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Generation of Electricity from Sound and Light

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ABSTRACT: In this paper we have presented the photovoltaic solar panel's operation. The foremost way to increase the efficiency of a solar panel is to use a Maximum Power point Tracker (MPPT), a power electronic device that significantly increases the system efficiency. By using it the system operates at the Maximum Power Point (MPP) and produces its maximum power output. Thus, an MPPT maximizes the array efficiency, thereby reducing the overall system cost. In addition, we attempt to design the MPPT by using the algorithm of a selected MPPT method which is "Perturb and Observe" and implement it by using a DC-DC Converter. We have found various types of DC-DC converter. Among them we have selected the most suitable converter which is "BUCK" converter, for our design.

KEYWORDS: Solar, tracker, Solar Panel

I. INTRODUCTION

Solar energy is one of the most important renewable energy sources that have been gaining increased attention in recent years. Solar energy is plentiful; it has the greatest availability compared to other energy sources. The amount of energy supplied to the earth in one day by the sun is sufficient to power the total energy needs of the earth for one year. Solar energy is clean and free of emissions, since it does not produce pollutants or by-products harmful to nature. The conversion of solar energy into electrical energy has many application fields. Recently, research and development of low cost flat-panel solar panels, thin-film devices, concentrator systems, and many innovative concepts have increased. In the near future, the costs of small solar-power modular units and solar-power plants will be economically feasible for large-scale production and use of solar energy.

PV generation systems generally use a microcontroller based charge controller connected to a battery and the load. A charge controller is used to maintain the proper charging voltage on the batteries. As the input voltage from the solar array, the charge controller regulates the charge to the batteries preventing any overcharging. So a good, solid and reliable PV charge controller is a key component of any PV battery charging system to achieve systems maximum efficiency. Whereas microcontroller based designs are able to provide more intelligent control and thus increases the efficiency of the system. In this proposed system Maximum power point tracker battery charger is proposed for extracting maximum power from a photovoltaic panel to charge the battery.

The objective of this project was to design a Maximum Power Point Tracker (MPPT) to constantly calculate and maintain the maximum amount of power from a solar panel. By using a DC/DC converter and an arm lpc2148, our team was successfully able to create a system to reach this maximum power. The solar panel was modelled using a DC voltage source, which then was connected to the DC/DC converter. A buck DC/DC converter was used to step the voltage down. This was required to have the voltage be in the acceptable input range for the arm lpc2148. Using the arm lpc2148, a code was created for the Pulse Width Modulation (PWM), which determines the frequency of the PV source. The Perturb and Observe (P&O) method was used to calculate the maximum power the 'PV' source outputs, and the necessary duty cycle for the PWM. That information would then be relayed back to the PV source and adjust it accordingly, to maintain the PV source at the peak power. To test our design, the DC source was adjusted to various voltage inputs, and the maximum power was successfully calculated each time. This project was created using Matlab Simulink software and implemented using a breadboard then solderable board, an arm lpc2148, and a DC voltage source.

II. LITERATURE REVIEW

1. **Huynh D.C & et. all.** This paper proposes an advanced perturbation and observation (P&O) algorithm for tracking the maximum power point (MPP) of a solar PV panel. Solar PV cells have a non-linear V-I characteristic with a distinct MPP which depends on environmental factors such as temperature and irradiation. In order to continuously harvest maximum power from the solar PV panel, it always has to be operated at its MPP. The proposed P&O algorithm can reduce the main drawbacks commonly related to the P&O algorithm. This is achieved with determining the short-circuit current before each perturbation and observation stage. The obtained simulation results are compared with MPPs achieved using the conventional P&O algorithm under various atmospheric conditions. The results show that the advanced P&O algorithm is better than the conventional P&O algorithms for tracking MPPs of solar PV panels. Additionally, it is simple and can be easily implemented in digital signal processor (DSP).[1]
2. **Grzesaiik. W.** The work deals with a PV battery charge regulator assigned for advanced CdTe modules of output voltage much higher than the popular values of the order 12 or 24 V nominally. As at the same time most of the nominal PV autonomous installation voltages generally remain on the 12 or 24 V level because of convenience, technical tradition and battery features- this high DC module's voltage has to be transformed to a proper lower value by means of DC/DC inverter of possibly high efficiency. A new own developed 60/12 V charge controller solution is presented. This charge controller is equipped with a "step-down" inverter version furnished with modern MPP tracking technique. The choice of MPPT algorithm and its realization by means of microprocessor are explained and discussed as well as final test and measurement results. Very satisfactory exploitation results permit to estimate the solution as a valuable one for the new high voltage modules' market. [2]
3. **Petchjatuporn. P and et. all.** This paper presents the development of a maximum power point tracking algorithm using an artificial neural network for a solar power system. By applying a three layers neural network and some simple activation functions, the maximum power point of a solar array can be efficiently tracked. The tracking algorithm integrated with a solar-powered battery charging system has been successfully implemented on a low-cost PIC16F876 RISC-microcontroller without external sensor unit requirement. The experimental results with a commercial solar array show that the proposed algorithm outperforms the conventional controller in terms of tracking speed and mitigation of fluctuation output power in steady state operation. The overall system efficiency is well above 90%. [3]
4. **Longxi. Chang & et. all.** A fully integrated solar charger controller is presented in this paper. The charger has wide input voltage range about 10V to 28V for the solar-powered panel. The input loop regulation is used here as the MPPT protection. This charger also provides different kinds of battery voltages about 4V to 12V. The controller system uses just one error amplifier and no external compensation components is needed. Besides, this controller has 600 kHz PWM modulation and offers the over-current/overvoltage protection. Other components like band gap, reference generator, saw-tooth generator, register controller and driver circuits are all implemented in this circuit. This chip is fabricated in a 0.4- μ m 5V/40V 2P4M process. The power consumption of this full-integrated solar charger controller IC is about 10mA. [4]

