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Analytical Results of Energy harvesting and Recycling System

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Abstract: Energy harvesting can be described as a process of capturing and amassing by product energy when it is readily available and can be converted into usable electrical energy. Energy harvesting is of great importance for both low-voltage and low-power applications in a wide range of portable or mobile markets such as consumer devices, medical equipment, transportation, industrial controls and military. As Energy is widely used for domestic as well as industrial work. There are many sources of generating energy which will get exhausted soon. So, there is an urgent need to search for the alternatives for generating energy and their analytical results. Solar panels are widely used these days as an alternative of generating energy from sun but there are several other devices (Windmill, Water Turbine) are also available through which we can generate electrical energy. We can generate energy with the help of these devices and further energy generated from these devices will be stored and can be utilized for further use when needed according to their analytical results. This paper shows how much time the energy harvesting and recycling system needs to charge a Battery.

Keywords: Solar panel, Windmill, Water Turbine, DC Motor.

I. INTRODUCTION

India is a rapidly growing economy which needs energy to meet its growth objectives in a sustainable manner. The Indian economy faces significant challenges in terms of meeting its energy needs in the coming decade. The increasing energy requirements coupled with a slower than expected increase in domestic fuel production has meant that the extent of imports in energy mix is growing rapidly. India is among the top five Green-house-gas (GHG) emitters globally. Solar energy is freely available and can be used extensively as per our requirement. In order to use this solar energy, we make use of solar panels to convert this solar energy into electrical energy to charge a battery (Direct current electricity is what solar panels produce and what batteries hold in storage). Solar panels absorb the photons and in doing so initiate an electric current. The resulting energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their atomic orbits and released into the electric field generated by the solar cells which then pull these free electrons into a directional current.

Wind is another very useful and easily available resource on earth which can be utilized by making use of windmill. The amount of energy in the wind speed varies with cube of wind speed, in other words if the wind speed doubles there is eight times more energy in the wind. As larger the swept area (the size of the area through which rotor spins) the more power the turbine can capture from wind. [1]

Water turbine converts the potential flow energy contained in water into mechanical energy; this mechanical energy is subsequently converted into electrical energy in a motor. The gear units for water turbines gear up the low turbine speed into a very high motor speed. They also convert the torque that is output by the turbine and transmit it to the motor. The extreme transmission ratio and the high-speed result in particularly high

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loads on the rolling bearings. FLENDER gear units are therefore equipped with bearings of the highest quality in order to reduce friction losses to a minimum. [1]

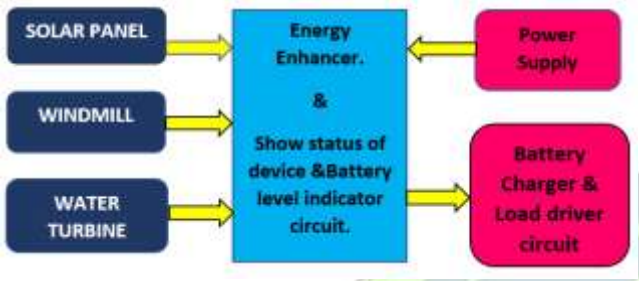

Fig 1: Block Diagram

Components Used:

Solar Panel
Windmill
Water Turbine
Battery level indicator
Battery charger circuit
DC-DC booster circuit

As shown in the above Block diagram (Fig 1) the main component of our project is Solar Panel, Windmill and Turbine. A Solar Panel works for allowing photons, or particles of light, to knock electrons free atoms, generating a flow of electricity as it comprises many, smaller units called photovoltaic cells. The energy obtained from sun (Solar energy) acts a source of energy and is converted into electricity with the help of solar panels. Moreover, another renewable source of energy that is being utilized is by making use of wind with the help of windmill (Wind Energy). The energy in the wind turns the blades around the rotor, the rotor is connected to the main shaft, which spins a motor to create electricity. A water Turbine converts the kinetic energy of falling water into mechanical energy. As water pushes a series of blades mounted on a shaft, which rotates the shaft connected to a generator. The motor, in turn, converts the mechanical energy to electrical energy. Energy generated from water turbine also contributes to the total energy generation. All these four systems together will make a linear system such that if one system fails the whole system will not stop. All the energy generated by the individual devices is given to the circuit. The circuit channelizes this energy and increase the efficiency by adding all the energy coming from individual devices. This Circuit then passes the energy to battery charging circuit to charge the battery, when all the devices are functioning simultaneously the rate of charging takes place at faster rate, thereby reducing the charging time of battery. Charging of battery is done by PWM method. Circuit also indicate the status of the individual devices connected to it and also helps us to determine the battery level using LED lights.

