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Designing a Cost Efficient Renewable Energy Powered Bicycle

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ABSTRACT: The fuel prices are raising steadily day by day along with increase in pollution level due to various factors, one of the major contributing factors is the pollution from vehicles in metro cities and urban areas. To solve the above stated problems we have to opt for such a power source which should be pollution free and the price is also minimal. The only feasible solution to this is commutation with solar power. Hence we have designed a solar assisted bicycle that could curtail the effect of pollution as well as the dependability on non renewable resources may be reduced.

Key words: Solar cycle, Renewable energy, Motor, Battery, Solar panel, Motor controller, Throttle, chain drive.

I. INTRODUCTION

Bicycle has been the major mode of transportation since 19th century, but the use faded cause of more human energy and time consumption required for its usage. So, various steps were taken to overcome the above mentioned problems along with the problem of increasing pollution and one of them being the designing of solar assisted bicycle [2].

The solar bicycle decreases the pollution as well as the reduction in the dependability on non-renewable resources [2]. This work makes use of manual drive as well as electricdrive. The manual drive uses pedals whereas the electric drive uses batteries.

In this solar bicycle the motor is connected to the rear axle which provides the torque and motor speed. The motor speed is controlled by a throttle. Depending on the requirement of high power, high rpm motor is used.

II. DESIGN PRINCIPLE

The drawings of electric powered bicycle suffers many disadvantages including the size and weight of the battery which made the bicycle design bulky and setting up the motor chain drive system was a major difficulty [5].

The aim of this project is to design a solar powered electric bicycle that could provide speed control along with pollution independence and comfortable drive without frequent battery charging.

Fig. 1.

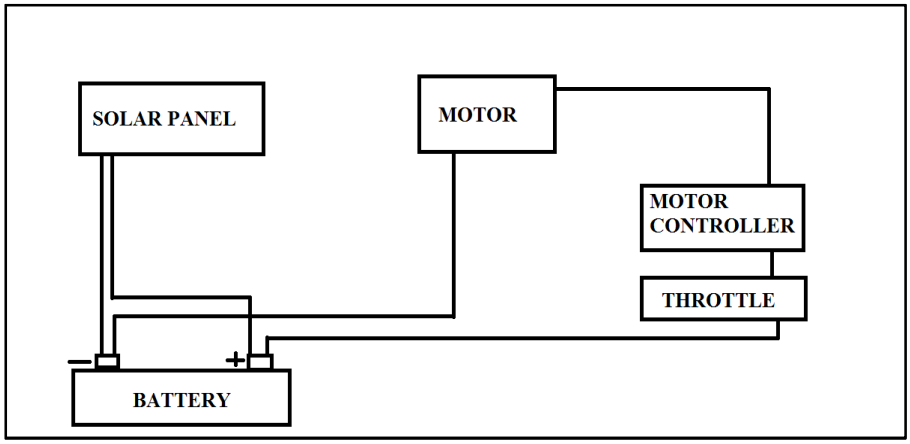

Fig. 2.

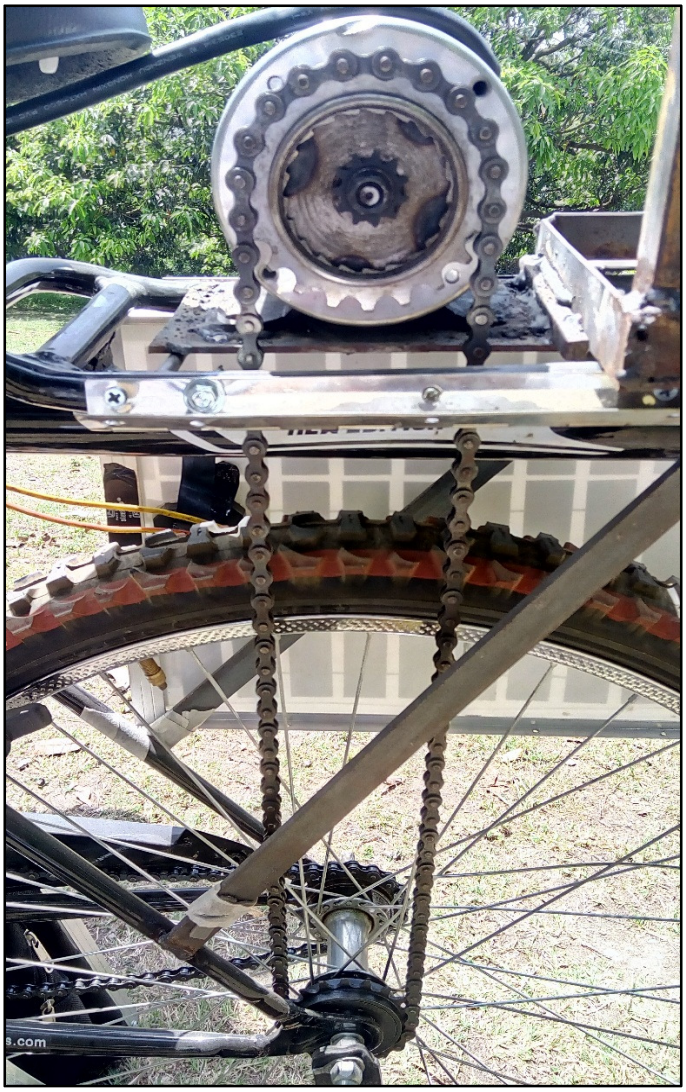

Fig. 3.

