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Internet Controlled Solar Panel Data Acquisition and Sun Tracking System using Arduino

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Abstract—*This Paper concerns with the designing and implementation of a Dual Axis Solar Panel controlled using an Arduino over internet. We propose to use Arduino atmega micro-controller environment to connect the Solar Panel System to internet and/or intranet and thereby make the solar panel accessible for control from remote location. The use of legit weather data and location information of solar panel will aid in automation of System in adjustment of the solar panel to a 90-degree angle between the Sun and the Solar panel.*

***Key Words*—Solar; Arduino; Renewal Energy; Internet; Data Acquisition;**

1.INTRODUCTION

During the last few year solar energy gain the much more importance in all over the world specially in India. Different type of renewable or green energy resource are being utilize for the supply of energy demand. Among the conventional renewable energy sources, solar energy is most essential and prerequisite resource of sustainable energy.

Solar energy refers to convert the sun's energy into useful form of energy, such as electricity or heat. Solar panel consist a series of photovoltaic cell which observe the sunlight and convert it into thermal energy or heat. The main advantages of solar panel is it's neat and clean renewable energy.

The physics of this cell is very much similar to the classical p-n junction diode, semiconductor material within the cell absorb sunlight which knocks electrons from their atom, allowing electrons to flow through the material to produce electricity. Because of its cleanliness, abundance and sustainability solar energy has become well recognized and widely utilize.

According to the research if the sun is perpendicular to the solar panel then its produce more energy as compare to other angles. The 90-degree angle between the Sun and Solar Panel would result an increase in the output by 20%.

2. EXISTING SYSTEM

Solar cells (photovoltaic cell) are constructed such a way that it can produce electricity till the range of light. But it does not cover complete solar range hence most of the energy get wasted by solar cells.
We could not redesign the existing solar material the is used for conducting energy. But, we can propose a system that could help result to better Solar Panel efficiency.

The existing system which is available in India is static solar system, to convert the solar energy into thermal energy. This panel gives us better efficiency when it's perpendicular to the sun as compare to other angles but problem is we cannot move static panels and when sun changes its angle the efficiency of this system is get decreased

On an average, the currently best achieving sunlight conversion rates (also known as 'solar module efficiency') is around 21.5% in commercial products and for residential use it is 5%. The current systems which are already installed at various geographic locations are in a "static" position where the solar panels are fixed at a particular pre-fixed angle. A "dynamic" solar panel could possibly be better.

3. EXPERIMENTS & RESULTS

To overcome the problem of static solar panel we are conducted some series of experiment on photovoltaic cells. This experiment is not only conducted in sun's light it's also conducted on artificial light w.r.t to different angles and distance between solar cell and the source of light.

When we finished this experiment, and analyzing our data we observe that the efficiency of photovoltaic cells gets increase when it's perpendicular to the source of the light. so, the basic idea was to maintain this angle of 90 degree to get the desired result

The idea of "dynamic" solar panel gave birth to the idea of a 'Dual-Axis' Solar panel. The basic concept of creating a

Dual-Axis Solar Panel System is to maintain a 90-degree angle.

From the below results of the experiments, we could be certain that maintaining a perpendicular angle between the two, Sun light and panel would directly result to most efficient outputs.

Solar cell angle to Sunlight	Voltage (Volt)	Current (ampere)	Power (watt)
90 degrees	0.450v	1.80A	0.810W
75 degrees	0.437v	1.75A	0.755W
60 degrees	0.425v	1.70A	0.722W
45 degrees	0.400v	1.60A	0.640W
30 degrees	0.362v	1.45A	0.625W
15 degree	0.325v	1.30A	0.422W
0 degree	0.287v	1.15A	0.330W

Fig 3.1.: Solar panel output readings

4. PROPOSED SYSTEM

The propose a system for two tasks in particular - Maintenance and Control. Maintaining the System is a very generalized way to describe the tasks we will be including. It will be consisting of recording and tracking the outputs from the Solar panel through a backend server that could be on internet or intranet; viewed by the user through a web page. There Web pages can also be directly used to control the Solar panels through the Arduino-servo motor mechanism installed onto it. This control over the Solar panel is necessary in-order to maintain the 90-degree angle.

The use of weather details and climate conditions from internet is another major part of the proposed system. We intend to inculcate some amount of intelligence into the system by acquiring such data. Using the weather and climate forecast would help the system to adjust the panels even in absence of a human user.

The basic system's diagrammatic representation is done in figure 4.1, where there are 2 servo motors which will be controlling the movement of the panel. These servo motors are controlled through a "Processing System" which will be responsible for the data acquisition and its response mechanism.