III. SCOPE, METHODOLOGY AND PROPOSED WORK

- a. **Scope:** The proposed system is to present a novel cost effective and efficient microcontroller based MPPT system for solar photovoltaic system to ensure the maximum power point operation at all changing Environmental condition. The P&O MPPT algorithm is used to control the maximum transfer power from a PV panel. This algorithm is executed by a pic microcontroller using the PV voltage and current data to control the duty cycle of a pulse width modulation signal applied to a DC/DC converter.
- b. **Methodology: Block diagram for tracker unit**
 - The primary objective of this thesis is to build efficient solar charger that will recharge the battery properly with minimum loss with overcoming the voltage variation in solar panel.

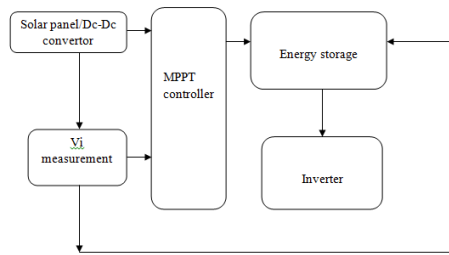


Figure no 1: Block diagram for tracker unit

Proposed work:

i] MCU: The MPPT control circuit is implemented in a microcontroller, that has 8bits analog-to-digital (A/D) converters and two four PWM mode signals. The boost converter is controlled by the microcontroller. It read the voltage and current of the solar panels through the A/D port of controller and calculates the output power. It also calculate power by reading the voltage and current of battery side in same way and send corresponding control signal to the boost converter and control the duty cycle of the converter by PWM signal through controller to accordingly increase, decrease or turn off the DC to DC converter. The pic is a perfect combination of performance, features, and low power consumption for this application. The control circuit compares the PV output power before and after a change in the duty ratio of the DC/DC converter control signal. It is expected that the MPP presents a constant oscillation inherent to the algorithm.

ii] DC-DC convertor: There are several topologies available for DC-DC converter. Among them buck converter is in an increasingly popular topology, particularly in battery powered applications, as level of the output voltage can be changed with respect to input voltage. The commonly used a converter in PV systems is a DC/DC power converter. It ensures, through a control action, the transfer of the maximum of electrical power to the load. The structure of the converter is determined according to the load to be supplied. In this article we focus on the step-up DC/DC converter (Boost converter). MPPT uses the same converter for a different purpose, such as regulating the input voltage at the Maximum power point and providing load matching for the maximum power transfer.

iii] Mppt: A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. Maximum power point tracking technique is used to improve the efficiency of the solar panel. According to Maximum Power Transfer technique, the output power of a circuit is maximum when the source impedance matches with the load impedance. In the source side a buck converter is connected to a solar panel in order to enhance the output voltage. By changing the duty cycle of the buck converter appropriately by PWM signal the source impedance is matched with that of the load impedance. There are various MPPT techniques are proposed. Among those methods, the perturb and observe (P&O) and incremental conductance (INC) methods are widely used although they have some problems such as the oscillation around MPP and confusion by rapidly changing atmospheric conditions.

