Smart Solar Tracking System

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***Abstract*:- The growth or energy demand in response to industrialization, urbanization and social affluence has led to an extremely uneven global distribution of primary energy consumption. The Sun, Wind, Waves and geothermal heat are renewable energy sources that will never run out. They are perpetual or self renewing. The rate of consumption does not exceed rate of renewability. The cost of generating electricity from wind and solar power has decreased by 90% over the past 20 years.**

Keywords: Renewable Energy, PV Cell, LDR

1. INTRODUCTION

Today, 70% of the population in India rural areas experience a dramatic situation where the electric supply is very low and irregular, and in some cases, completely absent from 80,000 villages in the country. The country suffers from unequal energy distribution, with power cuts of 2 to 3 hours in major cities, and in rural areas from 6 to 10 hours during the hot season (May to June). Up to 50% of households in India have no access to modern lighting and the electric grid did not reach remote places of the countryside, with some provinces lacking electricity in the 95% of the region [1]. There are some solutions like solar electricity from solar panels. Although many assume that renewable energy is too expensive for the poor but if it is combined with affordable financing mechanisms, it can be fully implemented and makes this type of clean electricity (and many others like portable rechargeable lamps) a viable option for millions in India. Both renewable and non-renewable resources are being used for production of electricity to meet the needs. But nonrenewable resources are under the stage of extinction so it is better to choose the renewable resources.

2. SENSING AND TRACKING PRINCIPLE

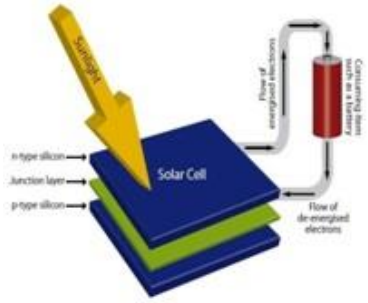

Fig.1 Prototype of PV cell

Various methods have been implemented and used to track the position of the sun. The principle of operation of a PV cell;
The simplest of all uses an LDR a Light Dependent Resistor to detect light intensity changes on the surface of the resistor. Other methods, such as that published by Jeff Dam in "Home Power" [10], use two phototransistors covered with a small plate to act as a shield to sunlight.

3. BLOCK DIAGRAM

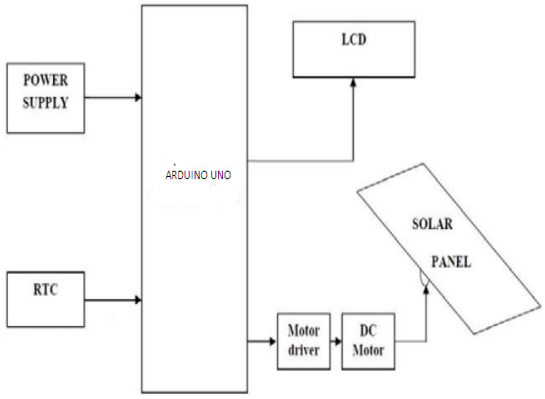

Fig.2 Block Diagram of PV cell

4. PROTYPE OF TIME OPERATED SOLAR TRACKING SYSTEM

Fig.3 The prototype of time operated solar tracking system using RTC

The main components used are microcontroller (AT89S52), RTC (DS1307), ADC (MCP3201), Op-Amp (LM324N), 16 LCD, Voltage controller (7805). The solar panel, Battery, DC motors are connected externally [2]. The solar panel used in our project is made up of poly-crystalline cells. For these cells aiming is not critical as the cells are picking up the light from many different angles.

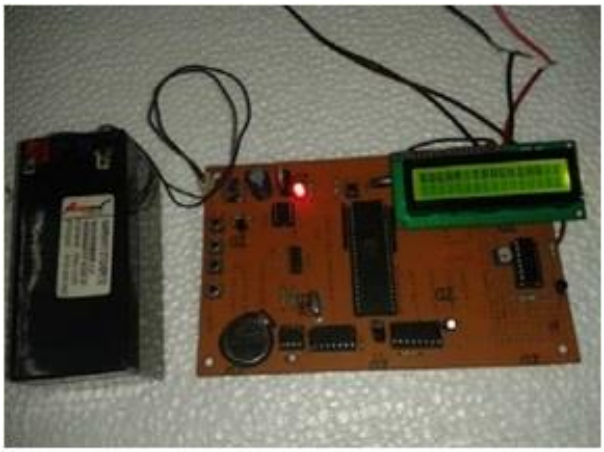

Fig.4 Main components of AT89S52/ MCP3201

5. WORKING OF THE PROPOSED SOLAR TRACKING SYSTEM

The power supply is given to the tracking system from external battery.7805 voltage regulator converts this incoming power supply into 5 volts in order to provide supply to other components in the system [5]. The program to the AT89S52 micro controller is given through ISP pins. Based on RTC, the number of tilts of the panel will be set manually using four switches that are fed as an input to the 74LS21 AND gate and its output as an interrupt to the controller. Real Time, Tilt time settings are displayed on LCD which is connected to Port 1 of the micro controller.

