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Cost Effective Conversion of Existing Bike into Hybrid Electric Bike

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Abstract: ***Air pollution from motor vehicles and exhaustion of natural resources has become a serious global and environmental hazard. The emission of poisonous gases such as Carbon monoxide (CO), Nitrous Oxide (N_2O), Sulphur dioxide (SO_2) and other hazards gases from Two-Wheelers is a significant contributor to air quality problems which cause severe threats to all living organisms. Due to increase in number of vehicles and limited use of emission control strategies, two-wheelers are considered to be a significant source of urban air pollution in most of the Indian cities. To overcome such harmful effects, the modification of Existing bike into a Hybrid Electric bike is necessary. This Hybrid method involves two modes of operation where the battery is operated as the main source and the fuel is operated as back up supply. Through switching operation, the modes of process can be switched from battery into fuel and vice versa. BLDC hub motor is used for its long operating life, compact size, high efficiency and better Speed-Torque characteristics. The Sealed Lead Acid battery is used and the Controller is used to governor the speed of the vehicle. Through this conversion long distance is facilitated. The conversion of Existing bike into Hybrid bike is cost effective. The pollution due to air and fuel consumption is highly reduced which in turn reduces the maintenance cost of the vehicle.***

Keywords: Controller, Charging, Switching operation

I. INTRODUCTION

Our current industrial society works only with the conventional energy sources like coal, oil, natural gases or uranium. Meanwhile, there are some problem associate with them. They produce several kinds of pollution. If there is no care for atmospheric pollution, climate change and nuclear waste can endanger our living condition on the earth. After several years, the limited energy source will be exhausted and will not guarantee energy supply in the future. On the opposite side, the renewable energy sources uses the natural flows. Two-wheelers are considered to be a major transport medium for most of the people. Two-wheelers powered by 2-stroke engines are a major source of pollution in large cities. The high levels of pollutants emitted by these vehicles are mainly responsible for respiratory ailments including lung cancer, asthma, etc. Therefore, the high fuel consumption and greenhouse gas emission are contributed by two-wheelers in urban areas are need to be more urgent attention to improve the near-term sustainability of energy and urban air quality in the future. The energy security is one of the important concerns of all countries. In India, the most commonly used energy source is based on fossil fuels. These problem can be overcome by using the renewable energy source as a fuel. To achieve this condition, battery can be used where it can be recharged whenever drains out. Thus electric bike can be used instead of petrol engine bike. Even though it is used, there are certain disadvantage associated with this method. Some of the disadvantage include, it is quite difficult to climb the hill using electric bike. The initial cost of buying a new electric bike is very high. The continuous charging and discharging of battery will reduce the life of battery. This in turn increase the maintenance cost of electric bike. The above disadvantages can be overcome by converting the existing petrol engine bike into a hybrid electric bike. By making some modification in the existing petrol engine bike, it can be used as a hybrid one.

II. METHODOLOGY

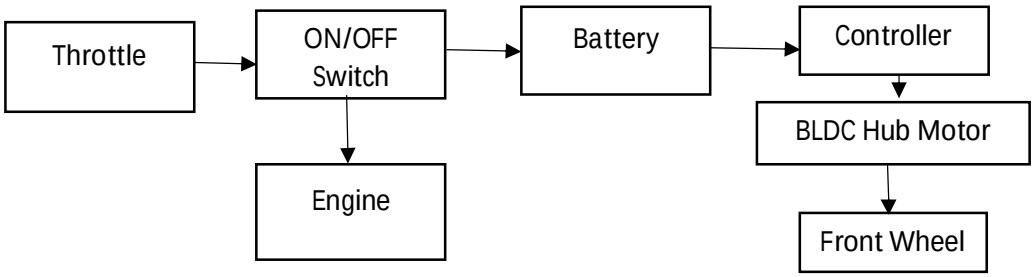


FIGURE.1 Block Diagram of Hybrid Electric Bike

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In conventional bike, it has only back wheel drive but in hybrid electric bike, it will have both front wheel and back wheel drive. There are two mode of operation in Hybrid Electric bike. They are fuel mode and battery mode. In this proposed model, the battery is used as a main source and fuel is used as a backup supply. The engine is used to drive the back wheel by using the fuel. Through the crankshaft and drive chain, the back wheel of the vehicle rotates.