The figure 4.1 is a block diagram that explain the interaction between the sensors on the solar panel with the Atmega micro-controller that will in response react by adjusting the motors connected to the panel. The Adjustments in the angles of the panel will be done keeping in mind the factors like temperature, humidity, wind direction, wind speed etc. This data will be used to improve the efficiency of the solar panel and various application by adjusting the angle of the solar panel with respect to sun's incident ray.

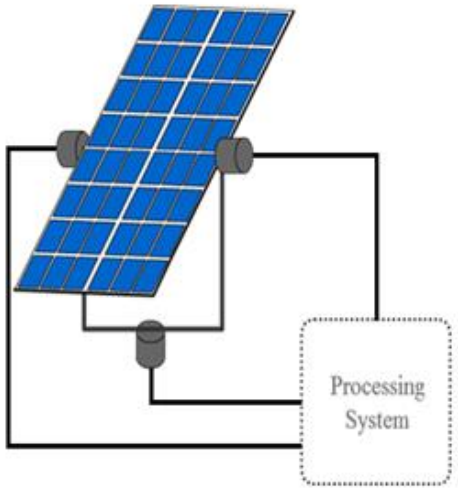

Fig 4.1: Simple System Representation

5. IMPLEMENTATION

We created a website which would communicate with the Arduino system as well as act as an interface between the user and the system. So, we created a small prototype of Arduino system with solar panel installed on it. Fig 5.1.1, Fig 5.1.2, Fig 5.1.3 tells the top view, side view and front view respectively.

We used 2 servos for the rotation of the solar panel. The sun tilts 23-degree in a span of 6 months so we use the X servo to track the 23-degree change and Y servo is used for the daily rotation. We can see the Y servo attached to the solar panel in Fig 5.1.2. The Y servo tracks sun position in the east-west pattern in hourly basis and changes its position accordingly.

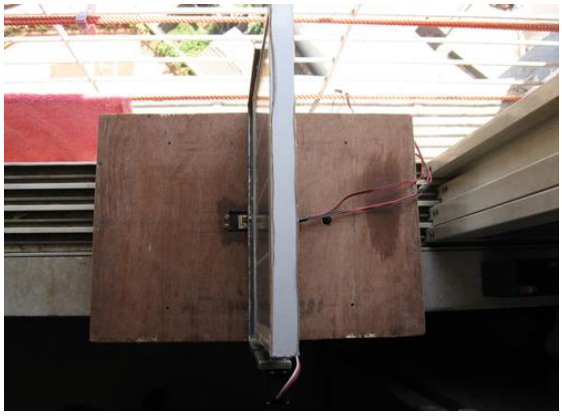

Fig 5.1.1.: Top view of the system

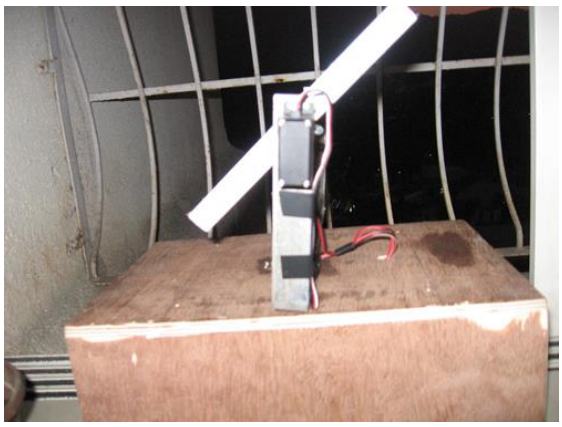

Fig 5.1.2.: Side view of the system

Fig 5.1.3.: Front view of the system

Arduino IDE has been used to obtain the operation code. The programmer card for the same IDE is used to upload the machine code into the micro-controller.

The process for the System goes down as follows:

1. connect the Arduino with the panel and servos
2. Register the Arduino
3. generate the MAC and IP address
4. register the user
5. validate the user
6. generate the (Hypertext Preprocessor) php code
7. install the php code into the Arduino
8. fetch and generate the weather report
9. Arduino sends the current voltage & current to the server
10. Server receives the voltage & current from the Arduino and calculates the servos positions and sends it to Arduino
11. Arduino receives the servos data from the server and changes the position of the servos accordingly.

6. CONCLUSION

This paper represents design and implementation of dual-axis solar panel. Using the Arduino, we can move the panel successfully and it's giving better result than current system. We used a php for web site and for the back-end of the system and using Arduino IDE for maintaining a communication between server and to control it over internet.

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