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Design and Fabrication of Hybrid Cycle with the Help of Solar and Generator

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Abstract: Energy conservation is a greater issue and this design proffered an efficient method of doing so. Hybrid bicycle combines the use of solar energy as well as the generator that runs through pedal to charge the battery to run the bicycle. Thus solar hybrid bicycle can become a very vital alternative to the fueled automobile, thus its manufacturing is essential. Our main objective is to reduced the time required for charging the e-bike by adapting renewable energy and a efficient circuit to charge the battery.

Keywords: Solar Cycle, Generator Cycle, E – cycle, Gym cycle, Hybrid cycle

I. INTRODUCTION

A hybrid vehicle is one that uses more than one means of propulsion - that means combining a petrol or diesel engine or any other mechanical power with an electric motor. The main advantages of a hybrid are that it utilizes the different form of energy without extra input and increases the performance of the vehicle by supplying additional energy to it. The fuel prices like the petrol is rising steadily day by day. The pollution due to vehicles in heavy traffic cities and urban areas is increasing steadily. To overcome these troubles, an effort regarding this is made to search some other alternative sources of energy for the vehicles. And also to provide a solution for the environmental pollution.

A hybrid bicycle is just like a normal cycle but it can also run using the electrical energy of battery to run the motor which ultimately runs the bicycle. Free rotor concept is used which act as generator to charge the battery. And also Solar energy is used to charge the battery. There are lot of cycle like this in a research department waiting for the manufacturing to the consumer end. Our research over here is to implement the concept and create a working model and a efficient circuit creation to reduce the effective charging time for the battery.

Nowdays in the market e-cycle are available which are running on wall plug charge point. We are likely to collaborate the two things solar and generator to reduce the effective charging time nearby to wall plug charging time with an renewable energy resource.

The market of e-cycle is increasing day by day, people are moving forward towards the green revolution like saving the environment. In these days the proper enhancement and amplification of e-cycle should be done carefully and precisely. So to create the more use of the electric cycle we tried an experiment to reduce the charging time of e-cycle to somewhere near to the charging time required by wall plug using solar panel, generator or dc motor.

II. PARTS CLASSIFICATION

A. DC Motor

Permanent magnet dc motor has basically a free rotor rotating in magnetic coils wound around the permanent magnet. The magnetic coil have basically electric current flowing through it which produces electromotive force and causes rotor to rotate, hence armature rotates and power is obtained. By increasing the rate of ampere the speed of the motor can be controlled. The preferable motor for experiment is 24v 250w. But for the real life terrain situations higher torque motor is suggested.



Fig. 1 DC Motor

B. Solar Panel

Solar panels consist of solar cells which uses light as a source to produce electricity. The solar cells are also called as photovoltaic cells. These cells consists of semiconductor which uses light energy to excite the photons and to come back to the stable form photon release electron hence electric current is produced. The solar cells are capable of producing large amount of energy. In our experiment we preferred to use two 30W solar panels in series such that output voltage required is obtained.



Fig. 2 Solar panel

C. Lithium Ion Battery

Lithium ion battery consists of small lithium cells connected in series and parallel to attain required voltage and current capacity. In recent times lithium ion batteries are preferred over lead acid batteries and nickel cadmium batteries because it is lighter in weight, high energy density, more charging life cycle, compact in size, high ampere hour rating and large current storage capacity. According to our motor specification we have choose 24V and 10Ah battery which is equipped with modern BMS.



Fig. 3 Lithium Ion Battery

D. Controler Unit

The speed of the motor will have to be varied depending on the road conditions and traffic. Therefore an accelerator or a throttle is necessary which facilitates the motor to run from zero speed to full speed. The throttle is fitted on right side of the handle bar and is connected to controller. The throttle converts DC voltage from battery to an alternating voltage with variable amplitude and frequency that drives the hub motor at different speed. So, we chose 24V 250W motor controller.



Fig. 4 Controller Unit

E. Generator or DC Motor

Generator is basically motor only, but instead of converting electrical energy into mechanical it converts mechanical energy into electrical. Here the armature is rotated in magnetic field with the help of mechanical attachments. The wound coil around magnets encounters the back emf due to the rotation of armature. Hence current is produced. The current produced from the generator varies on the speed of the armature more the speed more the current. The voltage and current constantly varies due to its non uniform motion so output current is to be stabilized before using it to charge battery. Various types of generator are available in market. But, we have used the same motor as a generator.