Thus in Hybrid Electric bike, the BLDC hub motor is connected to the front wheel of the existing bike. The rating of the motor will be differ according to the speed needed by the consumer. In BLDC hub motor, the Hall Effect sensors are placed. The Hall Effect Sensor is used to sense the rotor position for commutation. The Sealed Lead-Acid batteries are connected in series. The controller is placed between the BLDC Hub motor and sealed lead acid battery. The range of controller is depend upon the rating of the BLDC Hub motor which is used. The main purpose of controller is to control the current flow from battery to motor which is depend upon the speed raised by the user, it will also avoids the excess flow of current to motor which ultimately leads to damage of motor and the sensors connected with the motor. There will be switch which is used to switch the operating mode of vehicle from Battery to Fuel and vice versa. The indicator is placed in the vehicle and it is used to indicate the operating mode of vehicle. Here we have placed LED indicator which will glow when the vehicle is operating under battery mode and will not glow under fuel mode condition. The cartridge fuse is placed between the batteries to avoid short circuit problems.

III. RESULT ANALYSIS

A. Calculations

1) Power Calculation

One joule = 1 Watt sec

Where Power, P = $\frac{\Delta E}{\Delta t}$

1 unit = 1 KW

1Kwh = 1000Wh

= 1000*3600 sec

= 3600KW sec

= 3600K joules

B. Torque Calculation

The power P is given by the formula,

$P = \frac{2*\pi*N*T}{60}$

Where Power, P = 250 W,

Speed N= 3100 rpm

The Torque, $T = \frac{P*60}{2*\pi*N}$

$= \frac{250*60}{2*\pi*310}$

=7.701045 NM

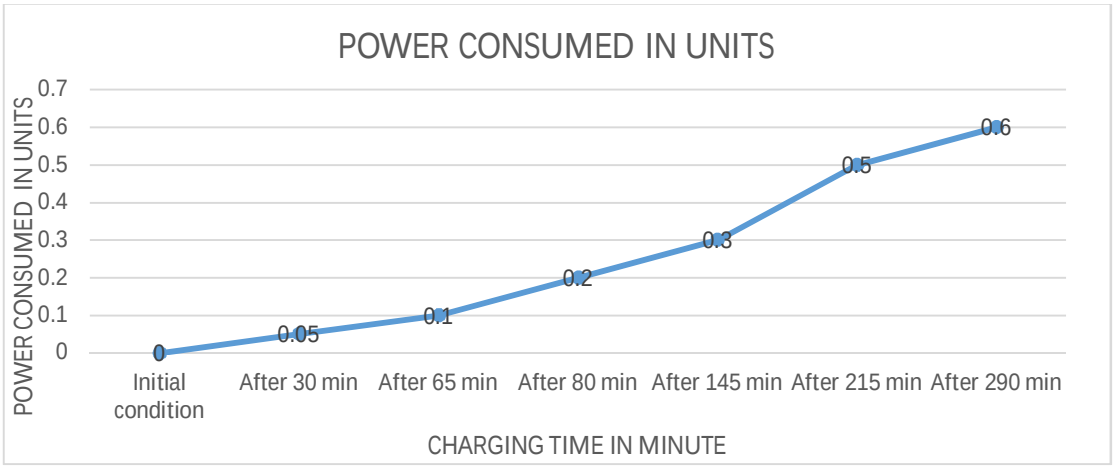
C. Tabulation for Charging of Battery

Table 1. Charging of Battery

S.no	Charging time of battery	Power consumed in units	Battery voltage level in v
1	Initial condition	0	48
2	After 30 min	0.05	49
3	After 65 min	0.1	50
4	After 80 min	0.2	50.6
5	After 145 min	0.3	51.8
6	After 215 min	0.5	52.6
7	After 290 min	0.6	53.5

