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Design and Fabrication of Solar Electric Scooter

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Abstract— Electric motorcycles and scooters are plug-in electric vehicles with two or three wheels that can be recharged from any external source of electricity, and the electricity is stored in a rechargeable battery, which provides power to one or more electric motors to attain movement. Electric motorcycles, as differentiated from scooters, do not have a step-through frame. The electricity generated from an external source helps in acceleration of the motorcycle. The speed of this cycle is limited and the electricity is generated using a solar panel. The generated electricity is stored using a battery and the locomotion and movement of the vehicle is hence propelled using a motor. The cycle need not be continuously fed with solar energy in order to gain the capacity to run. It gets its energy from the batteries where the energy is stored. Conventionally, these types of vehicles are hard to use with the help of just mechanical energy. The energy we get from human effort. But when energy is converted using solar energy and a battery, it becomes more easy and helpful in the propulsion of the motorcycle. The motorcycle, not using an engine, becomes an effective way of road transport as it causes no pollution. It is eco-friendly and it definitely reduces human effort.

Keywords—Scooter, motorcycle, mechanical energy, solar energy

I. INTRODUCTION

The aim of the project is to design a scooter with renewable solar energy. Solar Bike aims to be a small research and development business that develops renewable technology and helps everyone start riding electric bicycles around rather than using their cars. We firmly believe that using solar powered bicycles is one of the best methods of reducing our dependence on fossil fuels and minimizing environmental damage caused by carbon dioxide emissions.

A solar panel is a flat rectangular shaped device, typically somewhere between the size of a radiator and the size of a door, made up of many individual photovoltaic energy collectors called solar cells covered with a sheet of glass on its surface. The cells, each of which is about the size of a palm of an adult, are usually octagonal in shape and colored bluish black. Similar to the cells in a battery, the cells inside a solar panel are designed to generate electricity; but where a battery's cells make electricity from chemicals, a solar panel's cells produce power by capturing sunlight instead. They are sometimes called photovoltaic cells because they use sunlight ("photo" comes from the Greek word for light) to make electricity (the word "voltaic" is a reference to electricity pioneer Alessandro Volta).

In this project we are going to use solar panel and DC hub motor. The voltage generated by the solar panel is stored in battery (48V/20AH) through charging circuit. From the battery, power will be supplied to the DC hub motor (48V/200W) through accelerator followed by gate switch. The purpose of gate switch is when break is applied then automatically it opens the connection between motor and accelerometer.

The wheel hub motor is an electric motor that is incorporated into the hub of a wheel and drives it directly. Hub motor electromagnetic fields are supplied to the stationary windings of the motor. The outer part of the motor in turn follows, those fields, turning the wheel attached.

Fig: 1 Solar Electric Scooter

II. RENEWABLE ENERGY RESOURCES

A renewable energy resource is a natural source of energy which can be replenished with the passage of time, either through biological process of reproduction or any other natural processes. Renewable resources are a part of Earth's natural environment and the largest components of its ecosphere. 16% of total global energy consumption comes from renewable energy resources

Renewable resources may be the source of power for renewable energy. However, the rate at which the renewable resource is consumed should not exceed its renewal rate to ensure its sustainability.

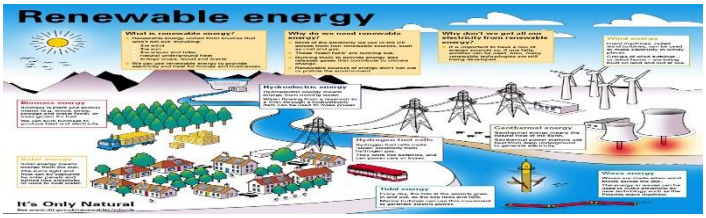


Fig 2: Renewable energy Resources

Solar Cells

A solar cell (also called a photovoltaic cell) is an electrical device that helps in the conversion of light energy directly into electrical energy by creating voltage when it gets exposed to light. It is a form of photoelectric cell which, when exposed to light, can produce and support an electric current without being attached to any external source of voltage, but requires an external load for power consumption.

This is the field of technology and research related to the practical application of photovoltaic cells in producing electricity from light, though it is more commonly used to refer to the generation of electricity from sunlight. Cells can be described as photovoltaic also when the light source is not necessarily sunlight (lamplight, artificial light, etc.). In such cases the cell is sometimes used as a photodetector (for example infrared detector), for detecting light or other electromagnetic radiations near the visible range and measuring light intensity.

The working of a photovoltaic (PV) cell requires 3 basic features:

1. The absorbing of light, generating electron-hole pairs or excitons.
2. The separation of charge carriers of unlike types.
3. The separate extraction of those carriers to an external circuit.

