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# IoT Based Smart Solar Energy Monitoring System with Wiping Mechanism

*Mr. Santosh V Patil
Assistant Professor, Department of Electrical Engineering, Annasaheb Dange college of Engineering & Technology, Ashta, India. 416 301

Mr. Rushikesh Gawade
UG student, Department of Electrical Engineering, Annasaheb Dange college of Engineering & Technology, Ashta, India. 416 301

Ms. Amruta Mane
UG student, Department of Electrical Engineering, Annasaheb Dange college of Engineering & Technology, Ashta, India. 416 301.

Mr. Rushikesh Bandal
UG student, Department of Electrical Engineering, Annasaheb Dange college of Engineering & Technology, Ashta, India. 416 301.

Mr. Toufik Naikwade
UG student, Department of Electrical Engineering, Annasaheb Dange college of Engineering & Technology, Ashta, India. 416 301

***Abstract:*** **As more nations are moving towards contamination free traffic, Electric Vehicles are acquiring fame across the globe. As the quantity of Electric Vehicles increments, Electric Vehicle charging foundation will likewise be an essential need. A Smart card empowered framework will smooth out the exhibition of EV charging and will further develop city arranging. Since the battery is a generally involved gadget for capacity of energy so estimation of the State of Charge assumes an indispensable part. The proposed technique is useful in transportation frameworks as it permits the charging of the batteries in an electric vehicle in a semi-independent way with negligible human intercession. When the client is familiar with the situation with his vehicle battery, he can without much of a stretch choose whether to continue with the charging system by allowing to accuse of the shrewd card. When the affirmation is gotten from the station the framework will play out the charging activity and work out the comparing charges and deduct the sum from the proprietor's e-wallet. In this manner remote brilliant card based shrewd charging has been created to screen the situation with batteries and make the charging system semi-independent. The proposed framework will give a smooth charging experience and a superior strategy to control the whole charging process".**

***Keywords: IoT, Arduino, Solar system, Wiping mechanism***

## I. INTRODUCTION

Human beings have three basic needs that is food, shelter and clothes. But now in this changing world we need electricity to perform various tasks and it became important part of our life. Renewable energy source play's important role while providing solution to address the insistent demand supply gap in power industry. There is large amount of solar energy available in our country unlike the other renewable sources which has certain limitation. Among all the available renewable sources, solar photovoltaic is the most beneficial. For monitoring the power generation from the renewable sources, we can use the IoT application. India is blessed to have atmosphere which emit the solar radiation, it leads to attract massive solar power plant installation. Electricity is a basic need in everyone's life. As the energy consumption is increasing, the energy resources reducing parallel. This is due increase in demand which results from increasing population. In order to balance the shortage of electricity, we can use various resources to generate electricity and full-fill the requirement. The Electricity can be generated by two ways either by conventional method or non-conventional method. We can generate the electricity using the energy carriers which includes fossil fuels and nuclear fuels. But the disadvantage of these type of energy carriers is that, they cannot be used again that is non-renewable resources. To overcome that solar power is used which is a sustainable power source. It is available widely across the world. Over the year sun is producing this energy which can be used to generate the electricity and this further converted to electric power. This application known as solar thermal power energy and it is conventional.

Monitoring of the system leads to predict the energy and increases the productivity in communities. Solar energy is one of the most important renewable sources which gaining attention of large number of groups. To make solar system more efficient, monitoring should be done so that we can get the maximum output. Monitoring play important role to make system efficient. It gives the information about solar parameters, extracted energy, fault detection and associate energy loss. By using monitoring, we can easily measure solar production. It helps in saving on monthly electricity bills. Monitoring help us to track all the parameter of the solar photovoltaic system.

## II. LITERATURE SURVEY

P. C. M. Carvalho proposed the design and development of a monitoring system that would provide information on broken solar panels so that they could be repaired and maintained as soon as possible. Using a low-cost wireless sensor network, the design, development, and work of a monitoring system for distributed solar panels, as well as automated data logging, has been reported to help with the current situation. This system can be used with solar cell systems up to 146 V and 15.5 A thanks to an automatic selection of best resolutions. Their system costs Rs. 12000 in total. Due to the depletion of conventional sources of electricity, some non-conventional resources that can be used indefinitely are required. One of the sources is solar power systems. This system converts sunlight into electricity, which it then stores

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and distributes. When there isn't enough sunlight to convert the sun's rays into electricity, the batteries provide the previously stored electricity. These Internet-of-Things-based PV systems are the next-generation system for solar system monitoring.

