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Design and Development of Economical E-Bicycle

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Abstract: *People around the globe using fuel powered bikes for city riding and short distance mobility. Which is one of the reason for increasing CO2 emission parallelly counts for increasing global warming. Because of this, electric bicycle come into the picture as an alternative. The need for an affordable and efficient transportation system has created a growing demand for Electric Bicycles in India and this project is seen as an opportunity, rather a challenge to design and develop a leading electric bicycle class for commute to quotidian. The electric bicycle has wheels that are specially powered by an electric hub motor, powered by a battery pack,that provides the required power. The electric bicycle has an electric motor with an intelligent controller and a battery pack connected to efficient cable systems and monitoring tools. Also, the use of electric bicycles will create less pollution and keep the environment alive. These project research mainly highlights into the design and development of a smart, Economical, and secure electric bicycle achieved through market research, studying the available options to determine the customers need and there requirement.*

Keywords: E-bicycle, Battery, Controller, Lithium ion Battery, BLDC Hub Motor, EV.

I. INTRODUCTION

The main reason for identifying the need to get once fix E-bicycle to overcome the problem of pollution due to traffic in major cities and towns the areas are swollen without disturbance. Considering everything the social class is not good for everyone to buy E-Bikes, scooters, mopeds. So, to combine both news, environmental progress and other economically viable ones could be much better solution. The most common parts of an E-bicycle are Brushless DC Motor (Hub Motor), Throttle, Battery Storage (36 v), Chain Drive, Frame and other parts of a bicycle. There two parts of an electric bicycle according to their functions and performance: Power on Demand and Pedal Assist. The motor is powered by a powerful on-demand throttle, traditionally handlebar-mounted as well as general motorcycles. By stepping on the electric hub motor can be controlled with pedal-assist. Disabling the power supply to motor is a sensory action of the brake.

II. OBJECTIVE

The main objective of this project is to design & develop an economical, durable and comfortable bicycle with some improvements such as Battery Level Indicator, Disabling the power supply to motor is a sensory action of the electric braking system. We are focused on covering the long distance E-Bicycle not with high speeds but with an economic speed of 25-30 kmph.

III. LITERATURE SURVEY

Wenhua Du, Dawei Zhang, Zhao (2009)

On the basis of multi-body dynamics theory; Also on the basis of vibration theory, dynamics performance of electric bicycle will be impersonate. First, two-dimensional mathematical model of integrated motor system for driver and electric bicycle was improved. A motive force model is developed with the electric one the bicycle model is subjected to mismanagement of prototyping technology computer code. Second, a check for a corresponding degree check is taken from it verify the feasibility of the model. Finally, the mass effect as well battery replacement mounting comfort was mentioned. The result indicates that the comfort of the ride is healthy due to the large amount of battery and. If the battery weight drops, the installation point will do a very small influence on riding comfort, Yet because it is great, the influence is special. Each thought of weighted acceleration values RMS on the seat and arm, on the electric paradigm bicycle, the battery mounted under the seat tube has high ease of ride.

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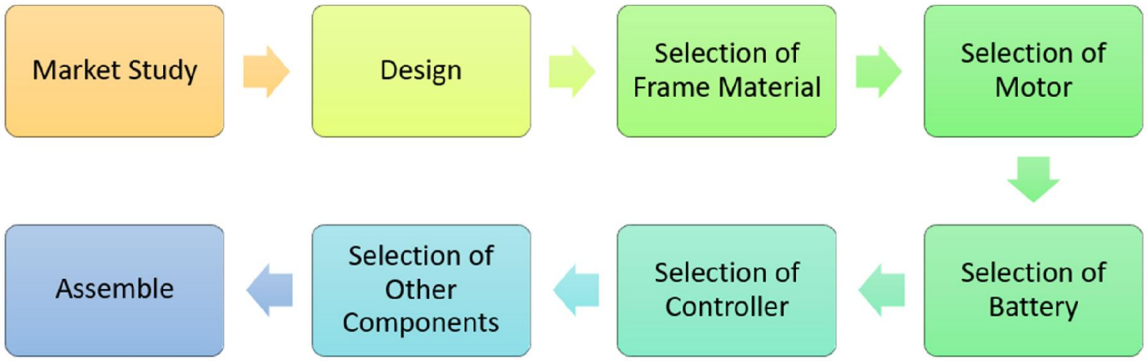
Dainis Berjoza, Inara Jurgena (2014)

Research should be done to determine the correct charging device, fully loading the cable network as you choose power and other parameters of power equipment to verify how to charge. The current analysis involves 5 different electric bicycles. Further analysis involves battery systems with full voltage of 24 V, 36 V, 48 V and 60 V. For analysis, each a information assortment system and electric battery discharging system was improved.