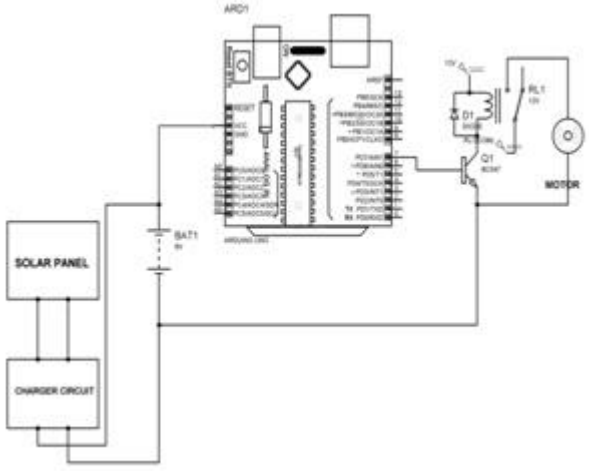

Fig.5 Circuit Diagram

In this paper, we use 4 tilts for tracking purpose and 5th tilt for bringing the panel back to the initial position. The RTC continuously runs and sends a high output to the microcontroller at our prescribed tilt time [6]. Then microcontroller sends a high output to the L293D driver which drives the DC motors connected to the panel. The panel rotation or tilt angles will be initially fixed in the program that is given to the microcontroller. The output of solar panel is connected to Op- Amp which amplifies the signal and gives it to the ADC which is connected to the port 1 of the microcontroller [3]. Voltage generated by the panel as per the individual tilt time is displayed on LCD.

6. EXPERIMENTAL RESULTS

Table: 1 Captured Panel voltage with propose tracking system

S.NO	TIME	PANEL VOLTAGE (IN VOLTS) with proposed
1	8.00AM (initial)	8.6
2	9.00 AM	11.5
3	10.00 AM (1st tilt)	14
4	11.00 AM	16.5
5	12.00 PM (2nd tilt)	17.5
6	1.00 PM	17.8
7	2.00 PM (3rd tilt)	15.5
8	3.00 PM	15.2
9	4.00 PM (4th tilt)	13.8
10	5.00 PM	12.3
11	6.00 PM (reverse)	4.5

Table: 2 Captured panel voltages without proposed tracking system

S.NO	TIME	PANEL VOLTAGE (IN VOLTS) without proposed
1	8.00 AM	7.5
2	9.00 AM	9.5
3	10.00 AM	11.5
4	11.00 AM	12.1
5	12.00 PM	13.5
6	1.00 PM	13.8
7	2.00 PM	12.1
8	3.00 PM	11.3
9	4.00 PM	8.2
10	5.00 PM	6.3
11	6.00 PM	1.5

7. GENERAL DESCRIPTION

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. Solar panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications [8].

Each module is rated by its DC output power under standard test conditions. Solar modules use light energy from the sun to generate 5W power through the photovoltaic effect. Efficiencies of solar panel can be calculated by MPP (Maximum power point) value of solar panels [9]. It is a capacity of the solar panel and the higher value can make higher MPP. These panels are designed for the most rugged off-grid applications.

8. PRODUCT DESCRIPTION

A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring. A single solar module can produce only a limited amount of power, most installations contain multiple modules.

The majority of modules use wafer-based crystalline silicon cells or thin-film cells based on cadmium telluride or silicon. Cells must also be protected from mechanical damage and moisture. Most solar modules are rigid, but semi-flexible ones are available, based on thin-film cells.

Electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired current capability.

- **FEATURES**
  - Output voltage: 12V
  - Output current: 42mA
  - Output power: 5W
  - Heavy-duty anodized frames.
  - Rugged design to withstand high wind pressure, hail and snow load.
- **APPLICATIONS**
  - Standalone PV systems
  - Solar planes
  - Solar vehicles
  - Solar-pumped lasers
- **ADVANTAGES**
  - Solar tracking system continuously arient photovoltaic Panel towards the sun and can help maximize your investment in your PV system
  - One time investment which provides high efficiency and flexibility on depending over other sources
  - Tracking system can help reducing emission and can contribute against global warming.
  - Bulk implementation of tracking system help reduce consumption of power of other sources.
  - It enhances the clean and emission free power production.
- **DISADVANTAGES**
  - Initial investment is high.
  - Limited power density
  - Solar cells produce DC which must be converted AC when using currently existing distribution grids

9. CONCLUSION

The design of ARDUINO based on efficient solar tracking system with real time clock is developed and described. The proposed system provides a variable indication of their relative angle to the sun by comparing with pre defined measured readings. By using this method, the solar tracker was successfully maintained a solar array at a sufficiently perpendicular angle to the Sun. The power increase gained over a fixed horizontal array was in excess of 40%. The proposed design is achieved with low power consumption, high accuracy and low cost.

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