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MODELING OF PHOTOVOLTAIC BASED SOLAR TRACKING SYSTEM USING RTC

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Abstract
Now a day's constant solar panels are used which do not move according to the direction of sun rays, so it receives only a limited sun light. To overcome this problem a sun tracking system is used which generate a high efficiency of power. When the intensity of light is decreasing, this system automatically changes its direction to get maximum intensity of light. The idea of this project is to convert solar energy into electrical energy using photovoltaic panel. But, the continuous change in the relative angle of the sun with reference to the earth reduces the watts delivered by solar panel. In this context, solar tracking system is the best alternative to increase the efficiency of the photovoltaic panel. Solar trackers move the payload towards the sun throughout the day. Solar energy is the energy generated by harnessing the power of the solar radiation. It is the cleanest source of energy which can pollute the climate the least. In this paper, the design and fabrication of smart solar tracking system for optimal power generation has been planned and implemented.
Keywords: LDR, Solar panel, RTC

1. INTRODUCTION

The extensive use of fossil fuels has resulted in the global problem of greenhouse emissions. Moreover, as the supplies of fossil fuels are depleted in the future, they will become increasingly expensive. Thus solar energy is becoming more important since it produces less pollution and the cost of fossil fuel energy is rising, while the cost of solar arrays is decreasing. In particular, small-capacity distributed power generation systems using solar energy may be widely used in residential applications in the near future.

The power conversion interface is important to grid-connected solar power generation systems because it converts the DC power generated by a solar cell array into AC power and feeds this AC power into the utility grid. An inverter is necessary in the power conversion interface to convert the DC power to AC power. Since the output voltage of a solar cell array is low, a DC-DC power converter is used in a small-capacity solar power generation system to boost the output voltage so it can match the DC bus voltage of the inverter. The power conversion efficiency of the power conversion interface is important to insure there is no waste of the energy generated by the solar cell array. The active devices and passive devices in the inverter produce a power loss. The power losses due to active devices include both conduction losses and switching losses. Conduction loss results from the use of active devices, while the switching loss is proportional to the voltage and the current changes for each switching and switching frequency. A filter inductor is used to process the switching harmonics of an inverter, so the power loss is proportional to the amount of switching harmonics.

The voltage change in each switching operation for a multi-level inverter is reduced in order to improve its power conversion efficiency and the switching stress of the active devices. The amount of switching harmonics is also attenuated, so the power loss caused by the filter inductor is also reduced. Therefore, multi-level inverter technology has been the subject of much research in the past few years. In theory, multi-level inverters should be designed with higher voltage levels in order to improve the conversion efficiency and to reduce harmonic content and electromagnetic interference (EMI).

2. METHODOLOGY

This paper proposed an automated system where Solar Panel direction is controlled based on the time by using Real Time Clock.

In the proposed concept is using a couple of RTC clocks, for detecting time. These sensors are connected besides the Solar Panels. Please note that there will not be any Solar Panels but the support base for the panels will be demonstrated. These panels will be fixed on DC Servo motors. The DC motors will move towards the direction of maximum sun energy. The signals from the TIME sensing device will be trigger the movement of the panel. The signals from the light sensing device will be processed by the microcontroller and the microcontroller drives the DC Servo motor in the desired direction.

A prototype of a multilevel solar panel system with a real time clock (RTC) based automated solar tracker has been developed for its use in urban residential areas. The proposed system consists of three

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panels mounted in a rack one above another at a fixed distance from each other to minimize the floor area while shifted horizontally from each other by half the panel width to avoid shading of the lower panels. The panels will be fitted with the solar tracker to track the sun to maximize the energy collection. Experimental result shows that the developed system can harness about 20-23% more energy while occupying 33% less area than that by the conventional fixed panel system of same size. The proposed system will be useful for large urban city dwellers, especially in third world countries, of roof top space to install solar panels is also very limited.

An 8-bit the ARDUINO microcontroller is used for this purpose. The programing of this microcontroller is done using Embedded C programs and to cross compile the .c file into hex. The programing of hex file into microcontroller done using ARDUINO IDE programmer.

3. IMPLEMENTATION

Major Hardware Components Used

1. Microcontroller
2. Regulated Power Supply
3. RTC
4. DC Servo Motor and Drive.
5. Power Supply.
6. LED Indicators

Software Used

1. ARDUINO IDE compiler for embedded programming.
2. ARDUINO IDE programmer for dumping code into Microcontroller.

ATMEGA 328

Arduino Board ATMEGA328P Board is a powerful development platform based on ATMEGA328 microcontroller which is one of the most feature rich AVR microcontroller from Atmel, featuring 128K Flash, 4K RAM, 53 I/O lines arranged in seven 8 bit ports, 8 ADCs etc.