Fig. 4.

Fig. 1: Illustrations of the present embodiment of the project is shown along with the block diagram. Fig. 2: Assembled gearless motor (5) behind the seat on the carrier along with the rear axle by using a chain drive system (6). The DC motor (8) is inspired from the H. Smith US Patent no 3,855,511 17 Dec 1974 (LINK). Fig. 3: Chain drive system. Fig. 4: Battery slots and specifications.

Components Specifications:

Motor (Fig B)

- 24 V, DC
- Max 500 watt, 26.7 Amps
- Max 2500 rpm
- Chain drive (II Teeth sprocket)
- Type of motor: DC, brushless.

Lead Acid Battery: In electronics, lead acid batteries are the most popular used batteries [1], whereas slightly lower in energy density than lithium ion. They have succeeded over other conventional type of batteries and are optimum choice for our solar energy powered bicycle [3, 4]. This project demands a battery with lighter weight with longer running hours and high capacity. Lead acid battery used is specifically designed for solar light vehicles.

This battery is placed on the middle of horizontal bar between the seats and handle. It is done to minimize the weight on any particular axle. For backup another void is welded for second battery**.**

Battery specifications (Fig. 4)

- Type of battery: Sealed lead acid
- Voltage: 12v
- Amp-hour rating: 36Ah
- Charge termination: when battery charge reaches 23.8v
- Standby battery voltage: 23.4v
- Charging time: 6-8 hours
- Safety: Good
- Operating Temperature (Celsius): -5 to 50
- Cycle Life(no. of cycles): 300

Throttle/Accelerator:-

Fig. 5.

Throttle allows us to control the RPM of motor i.e. it allows us to drive the motor from zero to full speed [1].

The throttle was fitted on the right side of bicycle handle by removing the originally fixed handle bar. It was set to provide acceleration via throttle wire. Throttle converts the DC voltage from battery to an alternating voltage with variable frequency and amplitude which drives the motor at different speeds.

Throttle/Controller specifications (Fig. 4).

- Manufacturer: OLBO
- Rated Voltage : DC 24 Volt
- Under Voltage : 20+- 0.5 Volt
- Rated power : 500 Watt
- Throttle : 1-4 Volt

Solar Panel (Fig. 6):

Fig. 6.

Solar Panels are placed on each side of the bicycle carrier to balance the weight. A setup is made to set the position up and down for charging up the batteries while parked.

Solar Panel specifications:-

- Maximum power (watt): 20 +/- 5%
- Short Circuit current (Isc): 1.4A
- Max power current (Imp): 1.5A
- Maximum voltage (Vpm): 17.7v
- Open Circuit voltage (Voc): 21.4v
- Maximum System Voltage: 600VDC
- Type: Poly Crystalline
- No. of cells in series: 36
- Frame type: Aluminum
- Weight: 2.60kg
- Lifespan: 10 years

Chain drive System (Fig. 7):

Chain drive system need sprockets, brackets and drive chain. The rotor of the motor and the rear axle of the cycle is connected by a chain mechanism at an angle of 90 degree to the bicycle. The connection is made on the left side of the cycle. There is also a traditional chain system for manual mode of bicycle using pedals (Fig. 7).

Motor Controller: It is the most important component of the system as it controls the amount of power supplied to drive the dc motor [1]. The controller function is to convert the dc voltage from battery to an alternating voltage with variable amplitude and frequency that helps to vary the speed of the motor.

Motor controller specifications:-

- Rated voltage(v): 24
- Under voltage(v): 20.5
- Throttle: 1-4v
- Casing material: Aluminum
- Weight(gms): 100
- Dimensions (L×W×H): 8×5×2

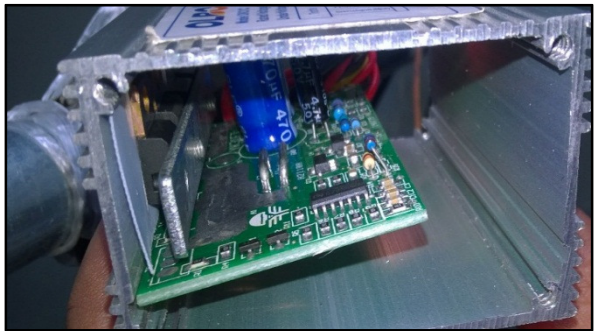

Fig. 7.

III. RESULT AND CONCLUSION

The existing bicycle is modified to the solar assisted bicycle which runs completely on green energy and running cost is very minimal (Rs.0 / 35 Km) and it is suitable for almost all kind of roads with an average speed of 9 Km/hr and the maximum weight carrying capacity is 53 KGs. This bicycle could be used for short distance travelling by all age group of peoples especially it is very useful for aged personals and kids. The important feature of this bicycle is it cost effectiveness (Prototype cost Rs. 19,000 /-), simple construction and it does not consume valuable fossil fuels or muscle power for transportation. Thereby saving crores on foreign currency and Kilo Joules of energy. However, it can also be driven by manual pedaling in case of bad weather conditions or any other low solar irradiation situations. The weight of the solar bicycle was reduced (37 Kg), but more reduction is possible to attain higher speed. Besides there is a strong possibility to improve the speed by using hub motor or by using the cycle gear mechanism**.**

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