In this proposed system perturb and observe MPPT algorithm is used. In this method the controller adjusts the voltage by a small amount from the array and measures power, if the power increases, further adjustments in the direction are tried until power no longer increases. This is called P&O method. Due to ease of implementation and cost effectiveness, it is the most commonly used MPPT method.

iv] Storage: storage device is 12v lead acid dry battery.

IV. BLOCK DIAGRAM

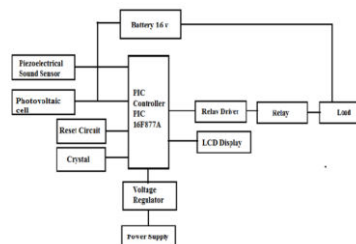


Figure no 2: Block Diagram

The following are the important elements in the block diagram:-

MICROCONTROLLER:-A microcontroller is a small computer on a single integrated circuit consisting internally of a relatively simple CPU, clock, timers, I/O ports, and memory. Microcontrollers are used in automatically controlled products and devices. Microcontrollers are designed for small or dedicated applications. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes.

CRYSTAL CIRCUIT: - This circuit gives the required clock pulses to the microcontroller to give it the sense of the reference time.

RESET CIRCUIT: - This circuit gives the microcontroller the starting pulse required to start the operation from the start. Unless this pulse is given, the microcontroller doesn't start functioning.

LCD: - Liquid Crystal Display which is commonly known as LCD is an Alphanumeric Display it means that it can display Alphabets, Numbers as well as special symbols thus LCD is a user friendly Display device which can be used for displaying various messages unlike seven segment display which can display only numbers and some of the alphabets.

RELAY: - Relay acts as a switch which is used to control the AC/DC supply. This relay can be used to turn ON the electrical appliances like Mobile, fan, tubes etc.

PIEZO ELECTRIC SOUND SENSOR: - These sensor converts sound energy into electrical.i.e means acts as transducer. The nature of the piezoelectric effect is closely related to the occurrence of electric dipole moments in solids. The behavior of piezoelectric elements as strain sensors. Strain is measured in terms of the charge generated by the element as a result of the direct piezoelectric effect.

PHOTOVOLATAIC CELL: - These cell converts light energy into electrical. By using photovoltaic materials to convert the radiant energy directly into electrical. Photovoltaic power has a number of advantages • It is noiseless and pollution free • It is renewable

BATTERY: - Batteries store energy being produced by given generating source and when this source is unavailable this energy can be used by loads. The inclusion of storage in any energy generating system will increase the availability of the energy.

RELAY DRIVER CIRCUIT: - Relays are components which allow a low-power circuit to switch a relatively high current on and off, or to control signals that must be electrically isolated from the controlling circuit itself.

V. HARDWARE SPECIFICATION

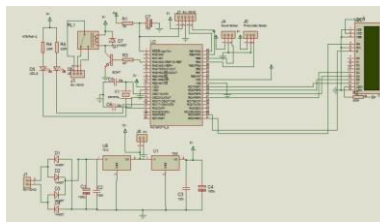


Figure no 3: Circuit Diagram

Hardware Specifications and Features: The following are the important elements in the circuit diagram:

PIC Microcontroller: - A microcontroller is a small computer on a single integrated circuit consisting internally of a relatively simple CPU, clock, timers, I/O ports, and memory. Microcontrollers are used in automatically controlled products and devices. Microcontrollers are designed for small or dedicated applications. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. The pulses coming as output from electricity meters on each increase in unit are applied to the microcontroller as input. Microcontroller reads the inputs & as soon as input pulse is received, it increases the count of units of electricity. Also, it reduces the unit prize amount from the balance amount. The count of units and the balance amount is displayed on LCD display. The updated values are now stored in EPROM.

Sound Sensor (Piezoelectric): Mechanical compression or tension on a poled piezoelectric ceramic element changes the dipole moment, creating a voltage. Compression along the direction of polarization or tension perpendicular to the direction of polarization generates voltage of the same polarity as the poling. The nature of the piezoelectric effect is closely related to the occurrence of electric dipole moments in solids. The behaviour of piezoelectric elements as strain sensors. Strain is measured in terms of the charge generated by the element as a result of the direct piezoelectric effect. Strain measurements from piezo ceramic (PZT) and piezofilm (PVDF) sensors are compared with strains from a

conventional foil strain gage and the advantages of each type of sensor are discussed along with their limitations. The sensors are surface bonded to a beam and are calibrated over a frequency range of Hz -kHz. Correction factors to account for transverse strain and shear lag effects due to the bond layer are analytically derived and experimentally validated. The effect of temperature on the output of PZT strain sensors is investigated. Additionally, design of signal conditioning electronics to collect the signals from the piezoelectric sensors is addressed. The superior performance of piezoelectric sensors compared to conventional strain gages in terms of sensitivity and signal to noise ratio is demonstrated.