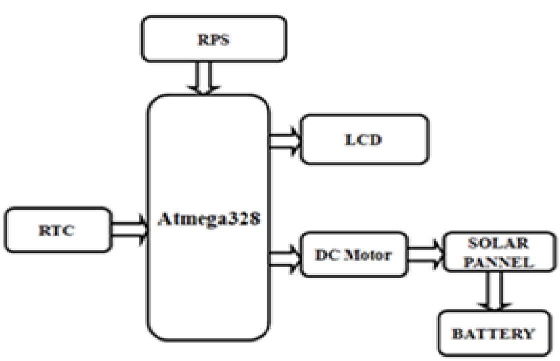


Figure 1 :-Block diagram of Solar tracking system

LIQUID CRYSTAL DISPLAY (LCD)

We have also provided Liquid Crystal Display (LCD display) to this system. We have used 16*2 alphanumeric displays. LCD display shows actual weight of the gas and at the same time it shows various status messages like "Sending SMS", "SMS sent" and "Gas has reached to 20% value" or "Gas has reached to 5% value". All these kinds of messages are shown on the LCD so that person operating this project can read these messages. LCD display is useful in testing purposes as well.

LDR (Light Dependent Resistor)

A Light Dependent Resistor (moreover called LDR, photoconductor, or photocell) is a contraption which has a constraint which moves as shown by the degree of light falling on its surface. A standard light ward resistor is appeared together with (on the right hand side) its circuit group picture. Assembled LDR's have unquestionable subtleties, notwithstanding the LDR's we move in the REUK Shop are very standard and have a constraint in full scale shadowiness of 1 Ohm, and an obstruction of a couple Ohm in radiant light (10-20kOhm @ 10 lux, 2-4kOhm @ 100 lux). Utilizations for Light Dependent Resistors. Light poor resistors are a central part in any electric circuit which is to be turned on and off thus as demonstrated by the fragment of consolidating light.

4. RESULTS

The Proposed concept has been implemented in MATLAB/ SIMULINK model. Later the same has been implemented in Hardware.

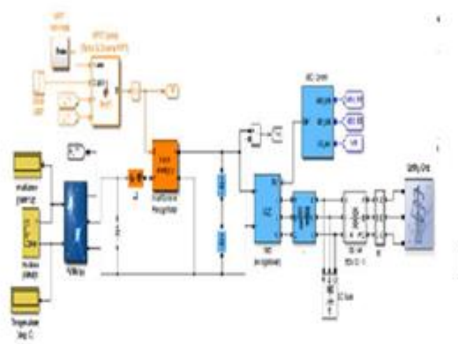


Figure 2: PV generating system (with P&O MPPT technique) integrated with grid

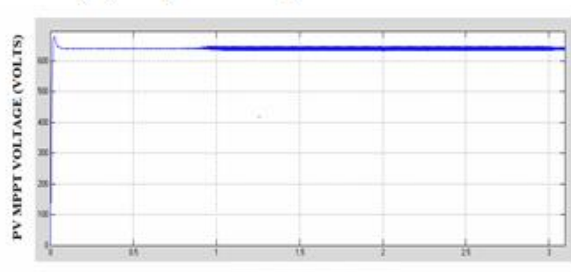
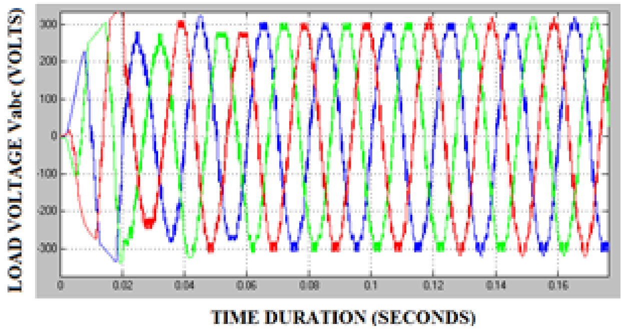


Figure 3: Phase Voltage observed at the PV array output connected to boost converter

Figure 4: Three Phase Voltage Supplied to the Load By The Inverter



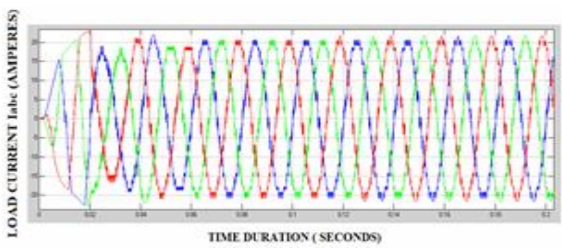


Figure 5: The load current supplied to the load is sinusoidal in nature as depicted in the simulation

