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Solar Panel Tracking & Monitoring System Using GSM

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Abstract: This project details about the development of an Automatic Solar radiation tracker. To make solar energy more viable, the efficiency of solar array systems must be maximized. A feasible approach to maximizing the efficiency of solar array system is sun tracking. Proposed in this project is a system that controls the movement of a solar array so that it is constantly aligned towards the direction of the sun. The power obtained from the generation can be used for the needs in any system. The PIC Controller is used to control the direction of the Solar Panel based on sun direction. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun. It reduces the power generation capacity of the module. The power output reduces as much as by 50% if the module is not cleaned for a month. Automatic Sun Tracking System is a hybrid hardware/software prototype, which automatically provides best alignment of solar panel with the sun, to get maximum output (electricity).In order to regularly clean the dust, a sun tracking- cum- cleaning system has been designed, which not only tracks the sun but also cleans the modules automatically.

Keywords: Solar Panel, Monitor, GSM

I. INTRODUCTION

As the range of applications for solar energy increases, so does the need for improved materials and methods used to harness this power source. There are several factors that affect the efficiency of the collection process. Major influences on overall efficiency include solar cell efficiency, intensity of source radiation and storage techniques. The materials used in solar cell manufacturing limit the efficiency of a solar cell. This makes it particularly difficult to make considerable improvements in the performance of the cell, and hence restricts the efficiency of the overall collection process. Therefore, the most attainable method of improving the performance of solar power collection is to increase the mean intensity of radiation received from the source. There are three major approaches for maximizing power extraction in medium and large scale systems. They are sun tracking, Maximum Power Point (MPP) tracking or both.

A. SOLAR ENERGY

One of the most important problems facing the world today is the energy problem .This problem is resulted from the increase of demand for electrical energy and high cost of fuel. The solution was in finding another renewable energy sources such as solar energy, wind energy, potential energy...etc. Nowadays, solar energy has been widely used in our life, and it's expected to grow up in the next years.

Solar energy has many advantages:

1. Need no fuel
2. Has no moving parts to wear out
3. Non-polluting
4. Adaptable for on-site installation.
5. Easy maintenance
6. Can be integrated with other renewable energy sources
7. Simple & efficient

Tracking systems try to collect the largest amount of solar radiation and convert it into usable form of electrical energy (DC voltage) and store this energy into batteries for different types of applications. The sun tracking systems can collect more energy than what a fixed panel system collects.

B. TRACKING TECHNIQUES

There are several forms of tracking currently available; these vary mainly in the method of implementing the designs. The two general forms of tracking used are fixed control algorithms and dynamic tracking. The inherent difference between the two methods is the manner in which the path of the sun is determined. In the fixed control algorithm systems, the path of the sun is determined by referencing an algorithm that calculates the position of the

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sun for each time period. That is, the control system does not actively find the sun's position but works it out given the current time, day, month, and year. The dynamic tracking system, on the other hand, actively searches for the sun's position at any time of day (or night).Common to both forms of tracking is the control system. This system consists of some method of direction control, such as DC motors, stepper motors, and servo motors, which are directed by a control circuit, either digital or analog.

II. TYPES OF SOLAR TRACKERS

There are many different types of solar tracker which can be grouped into single axis and double axis models.

A. SINGLE AXIS TRACKERS

Fig. 1. Single Axis Tracker

Single axis solar trackers can either have a horizontal or a vertical axle shown in figure 1.4. The horizontal type is used in tropical regions where the sun gets very high at noon, but the days are short. The vertical type is used in high latitudes (such as in UK) where the sun does not get very high, but summer days can be very long. These have a manually adjustable tilt angle of 0 - 45 °and automatic tracking of the sun from East to West. They use the PV modules themselves as light sensor to avoid unnecessary tracking movement and for reliability. At night the trackers take up a horizontal position.

