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HYBRID POWER GENERATION USING SOLAR PANEL AND PIEZOSENSOR

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Abstract - *Sun has been providing heat and light to the habitants of earth from centuries and its intensity is all the same. Photovoltaic cells can be used to collect the rays of sun and then to transform them into electricity. The method is although expensive but it is a onetime investment that can support life for decades. Solar electricity is a renewable source of energy that has been with use since the onset of life. Solar energy is captured through the solar panels and then it is converted to solar electricity using Photovoltaic (PV) technology. PV solar panels are longer lasting and efficiently convert energy from the sun to electricity. Piezoelectric Energy Harvesting is done by 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.*

Key Words: Solar Panel, Piezo Sensor, AVR microcontroller, Bridge rectifier, Hybrid electricity

1. INTRODUCTION

With increasing concern of global warming and the depletion of fossil fuel reserves, many are looking at sustainable energy solution to preserve the earth for the future generations. Other than hydro power, vibration and photovoltaic energy holds the most potential to meet our energy demands. The vibration energy is capable of providing large amounts of power but its presence is highly uncertain as it can be here one moment and gone in another. Similarly, solar energy is present throughout the day but the solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, birds, trees, etc. The common inherent drawbacks of vibration and photovoltaic systems are their intermittent natures that make them unreliable.

However, by combining these two intermittent sources and incorporating maximum power point tracking (MPPT) algorithm, the system's power transfer efficiency and reliability can be improved significantly. When a source is insufficient, the load demands some other energy sources to compensate for the difference. Several hybrid vibration power systems with MPPT control have been proposed and discussed in works.

Due to advancement in the field of technology in recent years, wireless data transmission techniques are commonly used in electronic devices. For powering them we rely upon power supply through wires charging, else power may be supplied from batteries. But while travelling for longer distances continuously we may not be able to obtain power supply for these devices to operate or to recharge their batteries. So in order to operate them continuously we need a power source that provides continuous energy to operate these devices.

The mechanical vibrations which are produced by the automobiles can be utilized as a source of energy for generating electrical energy that can be utilized by this electronic equipment to operate. These vibrations are produced by different vehicles around us which are going as a waste. Piezoelectric materials is used by this technique, where deformations done by the vibrations are directly converted into the electrical charge via piezoelectric effect and principle of electromagnetic induction between coil and magnetic field that produces Electromotive force (EMF) in the coil and so it provides displacement to the performance magnet by the vibrations. All the piezoelectric materials and magnets are used as the energy conversion devices for converting mechanical vibrations into electrical energy. In this context, we introduced two methods and considered its output performance provided input vibrations, by using piezoelectric materials such as piezoelectric for electromechanically conversion using Mass- spring system as medium of conversion of force from vibrations applied on piezoelectric materials and by using spring-magnet system where relative displacement of magnet with respect to coil, provided input vibrations generates Electromotive force in coil.