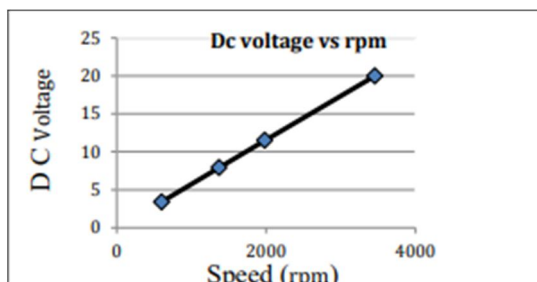


Fig. 5 Voltage vs RPM Graph

F. Circuit Diagram

As the generator and solar panel are connected in parallel to charge the battery so it was necessary to develop two different circuits so that no short circuit happens and functions properly. To charge the lithium ion battery we are using renewable energy like human efforts and solar power. We are using D.C motor to run the bicycle as well as a generator. Pedal arrangement is used to run the generator. We get variable D.C current as output from motor. Voltage of the current depends on the pedaling speed or the rpm of the wheel. The ampere and voltage keep on increasing and decreasing no stable current dc current is available.

- 1) **Generator Circuit:** To prepare own voltage regulator many type of circuits can be prepared with the help of different components such as IC, DIODES, and TRANSISTORS. To make this circuit we have used IC's. IC's are more accurate in voltage controlling functions as they are used in voltage sensitive environment applications such as in computers, radio, transmitters. They are the most reliable components in voltage regulation. The error in voltage output is about 0.01% in IC's. To create voltage regulator we have used IC – 7824 to create a constant output voltage of 24 v at constant rpm. Here 24 in 7824 denotes the required voltage output. This ic contains three legs 1st is for input positive, 2nd leg is common leg or negative leg, 3rd leg is output positive. By connecting desired supply to be step down between 1st and 2nd leg and the output current obtained from 2nd and 3rd leg is step down to 24v. No current voltage rating higher than 24v would be obtained at output. To increase the current carrying or load carrying capacity of the circuit the IC's are connected in parallel.

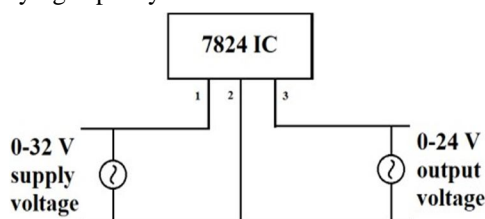


Fig. 6 Ic working

- 2) **Solar Circuit:** The current from the circuit is constant dc so we don't require any other transformer or circuit to use the current. The current from the solar depends on the conditions of environment, humidity, sun facing surface, dust, climate changes, intensity of sun etc. The current increase or decrease. But voltage always remain same. According from our specs we have decided to 30w two solar panels in series of 18v. We acquired a total voltage of around 42v from the solar when connected in series. We need to step down voltage to 24v for constant charging of battery. Using 5A DC – Dc buck converter circuit or CCCV circuit to decrease the output voltage at desired level. Hence just by using that simple circuit we get constant charging voltage and current. The solar circuit is connected in parallel with the generator circuit which helps in charging the Battery as we get the desired output of voltage and current.

3) **Discharging Circuit** : It consists of ECU controller which governs the working of the flow of battery output current. It decides the high peak current when required and minimum current required to drive the motor. The electric control unit (ECU) is the main heart of the system. As we are using D.C motor both as a generator and motor an arrangement was to be made to supply the current to the motor from battery (discharging) and charge the battery (discharging) with the help of current produced by D.C motor by pedal arrangement and also with solar panels. So, a double pole double throw (DPDT) switch is used to toggle between two circuits which are charging circuit and discharging circuit. A Double Pole Double Throw (DPDT) switch is a switch that has 2 inputs and 4 outputs; each input has 2 corresponding outputs that it can connect to. Each of the terminals of a double pole double switch can either be in 1 of 2 positions. This makes the double pole double throw switch a very versatile switch. With 2 inputs, it can connect to 4 different outputs. It can reroute a circuit into 2 different modes of operation.

