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Amelioration of Renewable Sources of Energy for Battery Charging

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Abstract: Power has become the very fundamental element behind the well being of all citizens in the world. The horrendous outcomes of power shortage are beyond any imagination. The necessity of discovering new aids to satisfy the human power needs is of prime significance. It's high time to think of using hybrid systems rather than depending on a single system. Here we are proposing an idea of utilizing both solar and wind energy in collaboration to bring out an excellent hybrid power source. For this we will be employing a normal solar panel and a different wind power generation method. The solar energy is available most of the day time where as we might not be getting the sufficient wind to generate adequate amount of power. To overcome this obvious issue we are presenting a power generation method that makes use of the breeze to generate energy. Ensuring a constant and stable output of energy is really important as the fluctuations in power may result in a complete loss of power without use to any. For this the Maximum Power Point Tracking controller is used. The controller will be burned with Constant voltage algorithm that makes sure that the performance level of Maximum Power Point Tracking controller is efficient and satisfactory. Thus the MPPT controller rules out the chances for any variations in the output stage. The auxiliary power storage serves as a backup if the output voltage is less than the set point value in the algorithm. The implementation of MPPT controller can be investigated using MATLAB.

Keywords: Solar & Wind Energy, Hybrid Power Generation System, Maximum Power Point Tracking (MPPT), Perturb & Observe (P&O), Auxiliary Power Storage

I. INTRODUCTION

Power demand is ever increasing all over the world. Non-renewable energy sources as coal, petroleum, natural gases and nuclear etc. are used for generation of electrical power. Electricity generation cost and investment become great issue. Renewable sources of energy as solar and winds are more popular and are natural resources available abundantly. The hybrid energy system for power generation focuses in fulfilling the increased demand and usage of power. The variation is always observed with solar and wind energy sources with reference to place, time, and season. Solar energy and energy from breeze are combined to form a solar-breeze hybrid power generation system, using both of these in combination will reduce this problem mostly. It is required to get uniform and constant voltage with maximum power at output. This paper recommends optimization method of generation of power using solar-breeze hybrid energy. The power generated by the hybrid generation system will be fairly enough for basic power necessities. Portability is an additional advantage of this system. It is neither big nor too bulky that affects its portability. An application of the battery that is being charged with this system can be integrated along with other parts.

II. HYBRID POWER GENERATION SYSTEM

This hybrid system mainly consists of 3 stages:
A. Power generation stage
B. Converter/controller stage
C. Output stage

A. Power Generation Stage

In this system, the power is mainly generated using breeze energy, solar energy or combination of both.

1) Photovoltaic Solar power: Solar panels acts as medium to convert solar energy into electrical energy. The solar panels can convert the energy directly or heat the water with the induced energy. Photovoltaic cells, are made up from the semiconductor structures. In PV cells, Sun rays are absorbed and electrons are emitted from the atoms which

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activates current and its output is related to ambient temperature and solar radiation. Some readily available solar panels like AcuTech SOLAR, SOLAR PHOTOVOLTAIC 10W MODULE, AGP12010 (Model Number).These produce output whose maximum output power is 10W. Solar panel is under Standard Test Condition (STC) at temperature 25° C and irradiance value of 1000W/m^2[6].

2) Breeze Energy: Breeze energy is a part of renewable system. They are used as an alternate to wind turbines which converts kinetic energy of wind into mechanical energy for generator, which converts mechanical energy into electricity. Wind turbines need a threshold velocity of wind below which power cannot be generated[7]. Breeze power generator has a coil and strong magnet arrangement. It includes a light-weight wing attached to a pivoted bearing oscillates even for a small velocity of wind. This pivoted point is connected to centre tapped magnets which is oscillated between a pair of coils. The nano-sized magnets on both ends move to and fro through the coil which will cut the magnetic flux and thus induces a current in the coil which is the required output. In order to maintain continuous oscillation of the magnets, two permanent magnets with same polarity are placed to provide repelling action. The number of coils can be increased if higher voltage is required. The set up is shown in figure 1.

