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Solar Tracking Scheme Based On Microcontroller

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ABSTRACT-
A Solar Tracker is a device onto which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. The Solar Tracker will attempt to navigate to the best angle for the exposure of light from the sun. Though initial cost of solar tracking system setup is costly, it suggests a cheaper solution. Designed construction of a prototype to track the sun with single degree of freedom that detects the sunlight by the motion of solar panel. The control circuit is based on PIC Microcontroller, programmed in a manner that dc motor rotates solar panel in direction of the sunlight to receive maximum amount of solar energy. Theoretical analysis and research analysis is shown in this paper to advocate that the designed system can improve the solar energy utilization.

Keyword: PIC, tracking, Solar Panel, DC Motor.

1. INTRODUCTION

Energy is one of the prime factor for the developing a nation. An enormous amount of Energy is distributed, extracted, consumed and converted across the world daily. More than 85% of production of energy depends upon fossil fuels. The resources from which fossil fuels come are limited and because of the use of fossil fuel it results in global warming due to emission of greenhouse gases. For providing a sustainable production of power and safe world to the future generation, there is a growing demand for energy from renewable sources like geothermal, solar, ocean tidal wave and wind. Among these renewable sources of energy- solar energy is one of the most promising renewable energy sources characterized by a huge potential of conversion into electrical power.

2. Literature Research

This aims at explaining solar panel and solar tracker used in this system.

2.1 Solar Panel

Solar panels are devices that convert light energy into electrical energy. They are called after the sun because the sun is the most abundant source of light energy available for use. They are sometimes called photovoltaic i.e. “light-electricity”. A solar panel is the collection of solar cell and this rely on the photovoltaic effect to absorb the energy from the sun and produce electricity. Solar panels provide maximum electricity when it is directly pointed towards sun.

Solar panels are mainly made of semiconductors materials. Si is one of the major components in solar panels which is maximum 24.5% efficient. It increases the cell efficiency, maximizes the output power and employ the solar tracker along with panels improves the overall efficiency.

2.2 **Solar Tracker Evolution**

For improving the efficiency of the solar panels and to receive the maximum amount of light energy the tracker is often incorporated in the panels to keep panels pointed towards the sun and receive maximum amount of light. A solar tracker is a device onto which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. Integration of tracker within the solar panels is the better option to obtain electricity in comparison with maximizing the output power from solar panels because this method can receive maximum energy only at a particular time as its stationary and its cost is also more in respect to the tracker system.

In today's Global market tracker system technology is more preferred because:

- The efficiency increases by 30-40%.
- The space requirement for a solar park is reduced, and they keep the same output.
- The return of the investment timeline is reduced.
- The tracking system amortizes itself within 4 years.
- In terms of cost per Watt of the completed solar system, it is usually cheaper to use a solar tracker and less solar panels where space and planning permit.
- A good solar tracker can typically lead to an increase in electricity generation capacity of 30-50%.

3. **Background Information**

This section presents background information on the main subsystems of the project.
Specifically, this section discusses microcontroller and dc motor theory in order to provide
a better understanding and also operation of solar tracker.

3.1 **Microcontroller**

A microcontroller is a single chip that contains the processor, volatile memory for input and output, non-volatile memory for the program, a clock and an I/O control unit also called a computer on a chip, more than billions of microcontroller units are embedded each year in a myriad of products from simple toys to appliances to automobiles. In this system we use PIC microcontroller.

- PIC refers to peripheral interface controller has either ROM or EPROM or Flash memory for storage.
- The storage is separated in program memory and data memory and data memory is either 8,16 0r 32 bit and program memory-12, 14 or 24 bits.
- This microcontroller is available at low cost, re-programmable and supports serial programming.
- It supports RISC architecture and has built in oscillators with selective speed.
- Pic microcontroller has 256 bytes EEPROM memory, 356 bytes RAM and 8K ROM memory.