Another low-cost IOT-based PV system is proposed, which employs a GPRS module and a low-cost microcontroller to receive all data from the PV system. In the world of electronics, the Internet of Things (IOT) is widely used. The temperature and current of the PV system are measured by this system. A website is used to access the system's data. Solar power panels are one of the non-conventional electricity resources, and thanks to the massive reduction in the cost of modern technologies, these solar power systems are now very affordable and accessible. However, in order for people to effectively track and control these systems, they must be monitored on a regular basis. Data loggers and monitoring methods are essential for a solar system to function properly. These methods enable us to collect all of the system's information about a malfunction before it causes more harm. Another paper suggested using Raspberry as the component integration platform for a solar power system based on IoT. This system also generates statistics on a regular basis and publishes them on a website. The data logger keeps track of humidity, temperature, voltage, and current. After a set amount of time, Kishore et al. proposed a cloud-based solar system monitoring technique that sends constant records to the cloud. The ability to track the power plant in real time allows for easy analysis of the solar system's current status. Analysis has the benefit of assisting in the location or detection of potential system faults while keeping a close eye on output from afar. Another environmentally friendly solar system was proposed by Rakesh and his colleagues. In the server, the amount of energy generated is constantly monitored and updated.

## III. PROPOSED WORK

The main objective of the proposed work is to monitor and analyses the output Of the PV system. This data is sensed by current and voltage sensor through Arduino. To implement in smart grid, this system helps for efficient usage. It uses the IoT platform so that the processed data can be analyzed remotely.

**System Design**

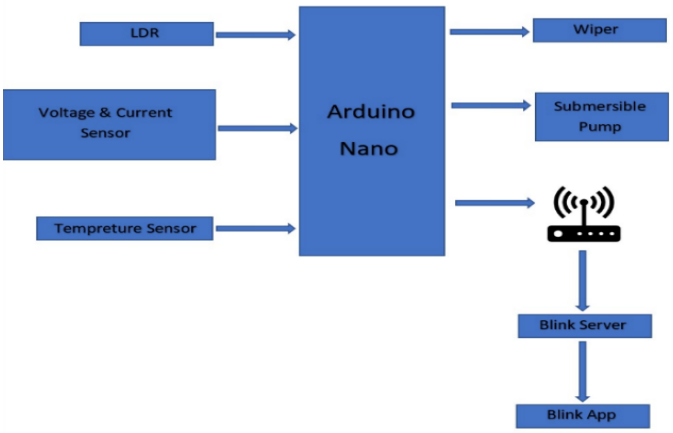


*Fig 1.* General block diagram of IoT based solar monitoring system

It is ATmega328P micro-controller from 8 bit AVR family. It is operated at 5V.It has 22 input/output pins. It has digital pin which will help to process the data. Arduino software is used to program Arduino nano. During this ATmega328 is programmed with the boot loader. This will upload the program without using exterior hardware programmer.

*Fig 2.* Arduino Nano

As this project deals with the solar parameter analyzing, so for this purpose solar circuit is used. Depending on Circuit rating of the solar panel chosen.

*Fig 3.* Solar Panel

LDR that is Light Dependent Resistance is a type of variable resistance. It changes with the intensity of Light falling on it.

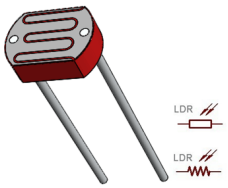


*Fig 4.* LDR

Stepper Motor is the device which converts the electrical signal to mechanical movements. Speed of the motor is related to the frequency of this input pulses and length of rotation. The sensors such as voltage sensor, current sensor and temperature sensors are used to sense the voltage, current and temperature respectively. ACS712 sensor is used to detect voltage as well as current while DHT11 temperature sensor is used.