PV Cell: Photovoltaic (PV) systems convert light energy directly into electricity. Commonly known as “solar cells.” A typical silicon PV cell is composed of a thin wafer consisting of an ultra-thin layer of phosphorus-doped (N-type) silicon on top of a thicker layer of boron-doped (P-type) silicon. An electrical field is created near the top surface of the cell where these two materials are in contact, called the P-N junction.

Power Supply: A power supply is an electronic circuit that supplies power to at least one electric load. Typically, it converts one type of electrical power to another. A power supply is an electronic circuit that converts an ac voltage to dc voltage. It is basically consisting of the following elements: transformer, rectifier, filter and regulator circuits. Power supply units (PSU) are used in computers, amateur radio transmitters and receivers and all other electronic equipment that use dc voltage as an input. Uninterruptible power supply is a must for computers which holds volatile data from time to time. This prevents corruption of data due to power failure and low voltage. A power supply is also known as a power supply unit, power brick or power adapter.

PROJECT SPECIFICATION:-

Microcontroller:-

- Current: 25mA sink/source per I/O
- Operating voltage: 2.0V to 5.5V
- Operating speed: DC – 20 MHz clock input
- DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory,
- Up to 368 x 8 bytes of Data Memory (RAM),
- Up to 256 x 8 bytes of EEPROM Data Memory
- Pinout compatible to other 28-pin or 40/44-pin PIC16CXXX and PIC16FXXX microcontrollers • 256 Bytes EEPROM data memory ICD

LCD Display: - Standard LCD module from LAMPDEX is used for the DISPLAY.

- 1) Display format CHARA. X LINE 16 x 2 mm.
- 2) Font matrix of W x H 5 x 8 mm.
- 3) Viewing area of W x H 64.0 x 14.0 mm.
- 4) PCB size W x H 80.0 x 36.0 mm.
- 5) Supply voltage of 5 V and current of 3 mA.

Battery: - Operating voltage:-16VDC Current Rating:-4.2Ahr, rechargeable

VI. SOFTWARE DESIGN

DESCRIPTION OF SOFTWARES USED:

MPLAB Software: - MPLAB is the proprietary freeware integrated development environment for the development of embedded application on PIC and dsPIC microcontrollers, and is developed by Microchip Technologies. MPLAB X is the latest edition of MPLAB, and is developed on the Net Beans platform. MPLAB and MPLAB X support project management, code editing, debugging and programming of Microchip 8 bit PIC and AVR microcontrollers, 16 bit PIC24 and dsPIC microcontrollers, as well as 32 bit SAM and PIC32 microcontrollers. MPLAB is designed to work with MPLAB certified devices such as the MPLAB ICD 3 and MPLAB REAL ICE, for programming and debugging PIC microcontroller using personal computers. PICKIT programmers are also supported by MPLAB. MPLAB X supports automatic code generation with the MPLAB code configurator and the MPLAB harmony configurator plugins.

PROTEUS Software: - The Proteus Design Suite is a proprietary software tool suite used primarily for automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. It was developed in Yorkshire, England by Lab Centre Electronics Ltd and is available in English, French, Spanish and Chinese languages. Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is included with all product configurations.

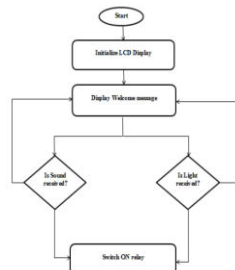


Figure no 4: Software design Flowchart

VII. RESULTS AND DISCUSSION

SIMULATION OF RELAY DRIVER CIRCUIT BY USING PROTUES 8 SOFTWARE:-

We can see the operation of relay driver and glow L1 needed 12V Supply. Before the input supply relay driver not in working condition.

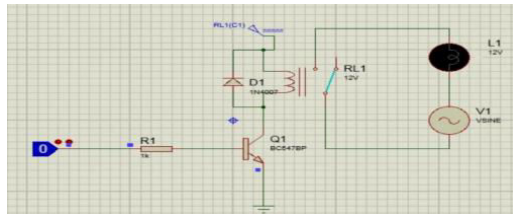


Figure no 5: Simulation of relay driver when it is off

When getting supply to transistor the relay driver circuit is on, and we can see the result to glow L1.

