Light Intensity RTC Based Solar Tracking for Power Conservation in Irrigation System

Prakash. N
P.G Scholar
Department of Electrical and Electronics,
Kumaraguru College of Technology,
Coimbatore, India

Dhakshinamoorthy. T
Asst.Professor
Department of Electrical and Electronics
Kumaraguru College of Technology,
Coimbatore, India

Abstract

Now we are living in technological world. The energy resources are getting depleted and affect our environment. So we can go for renewable energy resources.

India is both densely populated and has high solar isolation, providing an ideal combination for solar power in India. Moreover India is a tropical country with more than 300 sunny days; we can abundantly use solar energy that for generating power. We designed the SOLAR tracking irrigation system for maximum efficiency.

In order to obtain the maximum efficiency we are using microcontroller to tilt the position of the solar panel, according to the position of the sun using the stepper motor. We have used Light intensity and RTC (Real Time Clock) technique to track the solar panel. As time increases the panel automatically tracks and resets to original position after sunset. It again starts to track after 12 hours.

In the irrigation side we have designed an automatic turn ON and OFF of pump. Using the microcontroller programming we can have two ON and OFF timings. We can set the timing and motor automatically turns ON and OFF at the specified timings.

Keywords-*solar panel, Real time clock (RTC), Stepper Motor, Microcontroller*

1. Introduction

"Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, or from heat generated deep within the earth. Present renewable energy sources supply about 18% of current energy use and there is much potential that could be exploited in the future. While there are many large-scale renewable energy projects and production, renewable technologies are also suited to small off-grid applications, sometimes in rural and remote areas, where energy is often crucial in human development.

In the modern world everyone is moving towards energy sources. One of the sources which provide efficient energy is solar power. India is both densely populated and has high solar isolation, providing an ideal combination for solar power in India. Moreover India is a tropical country with more than 300 sunny days; we can abundantly use solar energy that for generating power. Solar PV water pumping systems are used for irrigation and drinking water. Majority of pumps are fitted with a 200-300 W motor that are powered with 1800Wp PV array which can deliver about 140,000 litters of water per day from a total grade of 10 meters.

There are more than 10,000 solar powered surface and bore water pumps in use around the world today. A typical solar powered pumping system consists of a solar panel array that powers an electric motor, in turn powers a bore or surface pump.

PV powered pumping systems are a cost effective alternative to agriculture wind turbines for remote area water supply.. India launched the Jawaharlal Nehru solar mission. The first phase of this mission aims to commission 1000MW of grid connected solar power project by 2013.So we designed a solar irrigation system for agriculture which considerably reduces the power obtained from the non-renewable resources. In order to obtain maximum efficiency from solar power we used the solar tracking system. This is an auto irrigation system in which the land will be irrigated according to the moisture content of the soil.

2. Working

This project deals with a Light Intensity RTC based solar panel tracking system. Solar tracking enables more energy to be generated because the solar panel is always able to maintain a perpendicular profile to the sun's rays. As the sun moves across the sky during the day, it is advantageous to have the solar panels track the location of the sun, such that the panels are always perpendicular to the solar energy radiated by the sun. This will tend to maximize the amount of power absorbed by PV systems. It has been estimated that the use of a tracking system can increase the power output by 30% - 60%. The increase is significant enough to make tracking a viable preposition despite of the enhancement in system cost. It is possible to align the tracking heliostat normal to sun using electronic control by a micro controller.

The system consists of the following units:

- Tracking unit
- Controlling unit
- Sensing unit
- Irrigating unit

3. Block Diagram

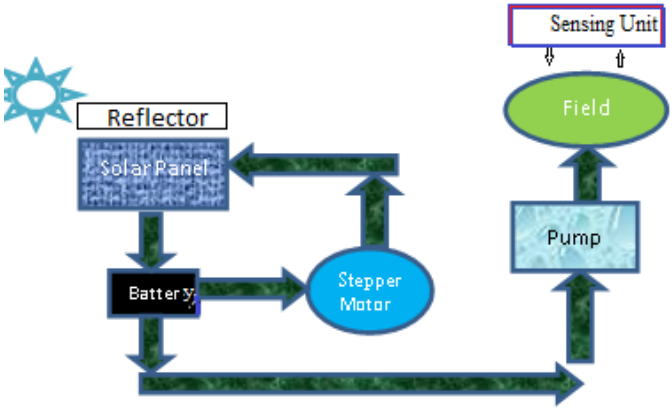

Fig.1.System work flow

4. Tracking Unit

The tracking is used to increase the efficiency of the solar panel. The concept is the solar panel has more efficiency if the panel is perpendicular to the sun. For everyone hour the sun goes upwards by 15 degrees. The sun rays are received from morning 6 a m to evening 6 p m so it will enough if track the for 12 hours. For another 12 hours no tracking will take place. After 12 hours the panel will move to initial position of morning 6 o clock position. To calculate the time a timer is used.

There are two main ways to make the solar cells more efficient, either by improving the actual cell or by installing the solar panels on a tracking base that follows the sun.