B. DUAL AXIS TRACKERS

Fig. 2. Dual Axis Tracker

Double axis solar trackers have both a horizontal and a vertical axle and so can track the Sun's apparent motion exactly anywhere in the world. It is shown in figure 1.5.This type of system is used to control astronomical telescopes, and so there is plenty of software available to automatically predict and track the motion of the sun across the sky. Dual axis trackers track the sun both East to West and North to South for added power output (approx 40% gain) and convenience.

III. STEPPER MOTOR

The stepper motor is an electromagnetic device that converts digital pulses into mechanical shaft rotation shown in figure 2.1. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. The sequence of the applied pulses is directly related to the direction of motor shafts rotation. The speed of the motor shafts rotation is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied. Many advantages are achieved using this kind of motors, such as higher simplicity, since no brushes or contacts are present, low cost, high reliability, high torque at low speeds, and high accuracy of motion. Many systems with stepper motors need to control the acceleration/ deceleration when changing the speed.

Fig. 3. Stepper Motor

IV. PERMANENT MAGNET (PM) MOTOR

Often referred to as a “tin can” or “can stock” motor the permanent magnet step motor is a low cost and low resolution type motor with typical step angles of 7.5° to 15°. (48 – 24 steps/revolution) PM motors as the motor name implies have permanent magnets added to the motor structure. The rotor no longer has teeth as with the VR motor. Instead the rotor is magnetized with alternating north and south poles situated in a straight line parallel to the rotor shaft. These magnetized rotor poles provide an increased magnetic flux intensity and because of this the PM motor

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exhibits improved torque characteristics when compared with the VR type.

A. PRINCIPLE OF STEPPER MOTOR

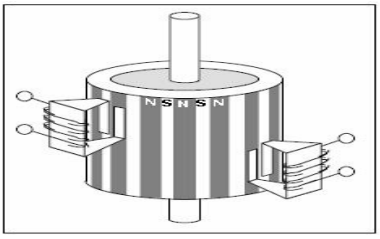

Fig. 4. PM Stepper Motor

V. PIC MICROCONTROLLER

PIC is a family of Hardware architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division shown in figure 3.1. The name PIC initially referred to "Peripheral Interface Controller".

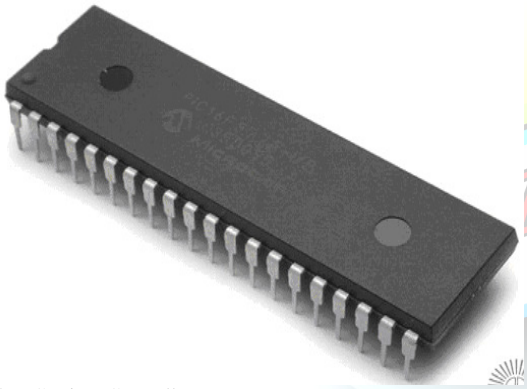

Fig. 5. PIC Micro Controller

PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

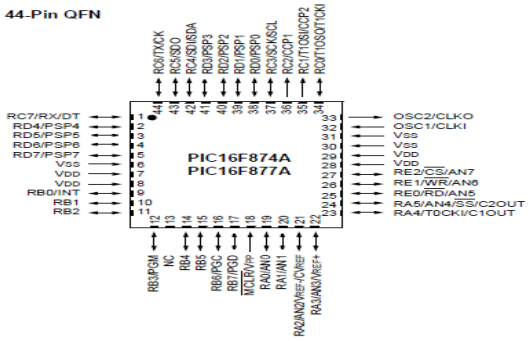

Table 1 PIC16F877A Device Features

Key Features	PIC16F877A
Operating Frequency	DC – 20 MHz
Resets (and Delays)	POR, BOR (PWRT, OST)
Flash Program Memory (14-bit words)	8K
Data Memory (bytes)	368
EEPROM Data Memory (bytes)	256
Interrupts	15
I/O Ports	Ports A, B, C, D, E
Timers	3
Capture/Compare/PWM modules	2
Serial Communications	MSSP, USART
Parallel Communications	PSP
10-bit Analog-to-Digital Module	8 input channels
Analog Comparators	2
Instruction Set	35 Instructions
Packages	40-pin PDIP 44-pin PLCC 44-pin TQFP 44-pin QFN