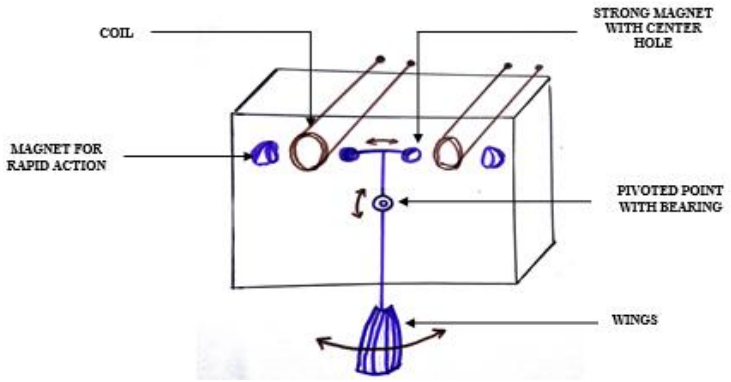

Figure 1: Coil and strong magnet arrangement

3) Solar-Breeze Hybrid energy system: Hybrid power system combines solar and breeze energy. It is the combination of Photovoltaic(PV) array and coil & strong magnet arrangement. Hybrid power generation systems have several advantages over stand-alone systems. One of the main advantage is that it can minimize the intermittency problem of renewable systems. Here solar and breeze power systems are added parallel so that they can work individually or together. The block diagram of the hybrid model is shown in figure 2.

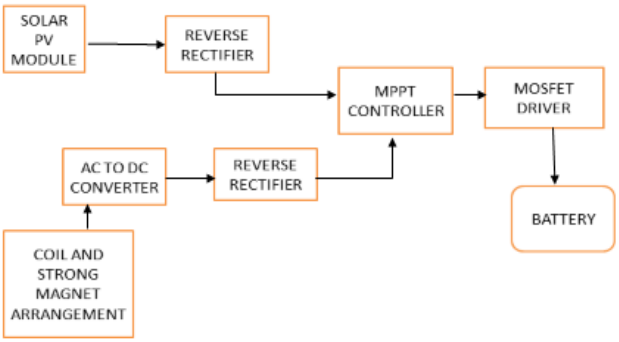

Figure 2: Hybrid system

B. Conversion/Controller stage

The inputs to the system are solar and breeze energy. PV cells directly supplies DC voltage, while the breeze energy system gives AC as the output. This AC is converted to DC voltage using AC to DC converter. Reverse rectifier is used as reverse voltage protection at output of 2 energy sources.[4] The combined output is given to next controller stage. In this stage MICROCHIP manufactured PIC18F452 controller is used which controls the input voltage and provides constant output voltage. At maximum power (P_{max}) voltage is displayed on the LCD display. MPPT algorithm is used in the microchip. Constant voltage method of MPPT is utilised[6].

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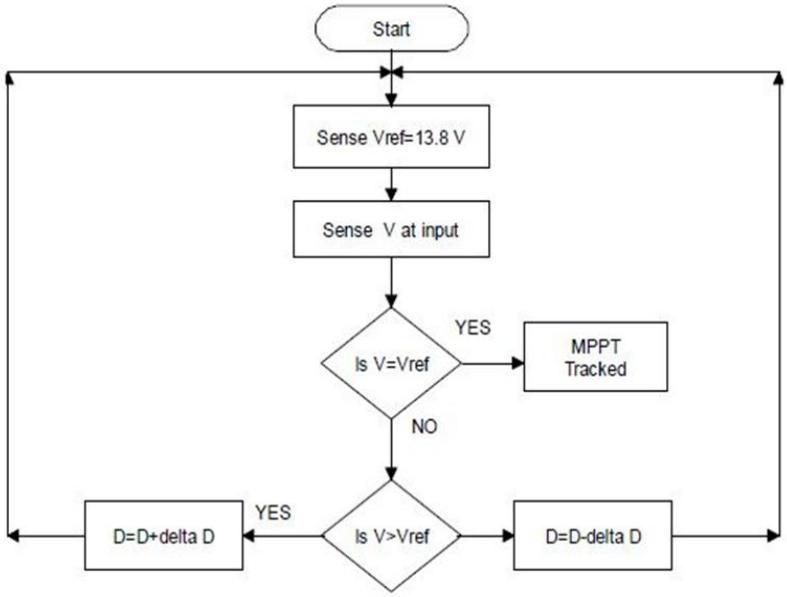