IV. METHODOLOGY



V. CALCULATIONS

1) **Maximum weight** = Weight of E bike + Weight of driver
   = 25+100
   = **125kg**
2) **Max speed** = 30 km/hr = **8.33m/s**
3) **Total force (Ft)** =Fr+Fd+Fa+Fg
4) **Rolling force (Fr)**=m*g*Cr
   =125*9.81*0.004=**4.906 N**
5) **Drag Force (Fd)**= 0.5*Air density* Cd* front area*v^2
   =0.5*1.1644*0.5*0.36*8.33^2=**7.2716N**
6) **Acceleration Force (Fa)** =m*a
   a=v/t=8.33/20=0.4165 m/s^2
   Fa=125*0.4165=**52.0625N**
7) **Gradient Force (Fg)**=m*g*sinθ=125*9.81*sin(2)=**42.79N**
   θ =inclination angle(slope on road) = 2degree

8) **Total force** = **Ft**=4.906+7.2716+52.0625+42.79 =**107.02N**
9) **Total Force without Acceleration and Gradient** = Fr+Fd=**12.176N**
10) **Power requirement** = force*velocity*1000/3600=12.176*30*1000/3600=**101.17W**

VI. MOTOR AND BATTERY SELECTION

6.1 Motor Selection

- From above calculations minimum power required to run the bicycle is 101.17W
- So standard power selected for Hub Motor is 250W.
- So **Motor selected is 36 V 250 W**

6.2 Battery Requirement

Power =250Watt*1hour=250watt.hr

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Out off 100% batter 80% is used

P= V*I

I=250/36 Ah = 6.94Ah

-So standard value for battery selection is 18Ah.

-So **Battery selected is 36V 18Ah**

VII. COMPONENTS

7.1 BLDC Hub Motor

A brushless DC motor (also known as a BLDC motor or BL motor) is a DC motor that is powered by a computer without brushes. The controller gives current pulse to the hub motor winding. This can control the speed of synchronous motor. Also it controls the torque same motor. These BLDC hub motor is consist of two main parts .The rotor and the stator. The rotor is a rotating part and has a rotor magnet and the stator is a vertical part and contains stator windings. In BLDC endless magnets are attached to the rotor and transmit electromagnets to the stator. High-power transistors are used to activate electric magnets to turn the shaft. The controller enables power distribution through a strong circuit.

Specification of BLDC Hub Motor -: 36 v , 250w

7.2 Battery

This is 36V 18ah Battery uses an (advanced) process, and power density is 50% the weight at the similar capacity. The operating voltage of a lithium ion battery cell is 36 v, which is approximately equal to 3 nickel cadmium or nickel hydrogen batteries connected in series. Due to the proper size and compact battery design, it can be placed easy.

Main highlights about battery

1. Detachable battery (user can detach battery and charge it at any desired place)
2. Lifecycle is aroun1000-1200 cycle.
3. Locking system for safety of battery.

7.3 Controller

This picture shows motor controller which is appropriate for 250W Hub Brushless Motor. This Motor controller has a range of power consumption of 31 to 36V up to 18A operating current in 250W brushless motor. Includes hub motor attachment, accelerator (throttle), brake, battery, battery charger, head light, switch lock.

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7.4 Throttle

Throttle mode is similar to how a motorcycle works. When the throttle joins the motor empowers and propels you forward with the bike. Motor power can increase or decrease the current power restriction (using the throttle), but generally come down. The word throttle refers to, in a sense, the way it is used the power or speed of the engine or engine is controlled. A few e-bikes are powerful, which may create the impression of clinging to the motorcycle, but in reality it is usually just small electric button. Throttle compression acts as a pressure pedal for gas your car is no other action required to accelerate or move forward.

7.5 Battery Level Indicator

Battery level indicator shows the level of charging content in battery (lithium ion). Its helps user to identify probably how many kilometres bicycle can travel on throttle. Also user can be aware about charging battery on time before threshold.

7.6 Main Assembly

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VIII. CONCLUSION

With our design we will gives assurance of long range **50 Km** in single charging. Lesser time for battery charging approximately around **3.5** Hours .With detachable battery which makes charging easier .Hub motor with good built-up quality gives assurance for all weather use and long life. Design of chassis makes it user-friendly and gives comfortable riding experience. Overall this project makes better option for in city transportation and cost friendly.

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