Hybrid Power Generation Using Non-Conventional Energy Sources

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Abstract - In today's technology driven world electricity is one of the foremost thing in our day to day life. Due to the increase in demand of the electricity we are facing power cut problems; this might increase in the near future. In India 65% of the electricity is produced by conventional sources of energy. To compensate this power demand we need to shift from conventional to non-conventional source of energy to produce electricity. The electricity produced by non-conventional sources of energy is less than conventional, but conventional energy do not have any effect on the environment. Hybrid power generation system is basically an integration of solar panel, wind turbine, piezoelectric material to generate power and store the generated power in batteries. Here three sources of energy is implemented to provide uninterrupted supply during bad weather conditions. This project can be used to power up street lights on roadways and domestic houses.

Keywords— Energy; Hybrid power generation; Solar panel; Solar tracking; Microcontroller

I. INTRODUCTION

Nowadays we require electricity for operating almost all the appliances we use in our daily life. With increase in population and advancement of technology, electricity consumption also increases exponentially. In order to meet the demands of the growing population we need to increase the production of electricity. Now there are two methods for generating electricity first by using conventional energy source and second by using non-conventional energy source. The disadvantage of using conventional resources is that their usage causes pollution due to the production of various pollutants like ash in case of a coal power plant, smoke in case of diesel power plant, radioactive material in case of nuclear power plant. This in turn increases the concern for global warming. So we need to find some other methods to produce electricity. The best possible way is by using non-conventional sources of energy. Out of all the possible options available in non-conventional sources of energy, we make use of solar, wind and piezoelectric material. Solar energy is present throughout the day but sun intensity levels vary due to bad weather conditions. Similarly electricity produced due to piezoelectric material are uncertain in certain areas, but wind energy is almost available for 24hrs. However by combining these three sources, the system power transfer efficiency and reliability can be improved significantly. When a source is insufficient, other energy sources compensate for the difference.

Piezoelectric material is integrated and placed beneath the footpath. Due to mechanical stress produced by the vehicles and people walking on footpaths, electric energy is produced which is then stored in battery. Solar tracking method is used to get maximum energy with little use of solar panel; here two LDR sensors are used to rotate the solar panel depending upon the intensity of light detected by the LDR. Wind turbine is placed on two way roads. Opposite motion of vehicles induces a rotational force of turbine, which in turn induces a electric power. Electric energy produced by this method is stored in battery to provide uninterrupted power supply. This battery is then discharged to power up street lights and domestic houses.
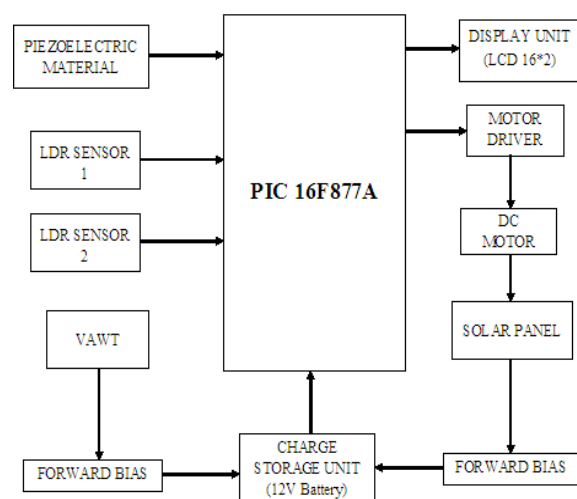
II. BLOCK DIAGRAM

Fig 1.   Block Diagram

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316

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The above proposed system uses an efficient way of harvesting energy. The brief introduction of the modules used in this project is discussed below

A. Piezoelectric Plates

Harvesting of piezoelectric energy is based upon the piezoelectric effect The essence of the piezoelectric effect works as follows: by applying a mechanical stress to a crystal, one can generate a voltage or potential energy difference, and thus a current. Piezoelectric generator principle states that the conversion chain starts from vibration for which a mechanical energy source is required. The vibrations are converted into electricity via piezoelectric element. Piezoelectric generators work due to the piezoelectric effect. This is the ability of certain materials to create electrical potential when responding to mechanical changes. To make it simpler, we can say that when compressed or expanded or while shape changes a piezoelectric material will give output as some voltage.