The end-user will prefer the tracking solution rather than a fixed ground system because:

- The efficiency increases by 30-40% (= more money)
- 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 amortises itself within 4 years (on average

The tracking system consists of

- Solar panel
- Axis
- Stepper motor

The solar panel will be fixed to the axis which is placed on a stand. The stepper motor will be coupled with the axis. It will be such that when stepper motor rotates the axis rotates and the solar panel will also rotate.

5. Technic Used

Owing to the fluctuation of fossil fuel prices, the renewable energy resources is rapidly taking role in day to day life.one of the significance renewable energy sources is the solar power. There are two different technic used they are

- Time-based control
- Sunlight intensity comparison

6. Solar Tracking Unit

Fig.2.Solar tracking system

7.Sunlight Intensity Method

A white reflector may reflect all the electromagnetic rays from the sun .By this method we can increase the solar energy. It is converted to electrical energy through photovoltaic cells. In this project we used the white reflector to increase the functioning of the solar cell. Some of the solar rays may reach the Earth's surface directly without considerable change in the direction. Most of the light energy transmitted by the panel through diffused reflection. Naturally energy of light is less, which reduces the output of the solar cell.

Fig.3.White Reflector

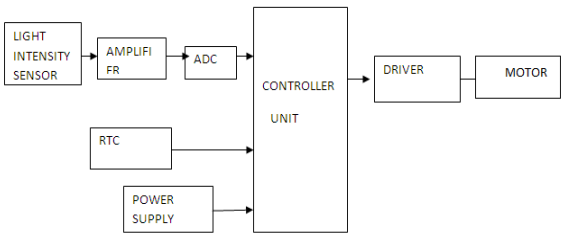

Fig.4. Solar tracking block

8. Solar Panel

The solar panel consists of array of solar cells. A solar cell is any device that directly converts the energy in light into electrical energy through the process of photo voltaic effect. Solar panels can generate electricity without any waste or pollution, or dependence on the Earth's natural resources. Solar panels have no moving parts so they are very reliable

and have a long life span. Solar panels are relatively easy to install and are very low maintenance. Solar panels can be installed to generate power where it is needed which removes the need to transport and distribute power over long distances to remote areas. In this project polycrystalline silicon panel has been used because it is the most efficient type and it provides an excellent balance of performance and economy.

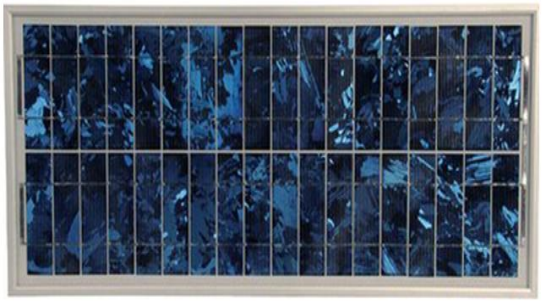

Fig.5.Solar panel

9. Experimental Data Record

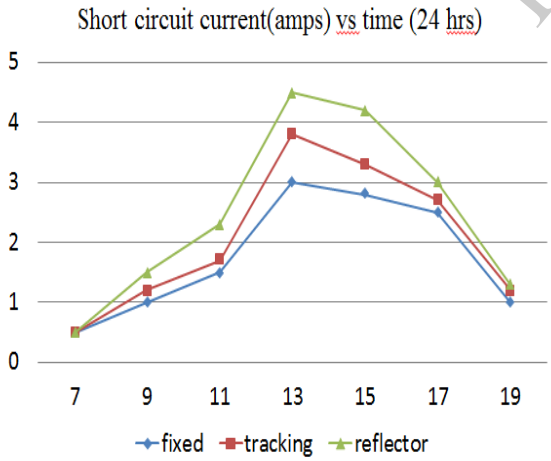

Fig.6. Short circuit current isc (amps) vs Time of Solar panel

10. Stepper Motor

A stepper motor is a motor controlled by a series of electromagnetic coils. The center shaft has a series of magnets mounted on it, and the coils surrounding the shaft are alternately given current or not, creating magnetic fields which repulse or attract the magnets on the shaft, causing the motor to rotate. The basic operation of a stepper motor allows the shaft to move a precise number of degrees each time a pulse of electricity is sent to the motor. The rotor of the motor produces torque from the interaction between the magnetic field in the stator and rotor. The strength of the magnetic fields is proportional to the amount of current sent to the stator and the number of turns in the windings. The stepper motor uses the theory of operation for magnets to make the motor shaft turn a precise distance when a pulse of electricity.