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VI. PROPOSED SYSTEM

In this way of programming is easy and it is easy to maintain and insulation was done in less time .we known that renewable energy is gift of god ,so it is ecofriendly**.** Our aim is to increase power generating capability of solar panel by tracking and automatic cleaning. Automatic Sun Tracking System is a hybrid hardware/software prototype, which automatically provides best alignment of solar panel with the sun, to get maximum output (electricity).The block diagram is shown in figure 4.1. In order to regularly clean the dust, a sun tracking- cum- cleaning system has been designed, which not only tracks the sun but also cleans the modules automatically.

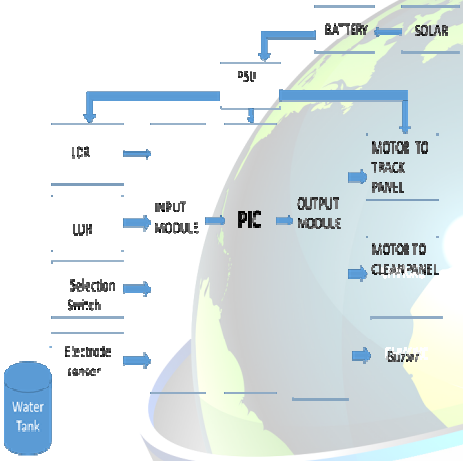

Fig. 6. Block Diagram

A. SENSOR

In our project we use automatic cleaning method so we use the level sensor it will indicate when the water level is low.

B. POWER SUPPLY

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronics' circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. Regulator Ics:- IC7805,IC7812.**3** Pins-**1** pin(input),**2** pin(neg), **3** pin(output).

C. TRANSFORMER

The potential transformer will step down the power supply voltage (0-230v) to (12-0-12v) level.Then the secondary of the potential transformer will connected to bridge rectifier which produces full wave pulsating DC.This rectified output is smoothed by using shunt capacitor filter .Then the p[ure DC output reaches the regulator IC7805 and IC7812.

D. RELAY OPERATION

Relay is a device consisting of a coil of wire wrapped around an iron core. When electricity is appiled to the coil of wire it becomes magnetic,hence the term electromagnet. The A,B,C, terminals are an SPDT switch controller by the electromagnetic .when electricity is applied to V1 and V2 the electromagnet acts upon the SPDT switch so that the B and C terminals are connected .When electricity is disconnected ,then the A and C terminals are connected .It is important to note that the electromagnet is magnetically linked to the switch but the two are not linked electricity.

E. AUTOMATIC CLEANING

Automatic solar panel cleaning system will keep your panels looking and working their best at all time.our system are automatic and easy to set in term of wash and rinse time professional installation stop wasting power because your system is not running at optimum capacity no more manual cleaning request your free quotes today.we include the automatic cleaning to reduce the manual interface in cleaning and to improve the power generating capability of the solar panel. In our project Auto cleaning done by two modes.

- RTC mode(Real time clock)
- Based on voltage level.

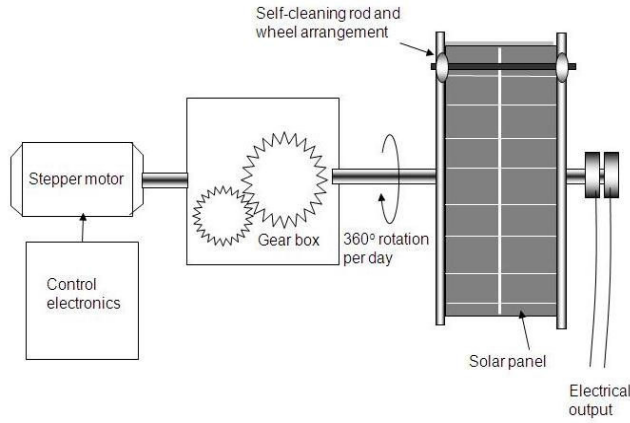

Fig. 7. Auto Cleaning

F. RTC

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Whether the dust or not the cleaning is done based on our time setting of the clock.

