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## Smart Solar Panel Efficiency Monitoring System

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**ABSTRACT:** The proposed system calculates and monitors efficiency of solar cells and also solar panel will rotate 180 degrees. The use of ACS712 current sensor and voltage sensor using voltage divider circuit and GSM communication system allows to monitor both the battery and the solar panel. The information from the current sensor and voltage sensor then processed by a Arduino Mega 2560 microcontroller. The microcontroller send the efficiency, voltage and current information to a server through a GSM communication system, if the efficiency of solar cells falls below a certain level, alert the user through short message service(SMS).In the server database has collected data using those data the user can analysis the efficiency on different time intervals. This information then can be accessed by internet. Two sensors will be used, Humidity and light dependent resistor (LDR). This device will measure the efficiency solar panel, moisture and light on the circumstances surrounding.

**KEYWORDS:** Solar panel, Arduino Mega 2560 microcontroller, ACS712 current sensor, GSM, LDR.

### I. INTRODUCTION

Sun based vitality is one of the wellsprings of sustainable power source that used to create power. It utilizes photovoltaic cells, or otherwise called sun powered cells, sunlight based vitality can be changed over into power. Sun oriented cells produce direct flow power (DC) and can be changed over to electrical substitute flow (AC) through reversal procedures. Sunlight based vitality has been broadly utilized today as a green innovation that has been actualized by the legislature. With expanding vitality supply, sustainable power source age innovation has drawn on the planet's consideration. Where sunlight based is one of the sustainable power source and condition amicable.

In this manner, this sun-based undertaking has grown quickly under government motivations to create green advances. With the sun light-based checking framework is a use of sun based vitality innovation that can successfully tackle the issue of ecological observing and woodland fire. The benefit of utilizing sun light-based boards is natural agreeable and sustainable power source, simple establishment and support, and long time span of usability and it is perfect for clients who are utilizing on a substantial size of sun oriented board.

Photovoltaic or PV for short, is a strategy that is novel and particular in bridling the sun's vitality. One of the results that ought to be considered in the utilization of sunlight based panel is the effectiveness of the sun powered board itself, since productivity refers to the measure of light of the entire module that transforms it into power. The effectiveness of the Solar board will be lower if there is a separation between the cells and furthermore on the grounds that the glass spread and mirror the light from the sun is retained into the cells. One more reason is the board is settled specifically heading only.



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Thus, it ought to be given specific consideration as a result of the effectiveness show precisely how much power will be produced from the sun-based board. The reason for this task is to create observing framework effectiveness sun based cells, where the framework will inform the client by means of SMS.

On the off chance that the productivity of sunlight-based cells falls underneath a specific dimension, the GSM will give a warning to the client. The venture will be manufactured utilizing the Arduino Mega 2560 microcontroller, GSM as a method for correspondence between Arduino Mega and GSM. Two sensors will be utilized, stickiness and light ward resistor (LDR). This gadget will quantify the effectiveness sun-oriented panel, moisture and light on the conditions encompassing.

## II. RELATED WORK

Solar panel are very helpful to get the power from the free source call sun, nowa day's solar system are playing a key role for producing the power mainly because that is ecofriendly to nature. Once we install the solar system to a place that will work in a long period of time. Installation cost is little bit high but that we invest at only once. We can install the solar panel system in anywhere but in that place sun rays should be present. Over a period of time lot of dust will fall on the solar panel due to that the efficiency of the solar panel will be decrease as compared to the clean solar panel and also the Earth is rotating around the sun, the sun raises from the EAST and sunset on the WEST due to that the position of the sun rays are moved from EAST to WEST in a day. If we fix the solar panel in one position some part of energy will be loss. In Existing system there was no mechanism for calculating the efficiency of solar panel. In addition, the solar panel was not able to rotate in the direction of sun shine. It was fixed in one direction only. In existing system there was no transfer the information remotely of the solar panel efficiency and also there is no alert to user if the solar panel efficiency is low.

*Disadvantage:*

1. Solar panel is not rotate
2. No alert to user
3. There is no Analyzing of Efficiency data
4. There is no provision for Storing energy into batteries.