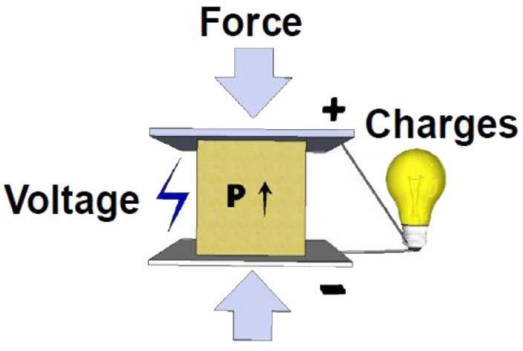

Fig.1

1.1 BLOCK DIAGRAM

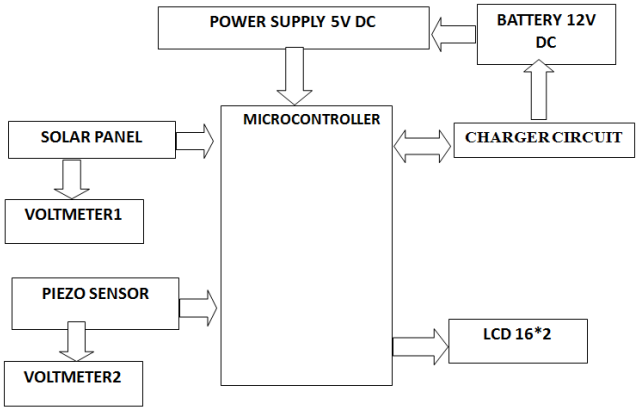

Fig.2

1.2 WORKING

1. In above diagram we can see that the battery is used to give 12V DC power supply which is required to drive all other components.
2. The 12V DC power supply needs to be converted into the 5VDc supply, because our microcontroller, LCD, voltmeter etc. drive on 5V DC supply.
3. Solar panel is used to take light energy from sun and converts that energy into the voltage form.
4. Piezo sensor converts force energy into the voltage.
5. So we getting output of solar panel and piezo sensor as voltage, by using voltmeter we find out exactly how much energy is actually being generated.
6. LCD 16*2 is used to display message from where is energy generating and LCD also display a message as we want.
7. The charger circuit is used to the charge the battery.

1.3 HARDWARE & SOFTWARE DESCRIPTION

A. Hardware Used:

1. AVR microcontroller
2. LCD 16*2
3. 12v battery
4. Bridge rectifier
5. Capacitor
6. SOLAR PANEL
7. PIEZO SENSOR
8. Voltmeter

12V Battery:-

All lead acid batteries have the same three fundamental components. These three fundamental components are dependent on the physical laws to provide a behavior that is relatively consistent from manufacturer to manufacturer depending on their choice. But depending upon the need battery manufacturers uses different technologies and construction techniques.

The three fundamental components are:

1) Anode – This is the also known as the negative electrode or terminal. It is made of lead.

2) **Cathode** – This is known as the positive electrode or terminal. It is made of lead dioxide.

3) **Electrolyte** – This is a mixture of sulfuric acid and water. If you have the type of lead acid battery known as a flooded cell, the electrolyte is the liquid that is sloshing around on the inside.

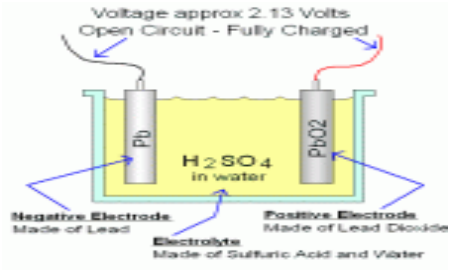

Fig.3

CONVERT DC TO DC Using Bridge Rectifier:-

Bridge rectifier convert 12V DC power is into 12V DC, but the required power is 5V DC; for this purpose, 12V DC power must be primarily converted into 12V DC power then it can be stepped down to the 5V DC. Bridge rectifier used for polarity protection.

Fig.4

AVR ATmega 16A Microcontroller:-

ATmega16A is a microcontroller of Atmel's Mega AVR family which has the quality that is occupies low power. It is an 8-bit high performance microcontroller based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. These instructions are orthogonal and also most of the instructions execute in one just machine cycle.

ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000; respectively.Atmega16 can work on a maximum frequency of 16MHZ. ATmega16 is a 40 pin MCU. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.

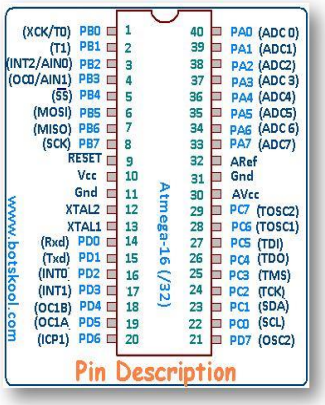

Fig.5

Solar Panel:-

Solar energy is produced by converting light (photons) into electrical propulsion known as the photovoltaic effect (PV). Contained within photon of light contains the number or rate of energy varies depending on the wavelength and spectrum of solar generated. When the photon is in violation or in contact with the solar panel, solar panels will absorb photons in some degree not all photons are absorbed by the solar panels because it depends on the type of semiconductor materials used to produce the solar panels.