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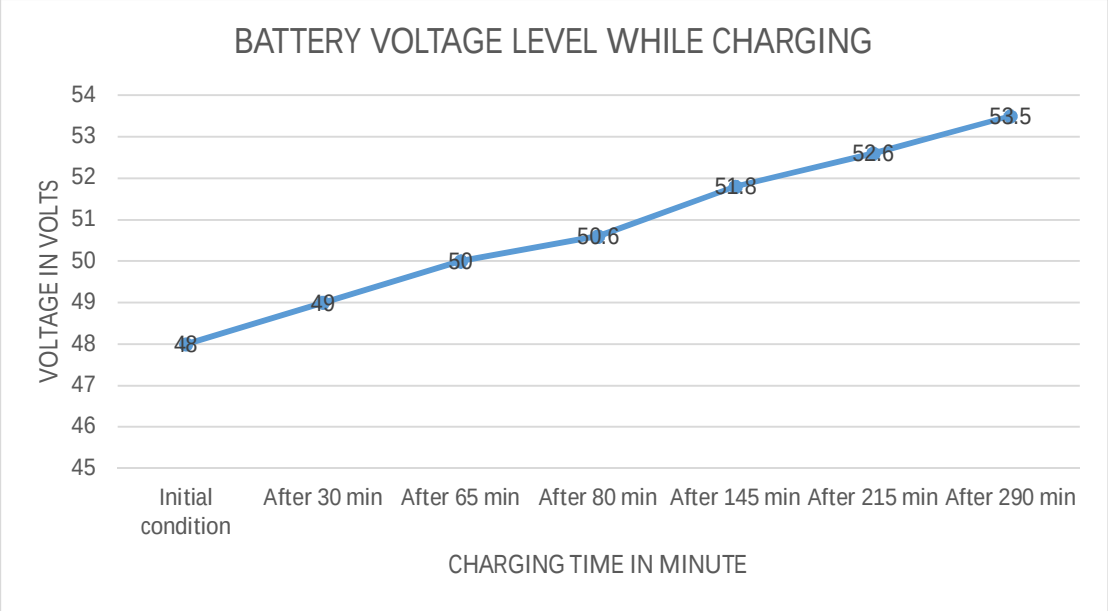
The following graph 1 shows the relationship between the time take by the battery to charge from initial charging condition to full charging condition and power consumed in units



Graph 1. Relationship between charging time and power consumed

The graph 2 shows the relationship of charging time in minute and the voltage level in the battery in volts.

Graph 2. Relationship between charging time in minute and level of voltage in Battery



D. Cost Of Power Consumption

Power consumed by electric bike from drain condition to full charging condition is equal to 0.6 units

Cost of 1 unit of Power = 3 Rupees (in Tamil Nadu)

= 0.6*3

= 1.80 Rupees

Thus average mileage of electric bike when it is under full charging condition is 25 Km

For 26 Km ≈ 2 Rupees

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E. Charging And Discharging Rate

The Sealed Lead Acid Battery takes around four hours for charging from dry condition to full charging condition. Once if it is charged and fuel is filled up to the maximum level, it is possible to achieve 74KM mileage. The discharging rate of battery is shown in the following graph 3.

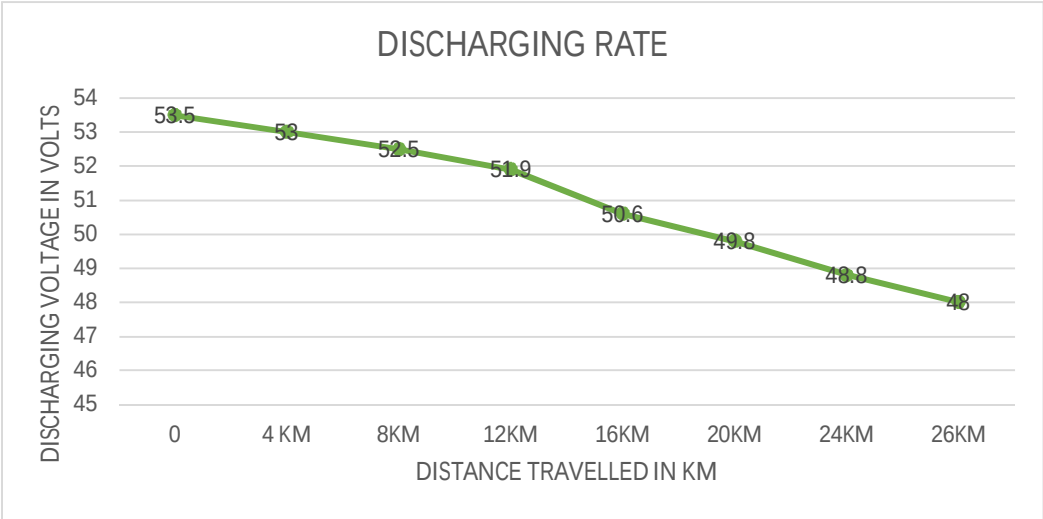
F. Discharging Rate

Here we have used four 12V, 12Ah battery which are connected in series for 250W,48V motor. The average mileage achieved by the vehicle for this rating will be 26 Km. If we increase the rating of the battery, the mileage of the vehicle will increase. The following table shows the discharging rate of four 12V, 12Ah battery from full charging condition to dry condition.

