Smart Solar Tracker and Energy Measuring System

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***Abstract*— Renewable energy is a valuable source as it makes a remarkable impact to the society. It makes a great impact not only in the life of urban areas but mainly in the life of semi-urban and rural areas.The power developed from solar energy is basically the energy extracted from the sun rays. Solar panels made up of solar cells are used to convert the solar energy into electrical energy. Solar cells or Photovoltaic cells are semiconductor diodes that convert sunlight to electrical energy. This is achieved by placing the solar panel towards the irradiation of the sun. But the solar panel remains stable in one direction, while the position of the sun changes throughout the day due to rotation and revolution of the earth. As the panel does always not face the sun it cannot produce maximum electricity and hence is less efficient. In this proposed method the panel would track the movement of the sun which will maximize the efficiency. The energy consumed and saved will be uploaded on cloud which would be available to the user.**

***Keywords*— Irradiation, Photovoltaic**

I. INTRODUCTION

Solar energy is one of virtuous source of renewable energy. During the present time the popularity of solar energy is increasing on a large scale and hence we use it in the households as well as industries. But still it seems that it is still very expensive compared to the charge of the electricity that is charged by the electric utility company charges per kilowatt hour.[4]

The sun changes its motion throughout the day because of the rotation and revolution of the earth. The conventional or current method does not track the movement of the sun. Because of this the efficiency obtained is quite less. In order to ensure the maximum use of the solar energy and to increase the efficiency of the system this new method is developed. Smart solar Tracker is a device that can move towards the sun all day long.

Solar energy can be defined as the energy extracted from the sun in the form of heat that gets converted to electricity. Photovoltaic cells are basically semiconductor diodes, these are responsible for the energy conversion. There is needed to also keep a check on the energy generated by the solar panel and the energy consumed. This is done by the energy measuring system. The amount of energy generated and stored s well as the amount of energy consumed is measured. This data is also made available to the user, so that a user can keep a track on the performance of the solar panel.

Smart tracker aims to provide an innovative way to increase the efficiency of the solar panel and to ensure maximum usage of the solar energy. As the existing system did not track the movement of the sun, also it did not maintain any records of the energy being saved and consumed. The process of collecting the data using sensors and storing as well as displaying the same is called as Automatic Meter Reading (AMR). This technique can be very useful in hugely populated countries such as India. In India employees are hired to go from house to house and collect the reading from the energy meters. India uses a slab-based model of pricing to charge the customers for the usage of electricity.

This method is basically used in order to reduce the burden on the poor people. But if ever an error occurs in this process then it can cause a huge loss to the companies providing power. In order to reduce this risk Automatic Meter Reading can be used, it can also be called as the cheap solution. It also prevents the manual labour required to collect data of each meter. The vital thing behind this approach is that it increases the efficiency of the conventional panel as well as it provides a cheap solution for reducing the manual labour and the possibility of error in the manual labour.

II. LITERATURE SURVEY

Much research has been done in order to maximize power generated from solar panel as Renewable Energy is one of the needs now a days.

Aashish Tiwari, Mayuri Vora, Prajkta Shewate, Vrushali Waghmare have presented a new approach by which the energy efficiency of the solar panel increases as we implement dual axis tracking. In the dual axis tracking maximum irradiance can be obtained on the solar panel thus more will be current generated from the panel.[1].

A Kaseem and M. Hamad have presented a new approach.

The PV systems basically consists of PV arrays that converts rradiations to electrical energy and the inverter converts the dc energy obtained from the PV array into AC which can be used to run home appliance such as TV, radio etc. The energy from the PV array can be fed back to the grid or can be fed to a battery which can act as a storage media in case of power outrage.The solar inverter is microcontroller based, it uses a microcontroller based driver, switching circuit, setup transformer & filter. The microcontroller-based driver generates PWM signal. This signal has a fixed frequency and duty cycle. [2]

A. C. D. Bonganay, J. C. Magno, A. G. Marcellana, J. M. E. Morante and N. G. Perez proposes a model which

collects the data from the energy meters with the help of sensors and uses Raspberry Pi to store the acquired data on cloud. [3]