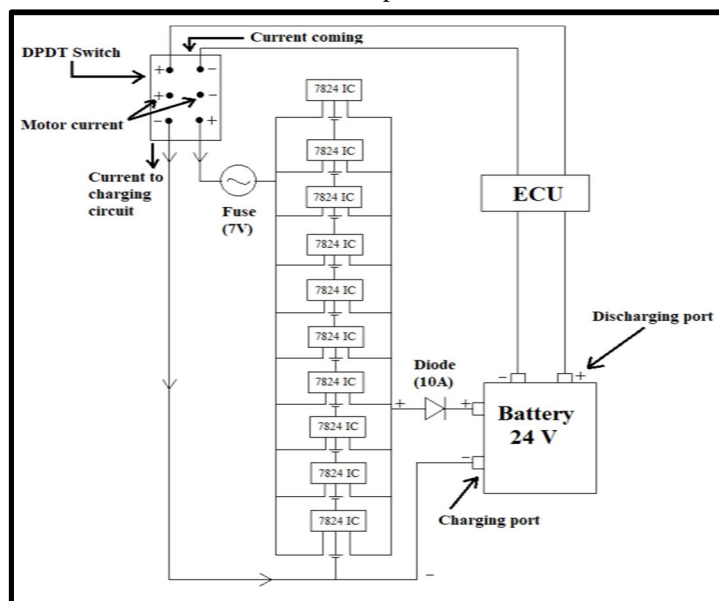


Fig. 7 Working Circuit

III. BODY CALCULATION

1) **Battery Calculation** : Since motor selected is of 24V hence battery voltage rating should also be 24. Charging of battery depends on the ampere rating of current.

Charging time- Time required o charge the battery by adaptor 24V 5Ah

$$P= 12*12= 144W$$

$$T= (10/5)= 2hrs$$

2) **Solar panel calculations**: Panel selection, we used two panels of 30W each having dimensions 350mm*550mm in series.

No load current = 1.6A Voltage rating = 18V

Using CC CV circuit to drop down voltage to 24V from 42V.

By using solar panel $T=(10/1.2)= 8hrs$ 20mins

3) **Charging time calculation**: Voltage rating of motor = 12-24V Rated speed = 1800-3900 rpm Current rating = 14 Amps

Power rating = 350 W Lithium ion battery = 24V

Bike wheel pulley turn ratio is 26" diameter to 2" diameter

= 1:13 , 15 kmph speed is required to charge the battery of 24v.

Using IC7824 to control the output current voltage from generator to 24v and output current is varying from the speed.

Maintaining rotation of wheel at constant speed about 10kmph we get produced current approximately about 1a at 24v constant.

Using the current from solar panel by stepping down its voltage with cc cv circuit at constant 24 v.

Using the solar current and generator current in parallel too charge up the battery.

Incoming current from the circuit = 3a (when battery is fully discharged)

Charging voltage = 25 v

Time required to charge the battery = 10/3

T = 3 hours and 20 minutes

IV. CONCLUSION

The fuel prices like the petrol is rising steadily day by day. The pollution due to vehicles in heavy traffic cities and urban areas is increasing steadily. To overcome these troubles, an effort regarding this is made to search some other alternative sources of energy for the vehicles. And also to provide a solution for the environmental pollution from all the research papers studied and implementing our concept with them, than we can reduce the charging time of battery, so that faster charging would be available which will help the people to move on to the green technologies easily at low cost. Nowadays we get hybrid car but we don't have that technologies in two wheelers or cycle so thought of advancing in that area. The technology developed by us can be implement in the two wheelers such as activa or motorbike we can coupled the electric motor with the engine. Thus smarter and more efficient use of energy can be done in the field of automobile. Using breaking energy which is called as regenerative braking or e – braking in proper unitized circuit to charge the battery in more efficient and effective way. The battery charging uphold capacity can be enhance by using the li-polymer batteries. This concept can be utilized to create a hybrid two wheeler vehicles systems. The speed ratio to operate the motor can be vary by utilizing the multiple gear ration arrangement between the wheel and motor assembly. The speed of the rider can be enhanced by using high torque motor. Flexible solar's are now available in market they can be also used to reduce the back space for the solar. By reducing the weight of the cycle and accessories the improvement to speed and charging time can be optimized.



Fig. 8 Testing Model of Project

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