Table 2. Discharging Rate

S.NO	DISTANCE TRAVELLED IN Km	DISCHARING RATE OF BATTERY FROM FULL CHARGED CONDITION TO DRAIN CONDITION IN TERMS OF VOLTAGE
1	0	53.5
2	4	53
3	8	52.5
4	12	51.9
5	16	50.6
6	20	49.8
7	24	48.7
8	26	48

The following graph is plotted by using the data which is furnished in the above table and it is used to know about the discharging rate of battery from full charge condition to dry condition



Graph 3. Relationship Between distance travelled in KM and discharging level of Voltage in Volts

IV. CONCLUSION

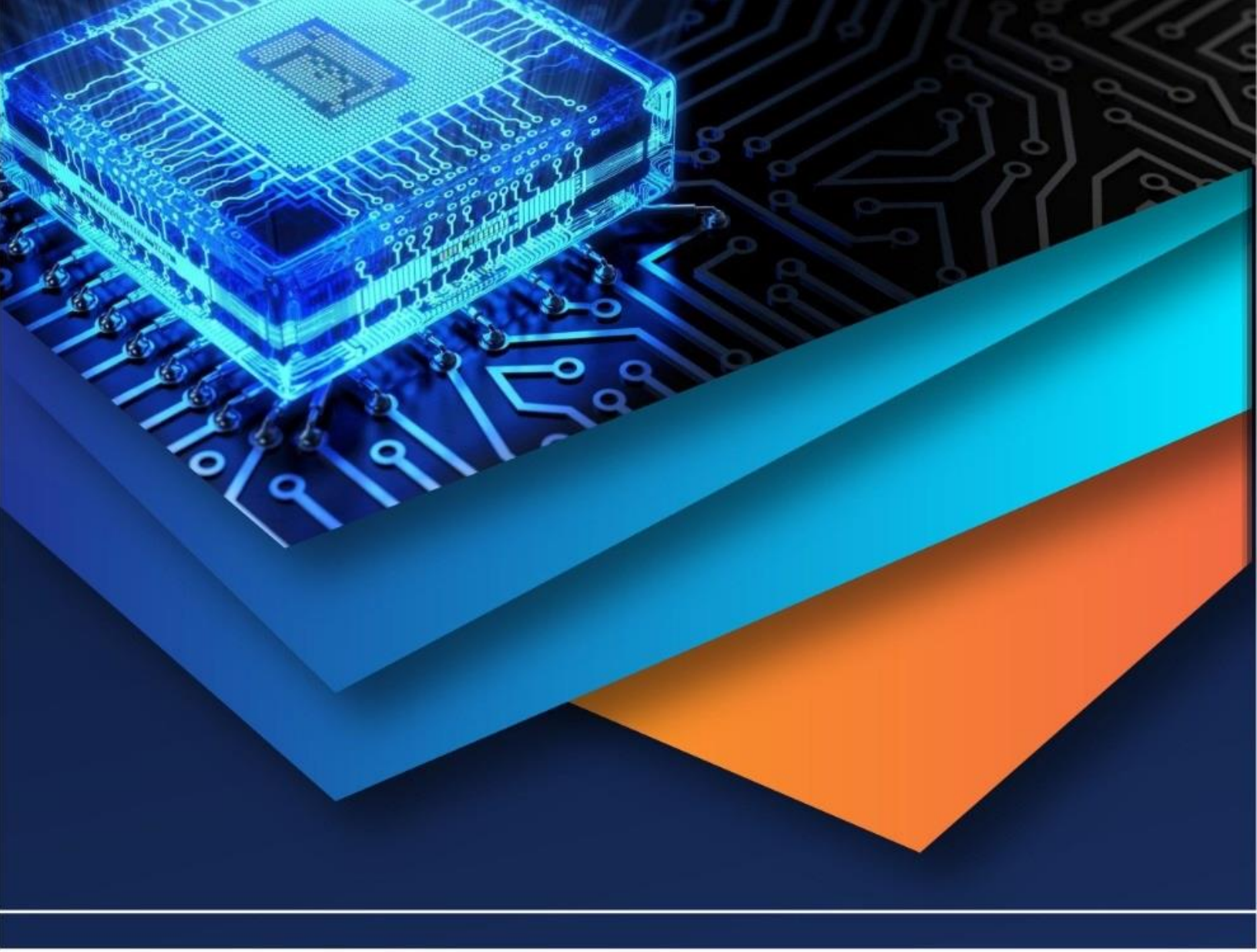
The unused conventional vehicles can be modified and can be used as a useful one. If the weight of the vehicle increases, the speed decreases. The hybrid electric vehicle reduces the air pollution caused by the conventional bike and also reduces the global warming. Since 250W 48V BLDC hub motor is used, the speed of the vehicle decreased. Future enhancements can be made to reduce the vehicle weight and battery weight.The mileage of the vehicle can be increased by increasing the motor rating and battery capacity.

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