The current method used involves a stationary panel. Which is kept tilted at an angle. The sun changes its position throughout the day, because of rotation and revolution performed by the earth. Therefore, the panel directly faces the sun for a very less amount of time. As maximum power can be drawn from the sun when the panel is directly facing the sun. If the panel does not face the sun, then less amount of power is generated. This fact makes this system less efficient.[5]

The current system does not have any provision for storing the energy and does not keep a check on the amount of energy consumed. As this system does not keep a check on the performance of the system the efficiency of this system is not known. Besides if there is any error or problem in the system it is known very late as there is no provision of supervising the system. The charge that is left after running all the appliances could be sent back to the MSEB but as there is no checkup on saved charge this is not possible. To overcome these problems new approach is proposed .[5]

III. IMPLIMENTATION

The proposed Solar Tracking system can track the movements of the sun; thus, it would always face the direction of radiation. Also, conveniently measure the energy used.

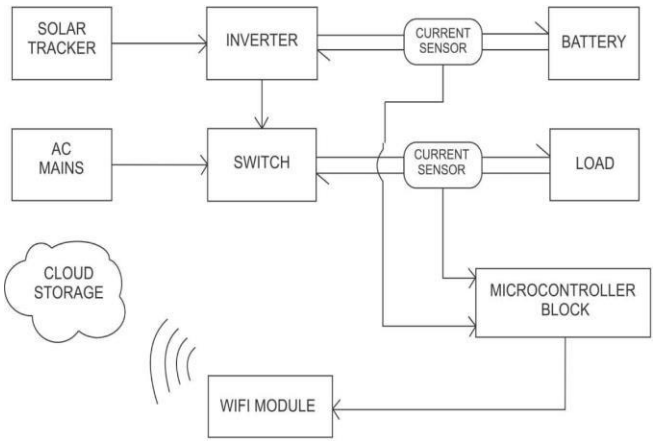

Fig 1. Block Diagram

The process followed by the sun tracking solar panel is as follows.

A. *Solar Tracker*

A standard solar panel consists of a layer of silicon cells. It also consists of a metal frame, a glass casing and various wiring to allow the current to flow from the silicon cells. As the solar panel faces the sun it absorbs the energy given by the sun and the silicon cells convert this energy into electricity. The solar panel is available in various shapes and sizes.

In order to implement tracking of the sun movement additional improvements are done in the normal solar panel. LDR's are used, they are light dependent resistors. Their function is to sense the direction of light. The LDR's can be placed in various methods on all four corners of the panel or on all four sides of the panel. Besides this a DC motor is used to move the solar panel when light is detected. PIC microcontroller is used in order to control the movement of the tracker The LDR's detect the maximum light, and the PIC is accordingly programmed to move in the direction of maximum light. Two motors are used to drive the tracker, one is for the tilt movement of the panel while the other is used for base rotation movement.[2]. Dual axis solar panel that has both the movements that is rotation from base as well as tilting is implemented.[1]

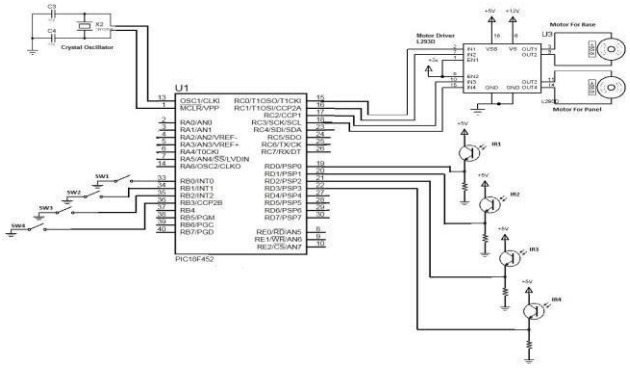

Fig 2. Solar Tracker Circuit Diagram

B. *INVERTER*

The supply from the solar panel is then given to the inverter. The energy converted to electricity by the solar panel basically, in the form of DC. But in order to drive various loads AC power is needed using an inverter. This converts the DC power received from the solar panel into AC. Before the supply is given to the inverter it is also passed through the charge controller. The basic function of the charge controller is to regulate the supply. The energy converted is uneven, so in order to regulate or smoothen it a charge controller is placed.