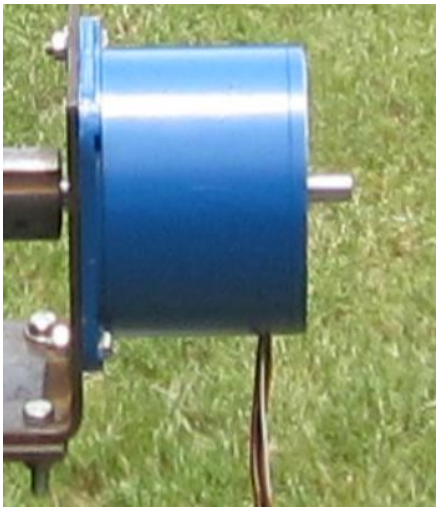

Fig.7.Control unit

11. Flow Diagram

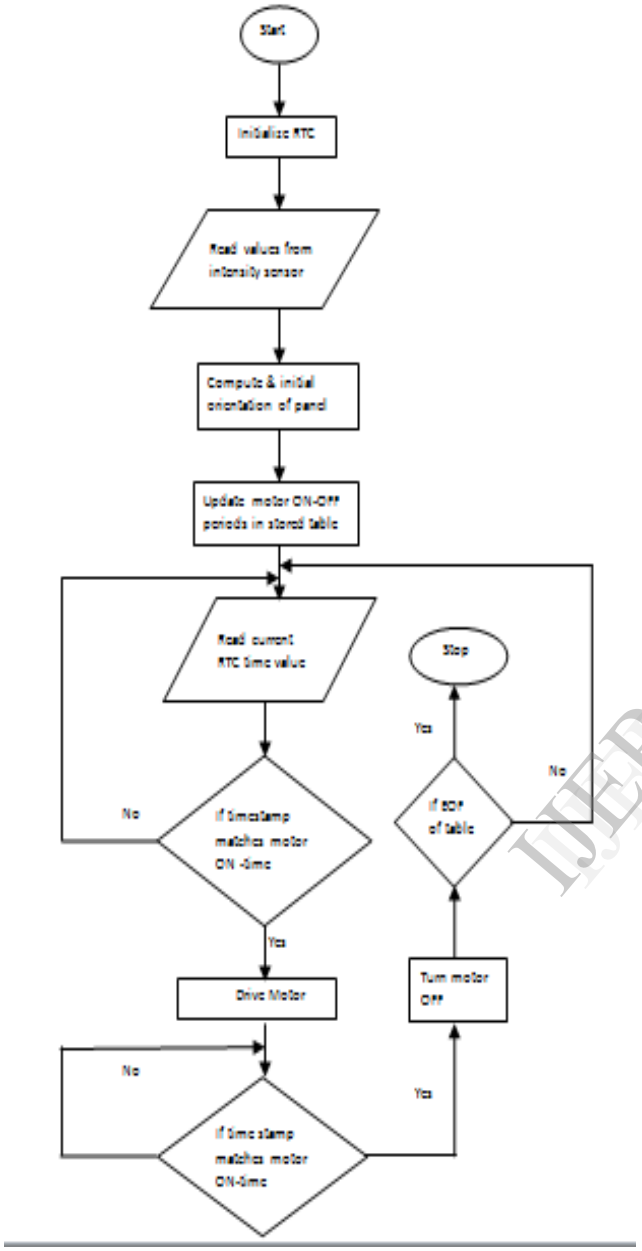

Fig.8.System Flow

12. Control Unit

The controlling unit consists of a microcontroller AT89S52. The microcontroller will be programmed to control the stepper motor and the pump.

The stepper motor control is such that every one hour the power is sent to the stepper motor and rotates it for 18 degrees. The stepper motor will have its own holding torque so that other times the panel does not go down due to gravity. The stepper motor should be selected according to the weight of the solar panel. Since the panel is always perpendicular to the sun while following this method the efficiency of the solar panel increases.

The controlling unit will also control the pump to automatically turn on and off. The on time and off time of the pump can be preloaded by the farmer. When the time is reached the microcontroller will turn on the relay and the pump will be turned on and it automatically turns off.

13. Pumping Unit

In this we are using pump, whose ON and OFF time is controlled by the microcontroller. We can irrigate the land by simply entering the ON and OFF time. According to the need we can change the time settings. If we set the time once, the process will repeat for every 24 hours.

14. Conclusion

By this process we can produce a clean and green power. Thus electrical power can be generated in rural areas itself at very low cost. This will reduce our dependence on Non- Renewable resources like coal and oil. This has the capability of replacing all the power plants which are using Non-Renewable resources

A solar tracker is designed employing the new principle of using small solar cells to function as self-adjusting light sensors, providing a variable indication of their relative angle to the sun by detecting their voltage output. By using this method, the solar tracker was successful in maintaining a solar array at a sufficiently perpendicular angle to the sun.

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N.Prakash *received the Bachelor's degree in Electronics and Communication from Bannari Amman InstituteofTechnology, Sathyamangalam,Erode,Tamilnadu,India in 2012.Currently ,he is a pursuing Master degree in Embedded System from KumaraguruCollegeofTechnology,Coimbatore,Tamilnadu,India in 2014.He Presented Paper based on New and Renewable Energy Technologies and Mobile Communication.*

T.Dhakashinamoorthy *received the Bachelor's degree in Electrical and Electronics from Thanthai Periyar Govt.InstituteofTechnology,Vellore, Tamilnadu,India.He received master degree in Embedded System from CEG, Anna university, Chennai. He received the Master of Science from The University of Toledo, Ohio, USA and his Research Interest RF/Microwave and Photonics*