Figure 3: Flowchart of Constant Voltage Method

1) Maximum Power Point Tracking (MPPT)
Since renewable energy sources are used at the input side there will be non-uniform amount of power generated in real time. In order to avoid this uncertainty at output side, a special method is used to fix the operating point. This method, Maximum Power Point Tracking (MPPT) ,is commonly used with wind and PV system to maximise power extraction under all conditions[2].

2) Algorithm for MPPT
Controllers can follow several strategies to optimise the power output of an array. MPPT has different algorithms like Perturb & Observe(commonly called as Hill climbing method)[2], Incremental conductance method, current sweep method, optimum tip speed ratio, power signal feedback method etc.[1] Constant voltage method is utilised here. The flow chart of constant voltage method for MPPT is shown in figure 3.

3) Constant Voltage Method
This method, also known as Open voltage method, is the simplest MPPT controller algorithm and has a quick response. In this method, the controller regulates the PV module voltage and operates it close to MPP, by matching the hybrid module output voltage to a constant reference voltage (V_{ref}). The value of V_{ref} is equal to the measured module output voltage at Standard Test Conditions (STC) or set to a fixed calculated value[6].

C. Output stage
The output from the controller will be at constant voltage irrespective of any input voltage to MOSFET driver circuitry. At output side MOSFET driver circuitry give the voltage to charge the battery.

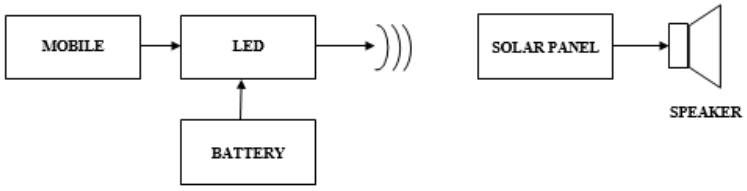

Figure 4: Li-Fi block diagram

It consists of 2 storage systems – main and auxiliary battery storage which has higher energy yield as compared to conventional energy system[3]. The output stage includes a Li-Fi system integrated with the hybrid power generator. The connection will be in such a way that the battery we charge using hybrid power generation technique will be used as the source of power for LED in the Li-Fi system[5]. The implementation can be done in 2ways: one way is to charge

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the battery at one time and once it is charged then unplug and use it as the input source and another way is to use a battery that can charge and discharge. The second choice is more preferred because no need to unplug the battery for it to use as the input for the secondary Li-Fi setup. The set is as shown in figure 4.

III. CONCLUSION

In this paper, a hybrid solar-breeze energy system in combination with Li-Fi and controller has been presented. It has the following advantages : 1)maximum power from the solar and breeze can be delivered to charge the load and is utilized by Li-Fi system, 2) good stability of the rectifier output voltage, 3)good speed of response to the change in wind speed, 4)power can be generated even for small velocities of wind. For generating power from breeze, coil and strong magnet arrangement is used which maintains constant oscillations even for small velocities. The constant voltage method is adopted to realize the MPPT algorithm for the PV array and the breeze energy. This algorithm is a simple (and inexpensive) method to continuously track the MPP of the hybrid system as the weather conditions vary. The Li-Fi system is integrated to the hybrid system at the output side. Future work includes finding the best material for the wing and analyzing the system for different loads. This system can be used for both domestic and industry applications.

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