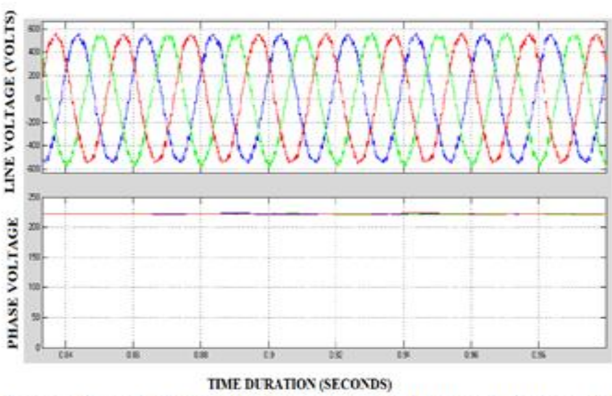


Figure 6: AC Line output Voltage and Input Voltage of Inverter

HARDWARE IMPLEMENTATION

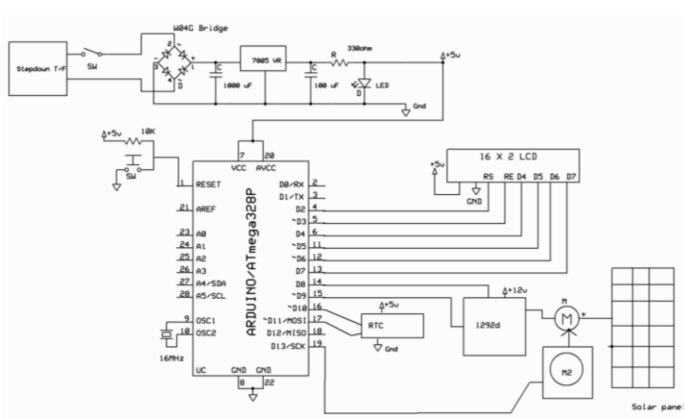


Figure 7: Schematic diagram of Hardware implementation

This proposed circuit is an automated system where Solar Panel direction is controlled based on the time by using Real Time Clock. This project uses a RTC clock, which will detect time. These sensors are connected besides the Solar Panels. These panels will be fixed on DC Servo motors. The DC motors will move towards the direction of maximum sun energy. The signals from the TIME sensing device will be trigger the movement of the panel. The signals from the light sensing device will be processed by the microcontroller and the microcontroller drives the DC Servo motor in the desired direction.

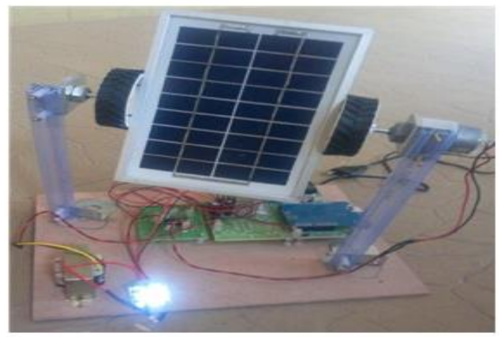


Figure 8: Hardware implementation of Proposed circuit

5. CONCLUSION AND FUTURE SCOPE

This project provides a classification of available MPPT techniques based on the number of control variables involved, types of control strategies, circuitry, and cost of applications, which is possibly useful for selecting an MPPT technique for a particular application. It also gives an idea about grid-tied or standalone mode of operations and types of preferable converters for each MPPT technique. This review has included many recent hybrid MPPT techniques along with their benefits. Further, the review has also included MPPT techniques meant for mismatched conditions such as partial shedding, non uniformity of PV panel temperatures, dust effects, damages of panel glass, etc. It has also given the idea of commercial products of MPPT techniques with the company names wherever possible. The review has discussed the efficiency calculation procedure of the developed MPPTs. This review is expected to be a useful tool for not only the MPPT users but also the designers and commercial manufacturers of PV systems.

The solar industry has been very hot. Record amounts of new solar capacity have been installed over the past two years. The accelerating pace of adoption of solar panels for distributed generation (installed at the point of use, rather than sold into the power grid) and the downward trend of module prices have created exuberance over the industry's future. Keeping all these points in mind and adopting AI based tracking techniques for MPPT will further help to extract efficient energy from the sun.

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