## III. PROPOSED SYSTEM

In proposed system has a mechanism for rotating the solar panel based on the sun shine. The sun rotates East to West so if we rotate the solar panel form East to West from zero degree to 180 degree, we can utilize the maximum amount of power from the solar panel.

Collecting the Analog data from different sensor such as current sensor, voltage sensor and humidity sensor given to Arduino Mega 2560 microcontroller process those data and then send to sever through the GSM module. For every few seconds (i.e. user choice) the data will be updated to the server. The data which is present in server database that can be useful for analysing the efficiency on different time interval and also, we can predict the how much amount of energy is used by load on different conditions in different period of time because the earth is rotating around the sun, so the position of the panel may vary on period of time. So, we can use the load more on certain period of time like summer we have large amount of energy will be generate from solar panel. But in winter we have less amount of energy because the sun may not present fully in this period of time. If the load may be some time utilize a small amount of power, but the solar panel give more that load utilize so that energy can be stored into battery that stored energy can be utilized in night time.

In summer time if efficiency of solar gives very less compared to normal summer time, we can analyse that there have lot of dust on solar panel due to that the power of solar panel is not gives as we expected.

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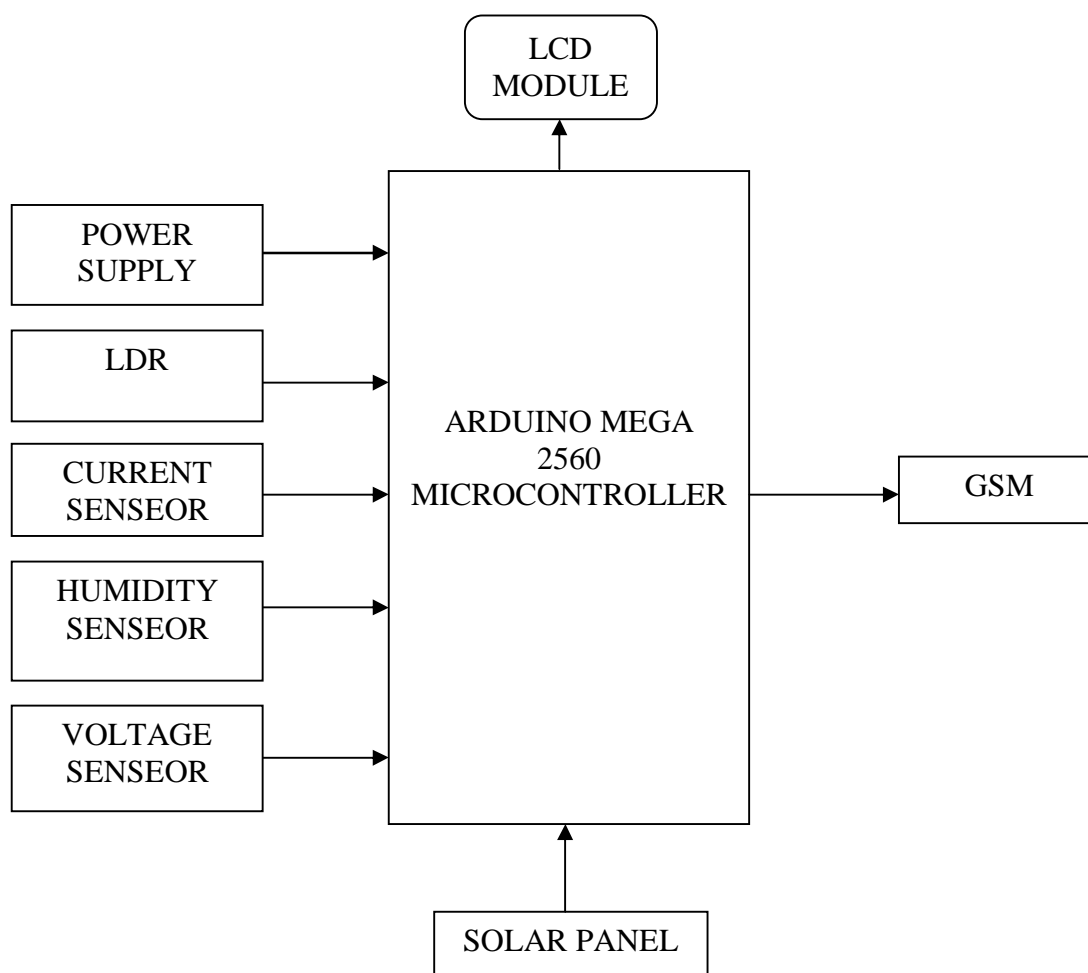