Figure 1 Shows the Pin Diagram of PIC Microcontroller

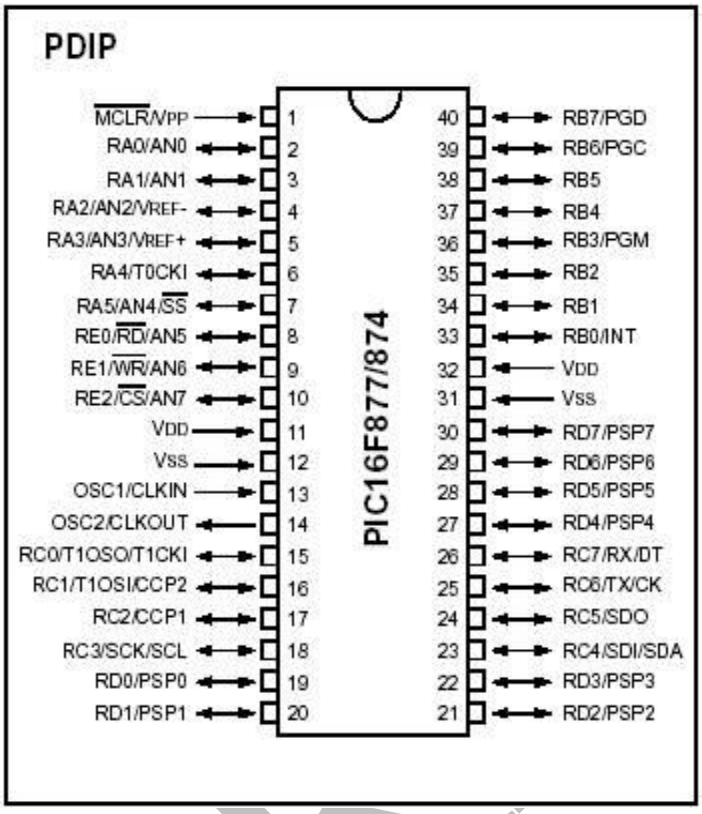

Figure 1

3.2 **DC Motor**

A **DC motor** is an electrical machines that is used toconvert direct current electrical power into mechanical power. Almost all kinds of DC motors have some internal mechanism, either electromechanical or electronic to periodically change the direction of flow of current inthe part of the motor. DC motors could be powered from existing direct-current lighting power distribution systems. The speed of DC motor can be controlled over a wide range, either by using a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The motor can operate on direct current but is a lightweight motor that is used for portable power tools and appliances. Larger DC motors can be used in propulsion of electric vehicles, hoists and elevator and in drives for steel rolling mills.
Figure 2 shows DC motor

Figure 2

3.3 **Construction**

In this figure 3 explains schematic block diagram of the system

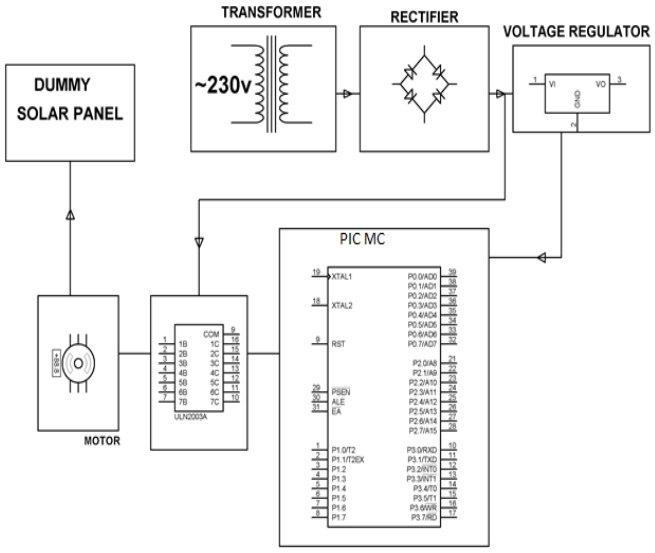

Figure 3

3.4 Operation of the Solar Tracker

Solar tracker provides three kinds of operation and control mechanism through the program that is written in microcontroller.

3.4.1. **Normal day light condition**: - Two photo resistors are used in the solar tracker for comparing the output voltages of the two junctions. When the sun rotates from east to west in the day time, AIN0 needs to provide higher voltage than AIN1 to sense the rotation of the sun. This condition os solar tracker is known as normal day light condition and tracker rotates the panel 3.75° in every 15 minutes.

3.4.2. **Bad weather condition**: - When there is cloudy sky, light will be striking less on both the photo resistors and that's why sufficient voltages may not be available at junction point. The difference between the voltages at junction point will not be greater than the threshold value to rotate the tracker. At the meantime, sun continues rotating in the western direction. To solve this problem, a short delay is provided which will check for voltage input from junction point at every 1.5 minutes. Microcontroller will use a variable Count for checking the consecutively 10 times for making the 'wait' state equal to 15 minutes (moderate delay) to rotate the dc motor one step.

3.4.3 **Bidirectional rotation**: - The solar tracker rotates only in one direction from east to west during day time. To count the total rotation of the panel during day time use variable I and no rotation is required in western direction once sun sets. For the panel to go to its' initial position for the next day variable I is used , when I>40, tracker stops its rotation and move back to the initial position that is eastern direction and tracker is off i.e. no more power supply till next day

4. Features of the Designed Tracker

The attractive feature of this constructed prototype is the software solution of the challenges that is related to solar tracking system. The designed prototype requires only two photo resistors to sense the light, which lessens the cost of the consumption of the system is negligible

Fig. 4: Designed working Prototype of solar tracker.

Since this type of systems is mostly used in dusty areas, the dust gets accumulated on its surface and this reduces the efficiency of the system and also power generation. To overcome this problem incorporate a brush with rollers on panels which rolls twice in 24 hrs for cleaning?

5. CONCLUSION AND FUTURE SCOPE

The paper has presented a means of tracking the sun's position with the help of microcontroller. Specially, it demonstrates a working software solution for maximizing solar cell output by positioning a solar panel at the point of maximum light intensity. The prototype represents a method for tracking the sun both in normal and bad weather condition. Larger Solar panel can be integrated with the system for better result and cost analysis It has been proven through our research and statistical analysis that solar tracking system with single-axis freedom can increase energy output by approximately 20%.Further mechanical enhancement can be done to the prototype, to implement dual-axis tracking.

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