Fig 3: Solar Panel

III. HUB MOTORS

Hub motor electromagnetic fields are supplied to the stationary windings of a motor. The outer part of the motor followsthose fields that turn the wheel that is attached. In a brushed motor, energy is transferred by brushes which are in direct contact with the the rotating shaft of the motor. In a brushless motor, the Energy is transferred electronically, with no physical contact between stationary and moving parts. Although the brushless motor technology is more expensive, most of them are more efficient and longer-lasting than brushed motor systems.

Electric motors have greater torques at startup, making them more suitable for vehicles as they need the most torque at startup too. The idea of "revving up" so common with internal combustion engines is unnecessary with electric motors. Their greatest torques occurs as the rotor first starts turning and this is why electric motors do not require a mode. A gear-down arrangement mightbe needed, but unlike in a transmission typecombustion engine, shifting is not needed for electric motors.

Wheel hub motors are common on electric bikes and electric scooters in some parts of the globe, especially Asia.

Fig 4: Hub motor

IV. REGULATED POWER SUPPLY

Power supply is a supply of electric power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a powersupply unit or PSU. The term is generally applied to electrical energy supplies, less often to mechanical ones, and even lesser to others. A power supply might include a power distribution system as well as primary or secondary sources of energy such as

- Conversion of one form of electrical power to another desired form and voltage, typically involving conversion of AC line voltage to a well-regulated lower-voltage DC for electronic devices. Low voltage, low power DC power supplying units are commonly integrated with the devices they supply, like computers and household electronics.
- Batteries.
- Chemical fuel cells and few other forms of energy storage systems.
- Solar power.
- Generators or alternators.

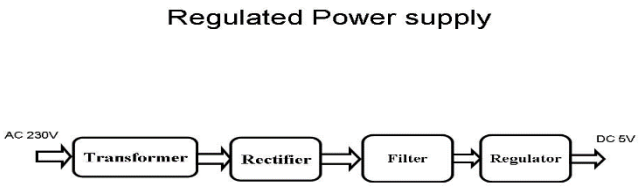


Fig 5: Block Diagram of Regulated Power Supply

V. LED INDICATORS

A light-emitting diode (LED) is a semiconductor light source. LED's are used as indicator lamps in different devices, and are increasingly used for emitting light. Initially introduced as a practical electronic component in 1962, early LED's emitted red light with low-intensity, but recent versions are available across all the wavelengths, with high brightness.

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a very simple and a strong structure. The semiconductormaterial emitting light is what determines the color of the LED. The LED is based on the semiconductor diode.

When a diode is forward biased (switched on), electrons are capable of recombining with holes inside the device, releasing energy in the form of small units of light called photons. This effect is known as electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm^2), and integrated optical components can be used to shape its radiation pattern and assist in reflection. LED's possess many advantages over incandescent light sources including lower consumption of energy, longer lifetime, increased robustness, smaller size, faster switching, and greater durability and higher reliability. However, they are very expensive and require more precise current and heat management than traditional light sources. Present LED products for general lighting are more expensive to buy than fluorescent lamp sources of comparable output. They also enjoy use in applications as vast as replacements for traditional light sources in automotive lighting (particularly indicators) and in traffic signals. The small size of LED's has allowed new text and video displays and sensors to be developed, while their comparative higher switching rates are useful in advanced communications technology.

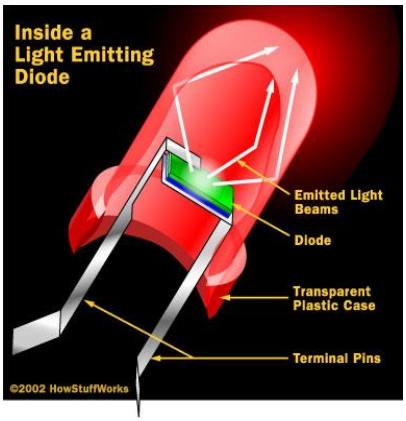


Fig 6: LED Indicators

VI. DESIGN CALCULATIONS

Solar Panel Specifications

Voltage: 12V

Current: 20A

Power (P) = Voltage (V)*Current (I)

P= 12*20

= 480W

No. of Cells in a panel = 39

Total number of panels = 4

Hub Motor Specifications

Voltage: 48V

Power: 350W

Weight: 4.6 Kgs

Motor Diameter: 0.148m

Motor Shaft Diameter: 0.214m

Maximum speed (rpm): 300rpm

Torque Calculations

Angular Velocity ( ) = (2*∏*N)/60 rad/sec

N= Maximum speed of motor in rpm

Power (P) = Torque (T) * Angular Velocity ( )

