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Electric Bike with Self Charging Mechanism

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Abstract- *Battery powered electric vehicles are gaining popularity worldwide. This trend is driven by several factors including the need to reduce air and noise pollution, and dependence on fossil fuels. The main drawback of today's electric vehicle is its limited range, and the long duration that is required to charge the electric batteries of the vehicles. In recent years, significant progress (through many R&D) has been made to decrease the charging time of the electric vehicle batteries through pulse charging rather than supplying continuous current and/or voltage. The part to be focused is that the estimation of electrical parameters of the battery in the electrical vehicle, which is the most important factor to get information about available driving range. If the amount of remaining battery capacity can be displayed for the driver then it is possible to make decision on the time of recharging the battery. To study battery behaviour under different conditions, it is necessary to know various battery performance parameters. Future trends in electric vehicle charging are mostly fast charging, contactless charging, and charging from renewable or sustainable energy sources. Furthermore, charging vehicles to grid or charging vehicles to home are the present field of scope for research. When the battery gets fast charging and are overcharged, it will lead to overheating, performance weakening and damage to battery. Likewise, deep discharge is root to permanent damage. The BMS lends a hand to battery life improvement, lessen damage rate, and make the most capacity, efficacy, durability and reliability in battery stacks. This study presents a comprehensive review and evaluation of an on-board charging system that will keep charging the battery as efficiently as possible while minimizing the losses.*

Key Words- **Electric Bike, BLDC Motor, Charging System for Electric Bike, Alternative fuel**

1. INTRODUCTION

As globalization is increasing, so is the demand for oil-based energy which is ultimately resulting in the rapid fluctuation of the market prices of the crude oil due to the basic principle of economics Law of Demand. This volatility and uncertainty in crude oil's demand and prices create pressure on governments and policymakers to look at new alternatives, one of them being the adaptation of green technologies. Green alternatives seem to be the trend of the future business and markets... Indian government has come up with ambitious plans of introducing the EVs to Indian market and keep in pace with the development of EVs globally. The National Electric Mobility Mission Plan 2020 (NEMMP 2020) has come with a detailed report on the EV's. Hence in this project an innovative method of self-charging of the electric bike has been proposed. The method involves the Mechanical and Electrical sections. The Mechanical element includes DC motor controlled through a power unit which moves the gearbox and the generator. The Electrical element includes a power supply unit which will continuously and stably provide the current to DC Motor.

1.1. Objective

- Our objective is to provide an electric bike with an onboard self-charging system which will keep charging the battery as the vehicle is operational.
- The second objective is to charge the battery by minimizing the losses that will be produced while the system will be operational.

2. COMPONENTS USED

- Our Electric bike consists of 8 components which are BLDC motor, motor controller, battery pack, battery equalizer, alternator, UPS, bench power supply, auto cutoff circuit.

2.1. BLDC Motor

There are 2 types of BLDC motor used in electric bike which are hub BLDC motor or a fixed body traditional BLDC motor. The Motor used in our bike is a three phase 2000W 48V fixed body BLDC motor. Figure no 1. Shows the 2000W 48V BLDC motor.

Figure no 1:- BLDC Motor

Type of Motor	Fixed Body BLDC Motor
Power	2000W
Torque	22 N-M
Speed	3000RPM
Voltage	48V-60V

Table No. 1:- Specification of Motor Used

2.2. BLDC motor controller

The BLDC motor controller is a device which acts as the brain for motor. It is the controller which decides how much current is to be supplied to the motor when throttle is applied. The Controller used in our bike is a 3000W 60A Controller. Figure no 2. shows the 3000W 60A BLDC motor controller.

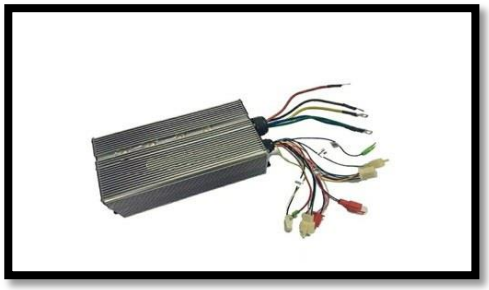

Figure no. 2:- 3000W 60A Controller

Rated Power	3000W
Rated Current	60A
Under Voltage Protection	42V
Rated Voltage	48V

Table No. 2:- Specification of BLDC motor controller

2.3. Battery Pack

The battery pack used to drive the electric motor is a 48V 18A SMF VRLA battery. It is a gel based sealed battery. Figure No.3 shows the CAD model of the 48V battery pack.

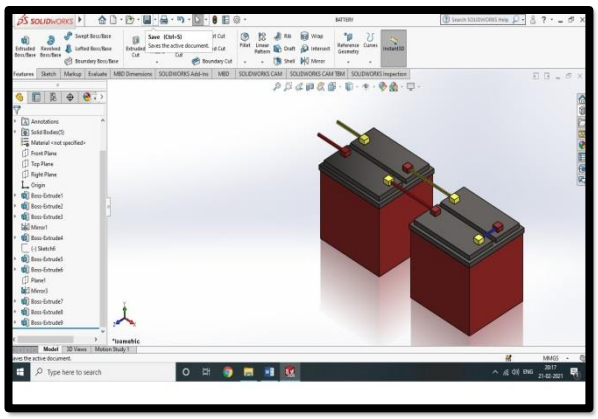

Figure No. 3:- CAD model of 48V Battery Pack

2.4. Battery Equalizer

Battery Equalizer is a device which is used to constantly monitor and maintain voltage level in batteries connected in series. The battery equalizer used in our system is a 48V battery equalizer. Figure no.4 shows the 48V Su-Kam Battery Equalizer.