C. *Battery*

In order to save the energy generated a battery is placed in the system. The battery also has a function of supplying to the load that is to be driven. A specific amount of charge is needed to drive the load connected. Hence the battery is first charged and then the charge is used to drive the load. It is also useful for storing the extra charge or unused charge. One alternative to the battery is the AC mains supply.

D. *Switch*

The switch is basically implemented for switching between the battery supply and the AC mains supply. Specific amount of charge is needed in order to drive the load. If this amount of charge is present in the battery that is if the battery is enough to drive the load on its own, then the switch allows the supply from battery. But if the charge present in the battery is not enough to drive the load completely then AC mains is

the alternative. In this case the switch allows the supply from AC mains.

E. *Current sensing*

A current sensor is used, the function of the current sensor is to sense the amount and flow of current. It is the device that gives the information about the amount of charge stored and the amount of energy consumed. The current sensors are placed at two places. One is placed before the battery; this gives the information about the amount of current being stored in the battery. The other current sensor is placed at the load. This current sensor is responsible for providing information about the energy needed to drive the load.[3]

F. *Transmission and uploading*

The information from the current sensors is to be uploaded to make it available to the user. For this Arduino Uno boards is used along with node MCU. The information collected by the current sensors is then supplied to the Arduino. The Arduino has transmission and reception ports. The information from current sensor is easily received by the Arduino board and it is then transmitted to the node MCU. Node MCU is basically microcontroller within built Wi-Fi module. It is used in order to upload the information received to cloud. Things speak free cloud is used, In order to make information available or viewable to the user.

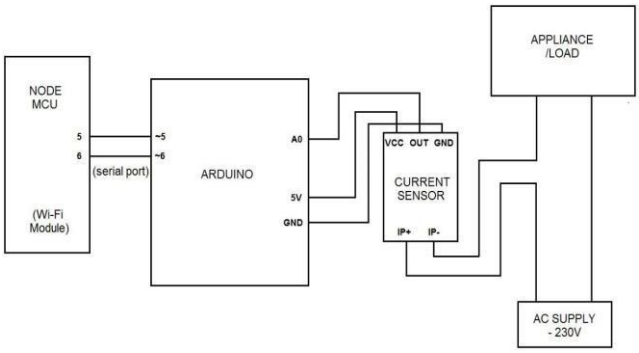

Fig 3. Data Transmission and Uploading

IV. Result

Smart solar tracker along with energy generated and consumed uploaded on cloud. The Dual Axis Tracking method provides with four dissimilar directions, because of which it is more effective in tracking the movement of the sun. The Dual Axis Tracker basically follows the east to west movement of the sun, along with this path it also follows the angular height position of the sun. This method is more efficient as compared to the Single Axis because in Single Axis only one of the two paths will be followed that is either the east to west movement or the angular height position.

V. Application

The smart solar tracker can be used in various applications that require energy. The fields in which efficient energy supply is required, smart solar tracker would be a perfect pick. It can be used in house, factories, industries, etc. As the new approach provides a new way of keeping a track on the consumption rate, it would be beneficial to use in large industrial areas where it is required to keep a check on energy consumption and energy saving.

VI. Conclusion

This approach increases the efficiency massively as compared to the current system. As the panel tracks position of the sun throughout the day maximum output is extracted from this system. The maximum energy absorbed from the sun is converted to electrical energy. Due to continuous tracking the overall efficiency is increased The performance management provided by this system is very useful in order to keep a track of the whole system. The energy being used and consumed is uploaded. Any error if present is known faster. The provision of saving the amount of unused energy and sending it back to the MSEB is very innovative. It is an amazing step so as to prevent the wastage of energy

VII. Acknowledgement

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