Fig.1:Block Diagram of Efficiency Monitoring System

The block diagram explains clearly the which are modules are used in the system and which are the inputs to the controller and output are going from the controller. The power supply is given to the Microcontroller and GSM module is 12 volts this voltage can be given from external source or battery or these two devices can be used a load to the setup.

In this setup Arduino mega 2560 microcontroller is used because this controller having more number ADC channels, so we are using ADC channels for voltage measurement of solar panel LDR 1,LDR2, current measurement and also for measuring humidity. Through the serial communication we are sending commands to GSM module.

By using the Arduino IDE wrote the code and dumped into the Microcontroller. As per the code first initialized the all peripherals and GSM module then LCD show an initialization completed message.

If the solar panel broken due to damage that the efficiency will be decrease if that goes below certain limit that information will be send to user in the form of SMS as efficiency is low.

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Fig.2: Real setup of solar panel efficiency monitoring system.

The real setup is shown in the fig.2 we are using two DC stepper motors for rotating solar panel the angle of rotation is based on the LDR's values, the LDR 1 and LDR 2 sensors data is collected and processed by the controller then compare these two LDR's values. Which LDR value has higher value in that side the solar panel will be rotated. Battery is used for two purposes: 1) It can store energy, 2) Discharge the energy while solar power is not present. A voltage divider circuit is used for measuring the current, how much current can be drawn from the solar panel. The solar controller device controls and manages the power supplies.



Fig.3: LCD Display.

The LCD screen is used for displaying the readings of all sensors. The values of LDR are shown on the LCD display. L1 is placed on the East side of the panel and L2 is on the West side of the solar panel. Based on the voltage of these LDRs, the position of the solar panel is fixed. The humidity value is sensed by the humidity sensor; if the humidity value is high, due to that, the efficiency will decrease and finally the PV (Photo-voltaic) voltage is the voltage of the solar

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panel. If any obstacles like clouds, dust etc are come on the solar panel the voltage of the solar panel will be decrease. If the voltage is below 5 volts that information is send to user that can be done by the GSM module.

## IV. RESULTS

The Efficiency of Solar panel monitoring real setup is shown Fig.3By using this setup we can analyze the efficiency of solar panel in different time interval over a period of time. Based on the result of the analysis we can utilize the load. In these two DC motors are attached to two sides of solar panel that are rotating perfectly based on the sun shine. Solar controller device is using to control the battery and input power supply of loads. The value of the solar panel voltage, Two Light Dependent Resistors (LDR) values and Humidity value is displayed on the LCD screen continuously that is shown in figure Fig.3.



Fig.4:Uploading the data to sever.

The user defined time interval the data will be uploaded to the sever. We can watch the value of all parameters those are voltage, current, power and efficiency at a particular time interval and also we can plot the graph based on the time interval verses voltage.while uploading the data to server the LCD Display show as “Updngwait...” text on display for indicating to user the data is sending to the sever shown Fig.4.

