed of 25km/h should retain all the documents o the vehicle and we had bought the vehicle from the scrap dealer we don't retain any document related to the vehicle, hence we cannot exceed the speed limit of 25km/h. The motor used in this design is 1Hp (750W) BLDC motor because, BLDC motors have a higher torque-to-weight ratio, which is important for EVs because,

a) Advantages of BLDC motor

- It allows us to reduce the weight of the vehicle while still getting enough torque.
- As BLDC motors don't contain brushes, they're more reliable because there's lower outfit to deal with. Thus, it's easy to maintain.
- Compared to Brushed DC motors, BLDC motors are considered to be further energy efficient. The lack of friction in the brushes allows BLDC motors to convert further electrical energy into mechanical energy, which is why they're more effective than brushed motors.
- Since there is no friction between the brushes, the BLDC can operate without any mechanical noise. As a result, electric vehicles can move more still.
- Unlike traditional DC motors that operate with brushes, BLDC motors don't spark. This is an intriguing point of brushless motors, as it allows them to be used in spark-hazardous surroundings. For example, in surroundings with ignitable gases.

- The composition of the BLDC motor also keeps the machinery inside the vehicle cooler and thermo-resistant. Also, due to the motor is brushless, there are no dangerous brush sparks.

Indeed, we bought this motor from the Lamington Road, Mumbai.
The frontal sprocket is attached to the shaft of the motor. Motor was mounted where previously the gear box of the bike was located.

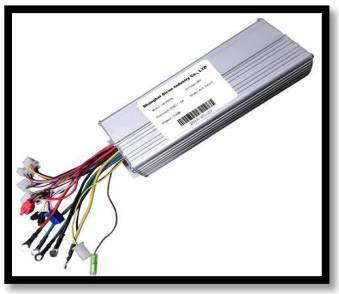
b) Specification of Selected Motor

- Type: Brushless DC Motor
- Power: 750 Watt
- RPM: 450

5) Motor Controller

Motor is supplied the current from batteries corresponding to the input from throttle. Controller takes input from throttle connector and varies the power supply to the motor. We selected controller suitable to our motor as per the current needs. It has the following specification.

a) Operating current: 18Ah
b) Operating Voltage: 48V DC
c) Operating Wattage: 750



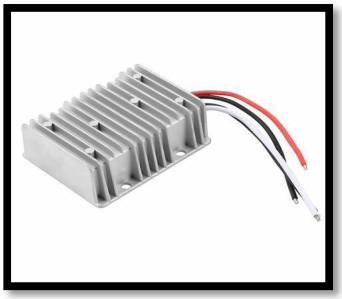
6) Battery Charger

Battery gets drained after running a distance of 30-35 km and it does requires to be recharged. For charging a charger is required. It converts AC current into DC. It consist of step down transformer, rectifier and filtering circuit to supply constant voltage. Specification of selected charger:

a) Input voltage: 240V
b) Input current: 1A max
c) Output voltage: DC 48 V
d) Output current: 3.5

7) DC-DC Convertor

A DC-DC converter is an electrical system (device) which converts direct current (DC) sources from one voltage level to another. In other words, a DC-DC converter takes as input a DC input voltage and outputs a different DC voltage. The output DC voltage can be higher or lower than the DC input voltage. As the name implies, a DC-DC converter only works with direct current (DC) sources and not with alternative current (AC) sources. A DC-DC converter is also called a DC-DC power converter or voltage regulator. We had used a DC-DC convertor that converts 48V into 12V for other accessories such as lights, horn, instrument cluster, etc.



VI. CALCULATIONS

A. Range Calculations

1) Battery Specifications

Battery Type: LFP (Lithium Ferro Phosphate Battery)
Voltage: 48V
Ampere: 18Ah
Wattage: 864W
Discharge Rate: 3C
BMS Type: Normal Self Balancing Type

2) Motor Specifications

Motor type: BLDC motor (Mid-Drive)
Voltage: 48V
Power: 750W
RPM: 450

3) Gear Specifications

Motor Sprocket Teethes: 14
Tire Sprocket Teethes: 28
Gear Ratio: 1:2

4) Range Calculations

Total Power: 864W
Range: $\frac{Battery\ Watts}{Motor\ Watts} \times Speed$
Speed: $\frac{Circumference \times RPM \times 60}{1000}$
Tire Diameter: 24 in = **0.6096m**
Circumference: πd
$= \pi \times 0.6096$
= 1.915114882 m

Speed: $\frac{1.915114882 \times 225 \times 60}{1000}$
$= \frac{25854.05091}{1000}$
= 25.85 km/h
Range 1: $\frac{864}{750} \times 25.85$
= 29.77 km.
= approx. 30km

Range while other Accessories are used (Range 2):
DC – DC Convertor Converts 48v into 12v.
Power consumed by other units:
Given: Voltage: 12v
Power Consumed:

- Horn: 10w
- Head Light: 10w
- Tail Light: 5w
- DC – DC Convertor: 5w

Total: 30w

Power: 864w – 30w = 834w

Range: $\frac{Battery\ Watts}{Motor\ Watts} \times Speed$

Range 2: $\frac{(Battery\ Watts - Wattage\ used\ by\ all\ other\ equipments)}{Motor\ Watts} \times Speed$

$= \frac{(864-30)}{750} \times 25.85$

$= \frac{834}{750} \times 25.85 =$ **28.74 km**

Hence, the difference between both ranges is almost 1km which is negligible.