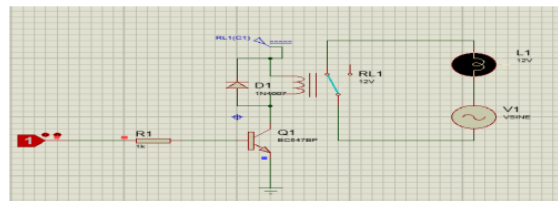


Figure no 6: Output simulation – relay driver on

SIMULATION OF LCD DISPLAY USING MICROCONTROLLER IN PROTUES 8 SOFTWARE:-

The name of project is generation of electrical energy is display on LCD using microcontroller input.

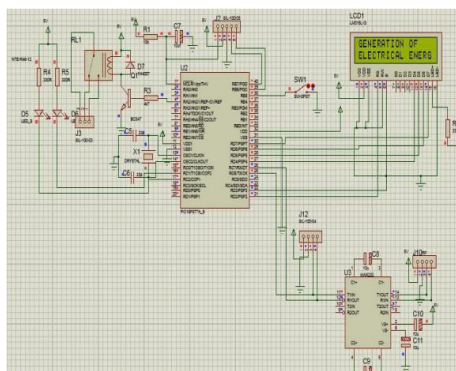


Figure no 7: Output - project name display

The sound input display on LCD using microcontroller input.

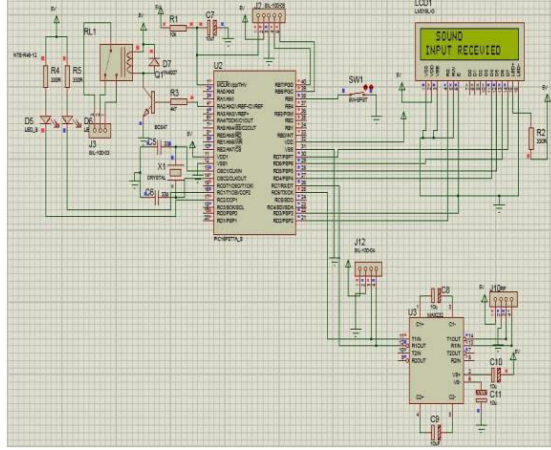


Figure no 8: Simulation Output - sound input display

VIII. IMPLEMENTATION AND TESTING

When the Microcontroller receives input from piezoelectric sensor or Photovoltaic sensor then it will display the name of sensor from which the Microcontroller is getting input pulse. We have connected LEDs and charging port at as the output devices. If sufficient energy is produced by the sensors then it will be detected by the Microcontroller and it sends a message on the LCD display.



Figure no 9: Model of generation of electricity from sound energy and Light energy

TESTING AND RESULTS: As shown in the table, pressure exerted on the piezoelectric plates formed according to input applied sound intensity. High mechanical pressure on piezoelectric plates gives more output in electrical form



Table No 1: Test and results

Sr.No.	Sound Output	Pressure Input
1.	115DB	11.2pa
2.	112DB	7.96pa
3.	109DB	5.64pa
4.	106DB	3.99pa
5.	103DB	2.83pa
6.	100DB	2.00pa
7.	97DB	1.42pa
8.	94DB	1.00pa
9.	91DB	0.71pa
10.	88DB	0.50pa
11.	85DB	0.36pa
12.	82DB	0.25pa

IX. ADVANTAGES AND DISADVANTAGES

Advantages

- Easy to convert renewable energy into electricity.
- User-Friendly.
- Sensors used have high sensitivity and are easy to handle.
- Low cost system, providing maximum automation.
- Low maintenance and low power consumption.
- The system is more compact compared to the existing ones, provides a userfriendly interface hence will have a greater acceptance by the technologically unskilled workers.
- No external source is needed for power generation

Disadvantages

- Continuous input is required to generate high power electrical signal.
- Sensors are costly.

X. CONCLUSION

- The sound energy is the unexplored source which has enormous potential to meet the future growing requirements of the electricity and serve as the eco-friendly and renewable source of energy.
- This technology is not practically usable up till now due to efficiency concerns but the present work on this field makes its future quiet promising.
- Phonons are the particles of sound that provide the mechanical energy as the output which could be utilized for conversion as per the laws of thermodynamics.
- The results show that as noise level increases, the corresponding voltage that was measured at the multi meter also increased. The results further show that there is a non- linear relation between sound energy and developed voltage. These results can be furthered using higher quality equipment.

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