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Fabrication of E-bike with Manual Transmission

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Abstract : *Increasing prices of petrol have led people to find an alternative for reducing travel expenses. Moreover, today's e-two wheelers lack the traditional clutch and manual transmission assembly, which makes people miss their biking experience. We engineered a bike with manual transmission and did our best to keep the authenticity of the traditional bikes. We are trying to make an e-bike with a range of 120 km with a 1kW motor of 48 v. The bike can travel to maximum terrains in urban and rural areas. The bike has dual suspension with an odometer which shows speed, indicators prompt, motor rpm, and SOC. We are working to integrate the traditional clutch and manual gear assembly of 4-speed including the flywheel and connecting it to a new age BLDC motor along with a battery and other safety convertors required for an electric system. We are also planning for a regenerative braking system at any point in the battery's SOC. The bike will have maximum comfort for the rider as well as the pillion. For re-engineering a traditional bike to e-bike we have selected Kawasaki-Bajaj Caliber 115.*

Keywords – *E-two wheelers, traditional bikes, clutch, manual gear, BLDC motor, Bajaj calibre 115*

I. INTRODUCTION

Recent studies show that it's high time to take a step ahead and resolve the problem of high pollution rates. One of the significant industries in increasing pollution is Automobile Industry. For years we have been using traditional engines with regularly updating our engine performance according to pollution norms in our country, yet the results are not that satisfying as they should have been. Therefore, a need to switching our modes of transport is important. Understanding this situation nowadays EVs have taken a major step to provide a solution for this problem. We, therefore, had engineered a bike in such a way that it looks traditional as well as makes you feel like a traditional one yet is not what it should be.

I.I Project Background

Electric bikes go down in history since the early 1970s. The first ever street legal E-bike was made by Mike Corbin. The commuter electric motorcycle was called Corbin Electric. The bike held a world record for speed of about 266.165 km/h.

I.I.I Electric Vehicles

EVs are automobiles powered with Electrical energy completely unlike traditional I.C. engine automobiles. If talking specifically about E-bikes these are compact two-wheelers with low range and power. Nowadays only mopeds are visible on roads of India and very rarely any bike is available. Revolt motors are currently the most known and strongest in the business of e-bikes.

There are majorly two types of EVs are Pedelec and Power on demand

Pedelecs are pedal assisted where the electric motor is regulated by pedalling. The pedal-assist augments the efforts of the rider when they are pedalling. These e-bikes – called pedelecs – have a sensor to detect the pedalling speed, the pedalling force, or both. Brake activation is sensed to disable the motor as well.

Power on demands is the bike in which the motor is activated by a throttle, usually handlebar-mounted just like on most motorcycles or scooters.

I.I.II Mechanical System

The mechanical system comprises of vehicle chassis, suspension system, mechanical power transmission, braking system, and handling system. These systems are not required to be designed manually as they are pre-designed and available as standards in market.

I.I.III Electrical System

The electrical system mainly comprises of motor, battery pack, safety controller, sensors, digital display, LV wiring, HV wiring, head-tail-side lamps. Most of the systems are available as stock in the market whereas motor, battery pack, safety controller, and digital display vary according to selection and function.

II. METHODOLOGY

We need a proper methodology to get everything in proper sequence and sort out things according to requirements. Below is the proposed methodology to be followed for the fabrication of e-bike with manual transmission.

II.I Selection of Materials and components

We need to select motor, battery, other material for mountings and deflectors along with different wires and miscellaneous items like bolts, screws, nuts, bearings. We also need to choose a proper digital display module for the bike.

II.I.I Motor

In bikes usually 750W to 1kW of the motor is generally used in bikes which have applications on urban and rural roads with moderate cemented or tar terrain or muddy roads with nominal power output.

We have selected a 1kW power BLDC motor with 3000 rpm and 48 volts IP33 rating of rated torque 4.5 Nm and max output power of 1.7kW with the regenerative feature. It has an efficiency of a minimum of 87%.

The IP33 rating states that it is protected from water spray of angles 60o or less in vertical.

II.I.II Battery Pack

We require a battery pack which can easily provide us a range of 120km at the maximum speed of 50kmph. The capacity of battery pack we selected is 36Ah and is IP33 rated. We would be selecting a lithiumiron phosphate battery of 48V and an efficiency of up to 80-90%. We are selecting the gross weight of the vehicle to be 130-150kg.

2.1.3 Motor Controller

A motor controller is a device used to safeguard the motor. It helps in providing a rated voltage and current to the motor as per the requirement of the motor so that it works at maximum efficiency and does not get damaged due to any major or minor electrical failure.

The BLDC motor controller has a rated DC voltage of 48v with an overvoltage cut-off of 58V and an under-voltage cut-off of 41V. it has a protection class of IP33 and operating temperature on -20 to 80^{o} C.

2.2 Cleaning and disassembling

The stock bike must be disassembled where the components which are not necessary such as engine head, engine cylinder, piston and piston rings, connecting rod, analogue display, engine mounts, fuel tank (inner tank only the outer metal shell may be required) are such components not required for E-bike must be removed.

2.3 Basic wiring testing

All the wiring systems and their layouts will be first tested with help of Fusion 360 electrical or SolidWorks electrical or preferably MATLAB. We would be using Fusion 360 electrical for wiring test as it the most versatile and easy to use software with nearly all the functions of all software know by far. Later, these will be tested in actual practice.

2.4 Assembling

After testing we will assemble the components at required places and complete all the wirings required in it. We are planning to place the battery right at the fuel tank and providing insulation too, whereas the motor would be completely replacing the engine and will be placed exactly at the same position accompanied with the motor controller.

2.5 Testing

Further regular tests in different terrains and different conditions will be performed to evaluate actual performance and compare it with theoretical calculations.

Fig. 1.1 Mike Corbin

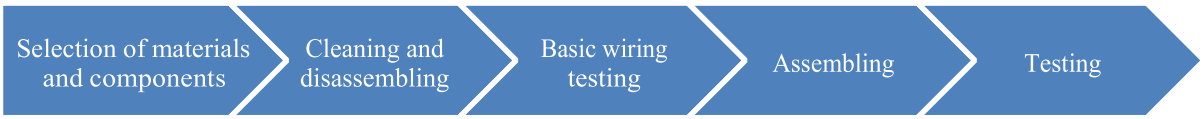

Fig. 2.1 Methodology

Table No. 2.1 Cost Estimation

Motor	6770
Battery	25000
Digital Display Module	2000
Motor Controller	4850
Safety Convertor	470
Throttle Set	380
Mounting Plate	800
Fabrication Cost	5000-6000
Miscellaneous	2000
Total	49000 (approximately)

IV. CONCLUSION

Increasing pollution all over the world has started showing how adversely it can affect the climate and human occupation. A study states that the planet has warmed up to 1 to 1.2 degrees Celsius more than the actual temperature due to the release of greenhouse gases, and as discussed automobile sector is the largest sector to emit greenhouse gasses in the world. We as an engineer should start taking necessary steps to overcome this problem by manufacturing affordable and premium quality e-bikes for the customers and eliminate the problems faced now for charging and other stuff.

In the context of the above information in the report, we have already selected a 1kW BLDC motor from Mechatronic Trading Co. and are now looking forward to a battery pack compatible with the motor and provide us a range of 150km. We have also spoken to experts in the field and discussed the wiring and starting and stopping of the vehicle.

Mechanically, the bike is firm and, we must work over the regenerative braking system for the bike to increase its overall running capacity. Also, we must work over a compatible display unit for the same.

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