5) Charging Time Calculations

Charger Specifications:

Output Voltage: 48V

Output Current: 4Ah

Output Wattage: 192W

Charging Time: $\frac{Battery\ Watts}{Charger\ Output\ Watts}$

$= \frac{864}{192} =$ **4.5 hrs.**

→ Top speed of 25 Km/h was achieved on a level road.
→ The range of bike is 25-30 Km after full charge, it depends upon the road conditions.
→ Bike was tested successfully for light daily use.
→ Battery charging takes around 4.5 hours for full charge.
→ Bike can also be used for rough road conditions.
→ The charging cost of the bike as approx. 4rs, which the less than 1/10th of the running cost of the I.C. Engine.

VII. CONCLUSION

We would like to conclude this Report by saying that we had successfully made an electric vehicle which is affordable to everyone, also as compared to IC Engine the running cost of our bike is as low as almost 1/10th. Our E-Bike has been fabricated and tested successfully, different parameters like running range, cost per kilometre, discharge time of battery has been measured with actual running condition and it delivered better results. The ultimate goal of this project has been achieved.

VIII. FUTURE SCOPE

The future of E-bikes' is poised to become something very different,

1) Lithium Batteries can be used for better range and reducing the weight of the Bike.
2) If solar panels with higher efficiency with lower space required are made then, they can be fitted on the bike and can be used for charging the bike while running which will increase the range of the vehicle.
3) Self-recharging technology can be added into this bike.
4) Regenerative Braking can be introduced into this bike.
5) Even Hydrogen Power Cells can be used for better range.
6) Cost of batteries could reduce.
7) E-vehicle could be more affordable to the customer.
8) Better BMS can be used for better range and results.

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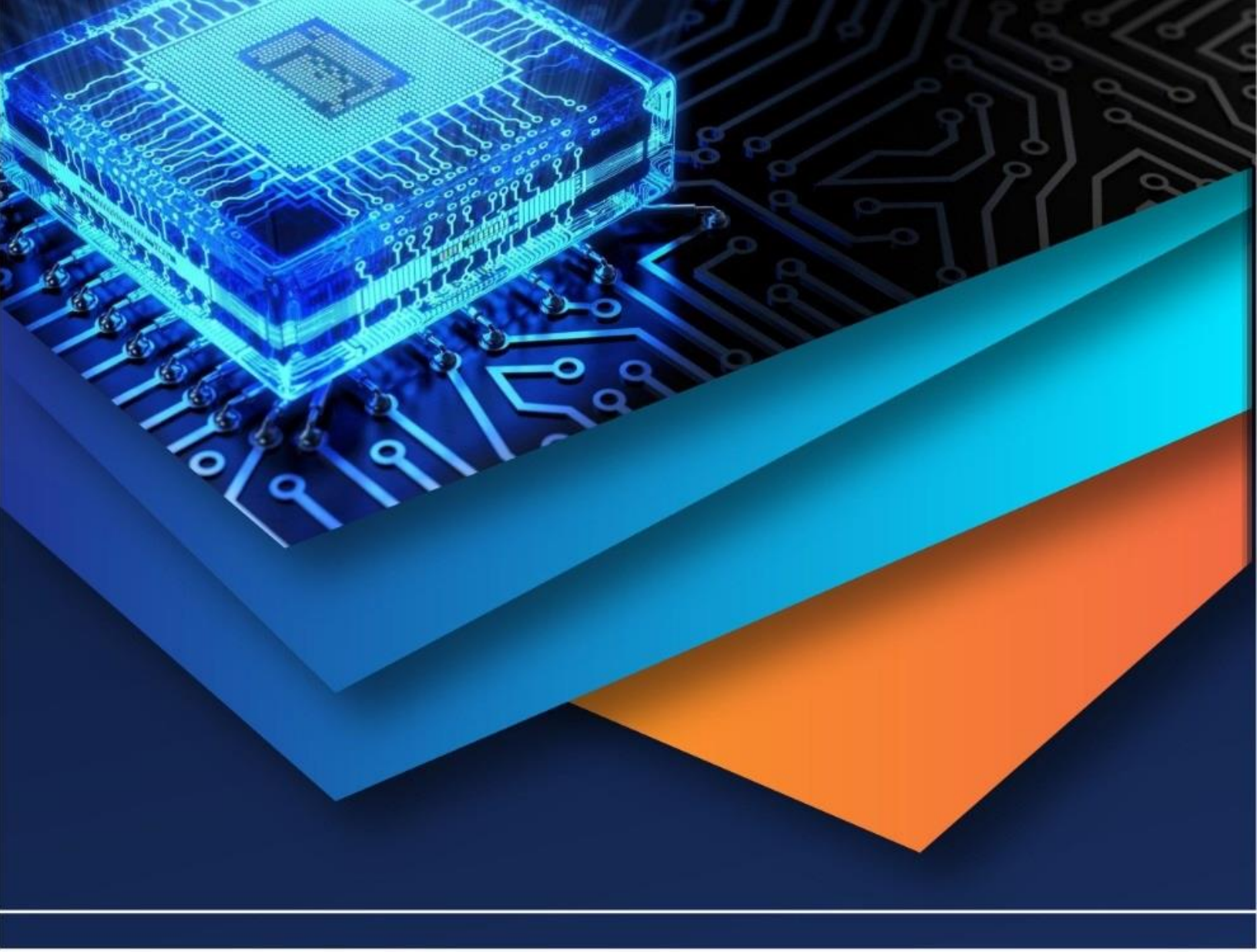

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