A. Solar Panel:

Solar panels collect clean renewable energy in the form of sunlight and convert that light into electricity which can then be used to provide power for electrical loads. Solar panels are comprised of several individual solar cells which are themselves composed of layers of silicon, phosphorous (which provides the negative charge), and boron (which provides the positive charge). Solar panels absorb the photons and in doing so initiate an electric current. The resulting energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their atomic orbits and released into the electric field generated by the solar cells which then pull these free electrons into a directional current. This entire process is known as the Photovoltaic Effect. An average home has more than enough roof area for the necessary number of solar panels to produce enough solar electricity to supply all of its power needs excess electricity generated goes onto the main power grid, paying off in electricity use at night. [4]

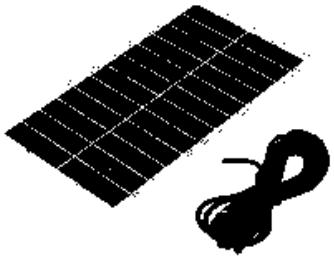

Fig 2: Solar Panel

B. Windmill:

A windmill is a type of working engine. It converts the wind's energy into rotational energy. To do this it uses vanes

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called sails or blades. Wind power converts the kinetic energy in wind to generate electricity or mechanical power. The electricity generated by harnessing the wind's mechanical energy must go through a transformer in order increase its voltage and make it successfully transfer across long distances. Power stations and fuse boxes receive the current and then transform it to a lower voltage that can be safely used by business and homes. This is done by using a large wind turbine usually consisting of propellers; the turbine can be connected to a generator to generate electricity, or the wind used as mechanical power to perform tasks such as pumping water or grinding grain. As the wind passes the turbines it moves the blades, which spins the shaft. The energy made by windmills can be used in many ways. These include grinding grain or spices, pumping water and sawing wood. Modern wind power machines are used to create electricity. These are called wind turbines or wind mills. [7]

Fig 4: Vertical Windmill

C. Water Turbine:

Water turbines represent a well-developed technology with minimal environmental risks (e.g., from leakage). Water from the surrounding sea provides an abundant supply of working fluid. In addition, the various designs offer some control over the volume of water flow; so that the device can cope with the variations in wave power levels and so enable relatively conventional electrical generators to be used. Water turbines are mainly used in power plants to generate electrical energy. To this end, river barrages or dams use the gravitational potential energy of the dammed water, also known as pressure energy. One special application is the use in pumped storage power plants. In times of low electricity demand an elevated storage reservoir is filled with water by means of electrically driven pumps. When electricity demand is higher, the reservoir is drained and additional electricity generated by water turbines. Water turbines are turbomachines. They convert the potential energy of the water into mechanical work. The gravitational potential energy is first converted into kinetic energy. The flowing water is accelerated to as high a speed as possible in a distributor or a nozzle. The momentum of the fluid is made usable as peripheral force by deflection in a rotor.[1]

Fig 5: Water Turbine

II. WORKING

The energy obtained from sun (Solar Energy) acts a source of energy and it is converted into electricity by solar panels. Moreover, another renewable source of energy that is being utilized is the wind energy with the help of windmill (vertical windmill). Energy generated from Water turbine also contributes to the total energy generated. All the energy generated by individual devices is given to the circuit and the circuit channelizes the energy by adding all the energy coming from individual devices, thereby increasing the efficiency of device. This circuit (Linear system) is connected to the indicator circuit which will show which devices are ON and which are OFF. Thus, circuit then passes the energy to battery charging circuit in order to provide charge to the battery. When all the devices are functioning simultaneously the charging of battery takes place in faster pace, thus reducing the charging time of battery.

III. CONCLUSION

In this study, we have seen the Analytical results for energy harvesting and recycling system. We have also used solar panels, windmill and water turbine to produce

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considerable amount of energy, in order to charge the battery with the help of a battery charger circuit. This energy stored in the battery can be used for operating CFL bulbs, LED bulbs and DC fans.

S. no.	Device Name	Outp--ut Voltage(V)	Output current(A)	Battery Charger ckt. Output voltage(V)	Battery charging time calc. [T=AH/A]	Charging Time (Hours)
1.	Solar Panel(25W)	20 to 22	0.8 to 1	13.5	T=7AH/ (0.8 or1A)	7 to 9
2.	Windmill	15 to 18	0.1 to 0.5	13.5	T=7AH/ (0.1 to 0.5)	14 to 35
3.	Water Turbine	15 to 18	0.1 to 0.5	13.5	T=7AH/ (0.1 to 0.5)	14 to 35
4.	Whole System	15 to 18	1.5 to 2	13.5	T=7AH/ (1.5 or 2A)	4 to 5

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