← → ↻ ⓘ Not secure | mtpsmarhome.000webhostapp.com/sfetch.php

SMART HOME Status Data

Sl No.	Owner Name	Humidity	Voltage in Volts	Current in Amps	Power Efficiency	Time
1	XYZ	66	12.1	11	89	2018-11-27 02:36:33 PM
2	XYZ	66	12.1	11	89	2018-11-27 02:37:16 PM
3	XYZ	99	12.92	0.45	79	2018-12-23 12:35:26 PM





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310	XYZ	27	11.92	0.50	5.93	106	2019-02-06 02:49:52 PM
311	XYZ	27	11.90	0.50	5.93	106	2019-02-06 02:50:46 PM
312	XYZ	27	11.90	0.50	5.93	106	2019-02-06 02:51:51 PM
313	XYZ	27	11.89	0.50	5.92	106	2019-02-06 02:52:43 PM
314	XYZ	27	11.88	0.50	5.92	106	2019-02-06 02:53:39 PM
315	XYZ	27	11.81	0.50	5.88	106	2019-02-06 02:55:01 PM
316	XYZ	27	11.86	0.50	5.91	106	2019-02-06 02:55:56 PM
317	XYZ	27	11.84	0.50	5.90	106	2019-02-06 02:56:45 PM
318	XYZ	27	11.83	0.50	5.89	106	2019-02-06 02:57:35 PM
319	XYZ	27	11.83	0.50	5.89	106	2019-02-06 02:58:26 PM
320	XYZ	27	11.82	0.50	5.89	106	2019-02-06 02:59:16 PM
321	XYZ	27	11.82	0.50	5.89	106	2019-02-06 03:00:08 PM
322	XYZ	27	11.81	0.50	5.88	106	2019-02-06 03:01:10 PM
323	XYZ	27	11.80	0.50	5.88	106	2019-02-06 03:02:03 PM
324	XYZ	27	11.79	0.50	5.87	106	2019-02-06 03:02:54 PM
325	XYZ	27	11.79	0.50	5.87	106	2019-02-06 03:03:57 PM
326	XYZ	27	11.78	0.50	5.86	106	2019-02-06 03:04:53 PM
327	XYZ	27	11.76	0.50	5.86	105	2019-02-06 03:05:48 PM
328	XYZ	36	11.46	0.46	5.27	100	2019-02-06 04:31:14 PM
329	XYZ	35	10.98	0.44	4.83	91	2019-02-06 04:32:03 PM

Fig.5:Data in the Server.

Go to the website [mtpsmarhome.000webhostapp.com](http://mtpsmarhome.000webhostapp.com). a web page is Web Based Solar Monitoring System in that page click on the “show Details” Button then immediately data will be shown on the screen these data sent by the controller is show in figure 5. By using these data’s, we can analysis the efficiency of the solar panel in different period of time that may be in hours, days, months and also years. Based on the analysis result we can understand how much power is generated by solar panel on different time intervals. We can also export the data into the excel those data can used for plotting the graphs between time to voltage, efficiency to voltage with a constant load.

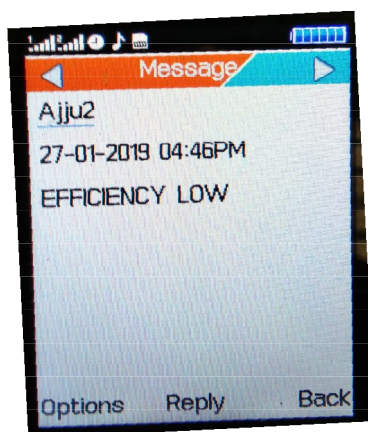


Fig.6: Alert SMS to User.

If the efficiency is decreased below the cutoff value, the GSM send an SMS to the user as EFFICIENCY LOW and also shows the efficiency value like EFFICIENCY = 49 shown in Fig.6.. By using GSM, we can send the data to server for analyzing the data and also we send the alert SMS to user. If the user get alert SMS they can check the solar panel on where they had placed if he doesn’t have the alert indication to user, they should be check the solar panel frequently.



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## V. CONCLUSION

The efficiency of solar cell influence on the output value of the solar panel, where is the higher the efficiency the higher the solar radiation is produced. But the solar panel should be monitored in order to maintain the output value and the consistency of the value. By this monitoring system, the solar panel can be use at long term usage and the maintenance can be done at instant when the notification (SMS) stem is installed on the system to the user and also storing energy into batteries that can utilize in unavailable of solar power.

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