At certain levels, Photon energy has the capacity to dissolve the bonding electrons from atoms to produce electricity. Quantity of the energy produce is difference between materials with other material in the production of solar cells. This energy level is known as band-gap energy which is measured in units of electron-volts. A material with band-gap energy between 1eV and 1.8 eV are the best material and have a high efficiency of energy production.

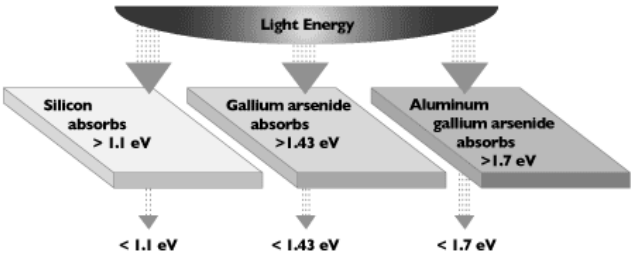

Fig.6

PIEZO-ELECTRIC Material:-

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. The electricity produced is then afterward formatted by a static converter before supplying the load (electrical device).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 changing shape a piezoelectric material will give output as some voltage.

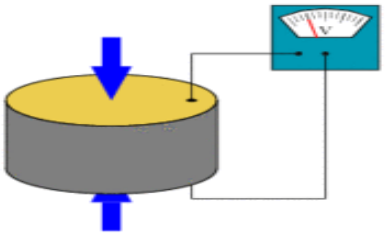

Fig.7

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. These modules are always preferred over seven segments and other multi segment LEDs (Light emitting diodes) display. Some of the main reasons for this are that LCDs are economical; easily programmable; have no limitation of displaying special & custom characters (unlike in seven segments), animations and much more to list.
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.

Pin Diagram:

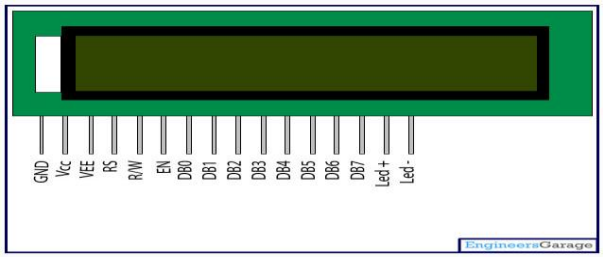

Fig.8

Pin Description:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Table 1

B. SOFTWARE USED:-

1. Code vision
2. proteus 8 professional.
3. Sinaprog

2. CONCLUSIONS

In this research paper, we have investigated and observed the feasibility of applying piezoelectricity for converting the mechanical vibrations of roadway to generate useful electricity. We have also investigated the practicability of employing solar concentrators to enhance the output power of the solar panel to a considerable level. We hope that our proposal towards an efficient way to electrify the streets of all the city corporations under the prevailing "Hybrid Power Generation Using Solar Panel and Pizeo sensor and Display on the LED Using "Microcontroller" project will help to more effectively implement the project within the budget and thereby reducing pressure on conventional power use and current generation.

3. FUTURE SCOPE

This paper comes up with an idea of using vibration and solar energy together for generating electricity for our future needs. Hybrid vibration and solar power generation system is one of its kind which is low maintenance and also economy to use. And this system is also very efficient. To get maximum efficiency this kind of systems should be installed in busy crowd places such as railway stations, malls, bus stops and busy footpaths, speed breaker, highway. In future we can also improve this system by making it dual sun tracking solar panels or if the area or geographical conditions allow we will also be able to add other power generation systems to increase efficiency in order to increase the output.
Solar power, a clean renewable resource with zero emission, has got tremendous potential of energy which can be harnessed using a variety of devices. With recent developments, solar energy systems are easily available for industrial and domestic use which has the advantage that it requires minimum maintenance. Solar energy could be made financially viable with government tax incentives and rebates. The solar generation system which has the capacity of 250 KWh units per month would cost around Rs. 5 Lacs, with present pricing and taxes. Most of the developed countries are switching over to solar energy as one of the prime renewable energy source. Lately, the architectural designs have the provision for photovoltaic cells and necessary circuitry while making building plans.

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