= (2*∏*300)/60

= 31.4 rad/sec

P = T *

350 = T * 31.4

T = 350/31.4

=11.4 Nm

Speed Vs Velocity Calculations

Velocity in km/h (V) = (2 * ∏ * r * N* 60)/1000

V = (2 * ∏ * 0.74 * N * 60)/1000

r = Radius of Motor Shaft

= 148/ (2*1000) m = 0.74 m

N = Speed of motor in rpm

Values of N = 50, 100, 150, 200, 250, 300 rpm

(i) V = (2 * ∏ * 0.74 * 50 * 60)/1000
= 13.9416 km/h

(ii) V = (2 * ∏ * 0.74 * 100 * 60)/1000
= 27.8832 km/h

(iii) V = (2 * ∏ * 0.74 * 150 * 60)/1000
= 41.8248 km/h

(iv) V = (2 * ∏ * 0.74 * 200 * 60)/1000
= 55.7664 km/h

(v) V = (2 * ∏ * 0.74 * 250 * 60)/1000
= 69.7080 km/h

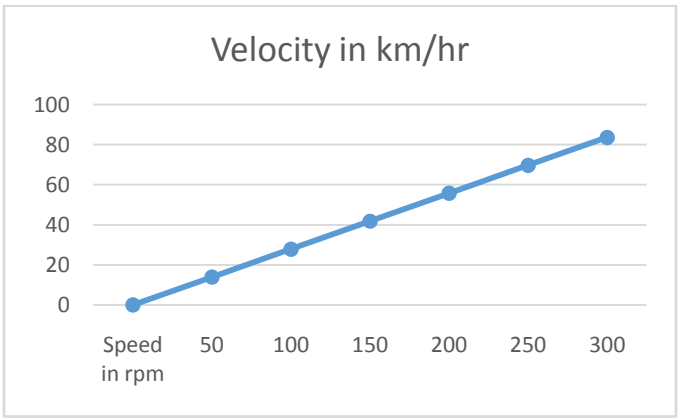
(vi) V = (2 * ∏ * 0.74 * 300 * 60)/1000
= 83.6496 km/h

Readings

Speed in rpm	Velocity in km/h
50	**13.9416**
100	**27.8832**
150	**41.8248**
200	**55.7664**
250	**69.7080**
300	**83.6496**

Graph

Speed Vs Velocity



VII. ADVATAGES AND DISADVATAGES

Advantages

1. Conservation of Non Renewable energy sources.
2. Maximum output can be obtained.
3. It does not cause any environmental pollution like the fossil fuels and nuclear power.
4. Solar cells last a longer time and have low running costs
5. Low power consumption.
6. Conservation of energy.
7. Utilization of free available source of energy from sun
8. Storage of energy into rechargeable battery.
9. Stored energy is used for running hub motor.
10. High efficiency can be achieved using inverter.
11. The electricity generated by the solar cell panel is stored during the day with the help of storage batteries which give us only DC i.e, Direct Current. But in order to operate our devices we need alternating current. Therefore we need to initiate the conversion from convert before using any appliance using inverter.

Disadvantages

1. Periodic Monitoring and Maintenance is required.
2. A drastic environmental change cannot be tolerated by the equipment.
3. The entire process of manufacture is still very expensive as silver is used for interconnection of these cells in the solar panel, which is a very expensive metal.
4. A practical problem linked with the use of solar cell panels is regarding the storage of electricity general by them.
5. The conversion of DC to AC uses inverter before using any appliance and thus it increases the cost of such solar panels as the sources of electricity.

VIII. FUTURE SCOPE

Our project "Solar Powered E-Scooter" is mainly intended to fabricate a scooter which runs with renewable energy i.e., the solar energy.

In this project we are using solar panel for charging a Lead Acid Battery (12V, 1.2 Amp hrs), a Peltier thermoelectric device which when connected to battery generates cooling effect on one side and heat is dissipated on other side through heat sink, a cooling fan is used for dissipation of heat from the heat sink. A regulator 7803 is used to drive the internal cooling fan and LED.

The temperature sensor LM35 senses the temperature and converts it into an electrical signal, which is then applied to the micro controller. The sensed values of the temperature are displayed on the 16x2-line LCD. The range of temperatures of the sensor is 1^0C to 255^0C.

This project uses regulated 5V; 500mA power supply. A 7805 tri-terminal voltage regulator is used for voltage regulation. And also, a bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

IX. CONCLUSION

Solar energy, a renewable source of energy is an upcoming form, which if properly used, can give rise to tremendous energy which can further be used in different forms. Research is still in progress on applications like solar powered automobiles, solar powered steam turbines, etc. A solar electric scooter, is a basic type of automobile which can run both on solar power as well as electricity. With an unhealthy hike in the prices of petrol and diesel, an automobile running on solar power can create a trend. This kind of a scooter is user friendly. It is very simple to use and manage. It comes at an affordable cost and the per unit electricity consumption is very less. It can be used even during the times when there is no sunlight. Because, the sun's energy trapped by the solar panel can be efficiently converted in electrical energy and stored in a battery. The importance of these kinds of applications is gradually increasing with the diminishing non renewable energy sources like fossil fuels and the like.

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