Here we use ceramic piezoelectric plates, these plates are connected in series to obtain maximum output. The output voltage generated from the piezoelectric plates is given to the battery storage.

B. Solar Panel

A solar cell is used to convert solar energy into electric energy, it is also known as photovoltaic cell. Sometimes the term solar cell is reserved for devices intended specifically to capture energy from sunlight, while the term photovoltaic cell is used when the source is unspecified. It is a p-n junction diode which consists of two different layers of a semi-conductor material called as n and p region, n region is heavily doped and is thin while p region is lightly doped and is thick. The radiation falling on the surface of p-n junction diode can pass through the n side. Most of the depletion region is contained in the p region which is lightly doped. The extent to which the n region can be penetrated is decided by the wavelength of the falling radiation. Electron–hole pairs are generated in the n and p region, due to the difference in potential the electrons move to the n region and holes towards the p region. The current starts flowing, when an external load is connected to the terminals of the n and p regions. Assemblies of cells are used to make solar panel, solar modules, or photovoltaic arrays. Photovoltaic is the field of technology and research related to the application of solar cells for solar energy. Solar cells can also be applied to other electronics devices to make it self power sustainable in the sun.

a) Solar Tracking

The main concept of this project is to get maximum energy with little use of solar panel. This model has two ldr sensors, motor driver and dc motor. In solar tracking system two ldr's are used. When the intensity of the light incident on ldr1 is higher than the intensity of incident light on ldr2, solar panel is rotated by 70 degree. When the intensity of light incident of ldr2 is higher than ldr1 solar panel is again rotated by 70 degree. This method tracks the sun depending on the intensity of incident sun light. DC motors are used to rotate the solar panel.

C. Vertical Axis Wind Turbine

Wind is a renewable source of energy. A wind turbine is used to convert the kinetic energy of the wind into electric. The wind turbine are of two types depending upon the rotating axis of the blades, first is vertical axis wind turbine and horizontal axis wind turbine. The output of the turbine depends on the speed of the wind. The power generated by the turbine is fluctuating. In order to obtain continuous supply of power first the electricity is stored in a battery unit and then it is transferred to the load.

Here we make use of vertical axis wind turbine. The VAWT are placed on road dividers on highways. As the wind is forced by the passing vehicles, the turbine rotates and generates electricity. This model can also be placed on rooftops to generate power from environmental winds.

D. PIC168F877A Microcontroller

PIC16F877A microcontrollers are manufactured by microchip. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, 2 Comparators, 8 channels of 10-bit Analog-to-Digital converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

PIC168F877A has 14.3 kb programmable flash memory, static RAM of 368 bytes and EEPROM of 256 bytes. It operates at 4v to 5.5v. PIC168F877A can operate at a maximum frequency of 20 MHz, with 20 ns instruction cycle. It has 15 interrupt sources and 35 single word instructions. PIC168F877A also has watchdog timer with on chip RC oscillator.

E. LCD Display

LCD (Liquid Crystal Display) screen is an electronic device that is a display module and finds a wide range of applications. A 16x2 LCD display is the most basic module and so it is very commonly used in many of the devices and circuits lately. A 16x2 LCD can display 16 characters per line and there are 2 such lines. In this LCD each and every character is displayed in 5x7 pixel matrix format. This LCD has two registers that are named as Command and Data. Data and command registers has different functions. The data register stores the data which needs to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. The command register stores the command instructions which are to be given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc.

F. Batteries

The batteries are used in order to store the electricity that is produced from wind and solar energy and piezoelectric plates. The capacity of battery may vary depending on the size of wind turbine or solar power plant and piezoelectric plates. Battery has low maintenance and charge leakage should also be low.

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317

Multiple batteries can be connected in series and parallel to increase or decrease the capacity of the battery, depending upon the output from the hybrid systems.

III. CONCLUSION

Developing hybrid systems is one of the most convenient and effective solution for producing electricity as compared to non-renewable energy resources. It is not only less costly but also it does not cause any harm to the environment. Another thing is that it can be used to generate electricity in hilly areas, where it is quite difficult to transmit electricity by conventional methods. Depending on the requirement its setup can be decided. All the people in this world should be motivated to use non-conventional resources to produce electricity in order to make them self-reliable to some extent. This system provides long life span and less maintenance.

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318