Figure no. 4:- 48V Su-Kam Battery Equalizer.

2.5. Alternator

Alternator is a device which is used to generate 12VDC when excited by a 12V battery. It is used to charge a single 12V battery. The alternator that is used in our bike is a 12V 40A Alternator. Figure No. 5 shows CAD Model of the alternator.

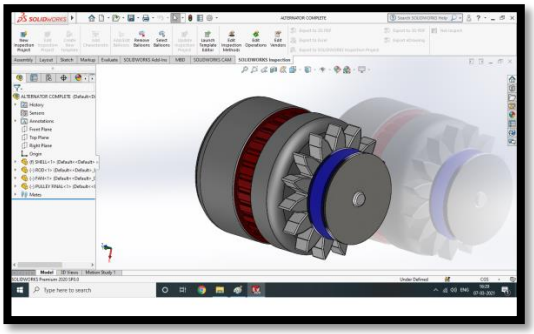

Figure No. 5:- CAD model of Alternator

2.6. Uninterrupted Power Supply (U.P.S.)

The U.P.S is a device that provides with AC voltage by using a DC battery as input. The U.P.S used in our bike is a 1000VA 12V U.P.S. Figure No. 6 shows the 1000VA U.P.S.

Figure No. 6:- 1000VA U.P.S.

2.7. Bench power supply

A Bench Power Supply is a device which takes DC voltage as Input and provides DC voltage as Output. The Power Supply used in our system is a 48V 10A Power Supply. Figure No. 7 shows 48V 10A Bench Power Supply.

Figure No. 7:- 48V 10A Bench Power Supply

2.8. Auto cutoff circuit

An Auto cutoff circuit is a device which cuts off the voltage that is being supplied to the battery pack for charging when it reaches the desired voltage. Figure No. 8 shows the auto cutoff circuit.

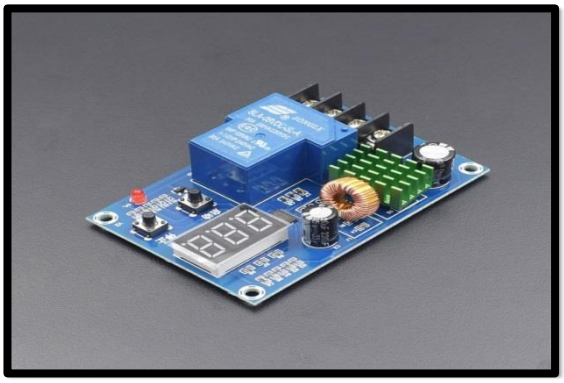

Figure No. 8:- Auto Cutoff Circuit

3. METHODOLOGY

To achieve our objectives as stated above, the system was assembled as follows:-

1. First, Four 12V 18A batteries were connected in series to produce a total of 48V 18A form the Battery Pack.
2. A 48V Battery Equalizer was connected across the 48V battery pack.
3. The charge from battery pack was being fed in BLDC motor controller and through controller to the BLDC motor.
4. The BLDC motor has a pulley and a Spur gear on its shaft to rotate the gearbox and alternator together.
5. The alternator is connected to the U.P.S. battery is constantly maintain the charge in the U.P.S. Battery.
6. The U.P.S. then provides AC charge to the bench power supply.
7. The bench power supply is calibrated to provide 54VDC at all time.
8. The charge from the bench power supply is then fed to the auto cutoff circuit.
9. The auto cutoff circuit keeps providing the charge to the battery pack till the battery reaches the desired voltage.
10. As soon as the battery pack reaches the desired voltage. The auto cutoff circuit shuts down the supply to avoid overcharging of the battery.

4. ADVANTAGES

The advantage of our proposed system over the current system that is being used for charging of Pure Electric automobiles are

1. The Regenerative Braking is the only thing that is being used for charging the system while the automobile is operational. As the name suggests, the system is operational only when the automobile is slowing down or braking. Our system will be operating as long as the motor shaft is rotating regardless the vehicle is moving forward or in reverse.
2. Since, the Regenerative Braking is going to be

operational only for a small duration the charge produced will be less. On the other hand, our system will be operational till 70% - 80% Throttle which means the duration of operating of our system will be more and hence, the charge produced will be more.

3. Since, the regenerative braking has low initial investment and low maintenance cost. It gives better short term benefit, but our system can provide a better long term benefit as the charge produced is much higher than the regenerative braking system.

5. CONCLUSION

This research paper highlights the effect of charge left in battery on Electric Vehicles performance and efficiency. However, the development of the charging system can solve those problems. The current mechanism utilizes existing parts of the I.C Engine powertrain, such as gearbox. The mechanism is mounted on a frame which is bolted to the gearbox. Because of the use of existing gearbox, we were able to use the motor to the fullest. Keeping throttle twisted to more than 50%, the mechanism will keep on maintaining the optimum charge level required while the rider waits. Even if, the rider is moving at any gear, at any speed, the mechanism will keep the charge balanced.

6. FUTURE SCOPE

1. Sensors can be installed in the system for detecting whether battery is charging or not, So that if the mechanism stops working, the rider will be alerted.

2. As the system produces heat, the performance of system gets affected. Liquid cooling of Components can be added for better cooling of the system.

3. Sensors can be used to automatically start or stop the liquid cooling of the components. When the temperature gets at a certain degree.

4. A better gearbox can be made in order to facilitate the need of extra power from even Bigger and better motor.

5. A more efficient DC-DC booster module can be made to supply the charge more efficiently from the battery to controller.

6. Better integrated wattmeter can be used to monitor the voltage that is coming from the Booster module and voltage produced from the alternator.

7. Better Battery Packs can be used to give better Performance and efficiency over time.

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