G. VOLTAGE LEVEL

In this cleaning is done, when the voltage level is decreased.

VII. OUTPUT DIFFERENCE OF FIXED AND TRACKED PANEL

The output of the panel is increased when the solar panel is tracked. The tracked solar Panel output is high compared to the stationary solar panel. In (fig5.20) the green curve shows the maximum output of the panel ,when the panel was tracked. The blue curve shows the minimum output of the solar panel, when the panel is stationary.

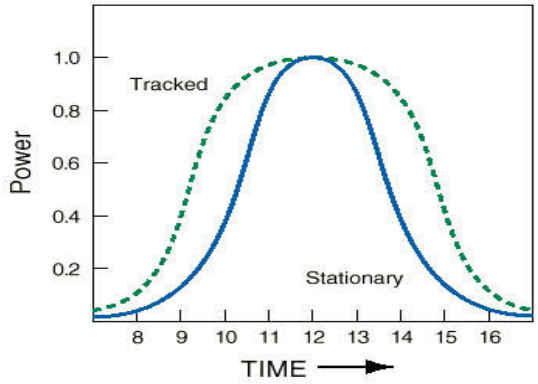

Fig. 8. Output Graph

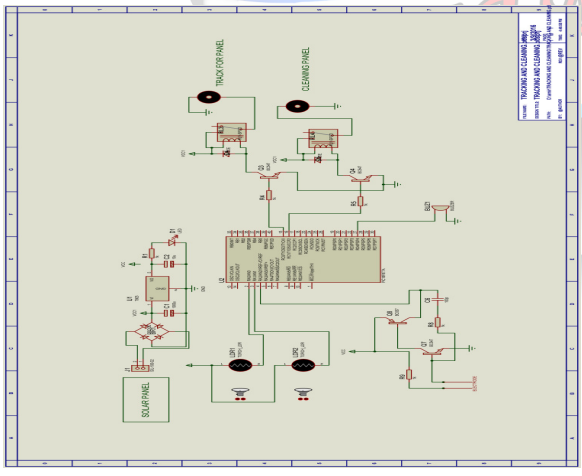

Fig. 9. Circuit Diagram

Fig:10 Hardware Photograph with pv panel

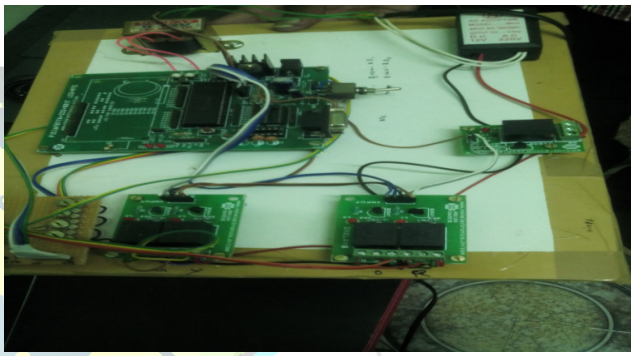

Fig. 11. Hardware photograph without pv panel

VIII. CONCLUSION

In this thesis, the sun tracking system was implemented which is based on PIC microcontroller. After examining the information obtained in the data analysis section, it can be said that the proposed sun tracking solar array system is a feasible method of maximizing the energy received from solar radiation. The controller circuit used to implement this system has been designed with a minimal number of components and has been integrated onto a single PCB for simple assembly. The use of stepper motors enables accurate tracking of the sun while keeping track of the array's current position in relation to its initial position. The automatic solar radiation tracker is an efficient system for solar energy collection. It has been shown that the sun tracking systems can collect about 8% more energy than what a fixed panel system collects and thus high efficiency is achieved through this tracker. 8% increase in efficiency and it can be more prominent in concentrating type reflectors.

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