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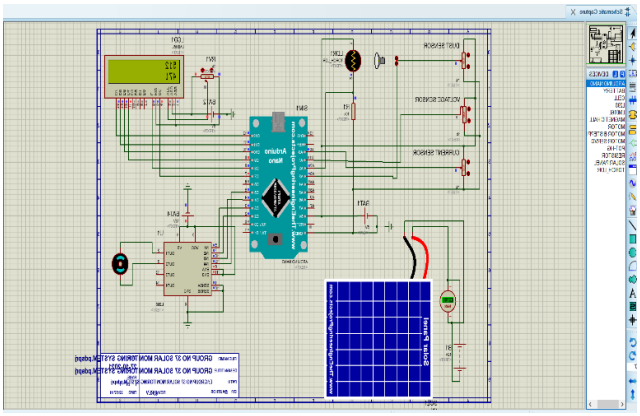

*Fig 5. Proteus Simulation*

## IV. EXPERIMENTAL METHODOLOGY

There is a small arrangement or arrangement of experiment of solar panels whose voltage variation is to be measured or is to be investigate. A panel is oriented to receive solar radiation for the maximum number of hours based on Thanjavur's latitude. The panel's specifications are listed on Tab 1.A 50rheostat connected to the PV module was used to measure the IV characteristics. Under standard test conditions (STC) of AM 1.5, 25°C, and 1000 W/m2, the solar panel was put to the test. Experiments were carried out in the open air with solar panels partially.

Table I. Solar panel specifications

| Specification | Rating |
|---|---|
| P(max) developed | 4 Watt |
| Open circuit voltge across solar panel(Voc) | 6 V |
| Short circuit current through outer circuit of panel (Isc) | 0.67 A |
| Voltage developed P(max) | 7V |
| Current when P (max) | 0.70A |
| Maximum system voltage generated | 500 V |

obstructed by shadow and soil dirt. The experimental setup is depicted in block diagram form in Figure 1. The experimental setup for the cleaned PV module, shadowed PV module, and dust PV module is solar panel with and without dust. The entire experimental study is presented in this document.

### Sensors for voltage and current

The ACS is an AC and DC current sensor that can detect both AC and DC current. For more information, you can compare AC and DC power. The peak AC and DC currents can be measured, and the output current can be measured by Arduino. It's also available in 30mA and 10A versions, making it suitable for both AC and DC current sensing in a variety of applications. The ACS is a precise and low-offset linear Hall sensor circuit with a copper conduction path near the die's surface. Switched-mode motor control ACS is used in a variety of sector devices, including power supplies, load detection and management, and overcurrent fault protection. In today's post, we'll look at its operation, Arduino interfacing, applications, pinout, and more. I'll also provide links to some examples of how I've used it to communicate with other microcontrollers. If you have any further questions, please leave them in the comments section and I will respond as soon as possible. So, let's get started with an overview of the ACS.

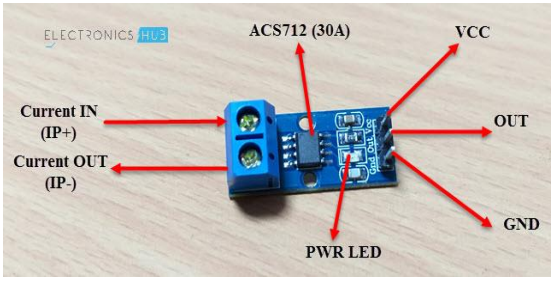


Fig 6. ACS712 Sensor

### Introduction to ACS Series Current Sensor

• The ACS series is a current sensor that can easily detect AC as well as DC current. The peak AC or DC values that can be detected are 10A. Its working voltage is 5 volts.
• The ACS comes in a small surface mount Mini package. Its front-frame is 100% mattering plated, making it compatible with standard lead-free printed circuit board assembly.
• Its software package makes it simple for customers to implement, typical applications include all drives and pore appliances.
• It is made up of a linear hall circuit with a copper conduction path near the die's surface. When current is applied to this copper conduction path, a magnetic field will be generated, which is sensed by a Hall integrated circuit (IC) and converted into a proportional voltage.
• When current is passed the pins which gets activated through pin 1 ,2, 3, 4 which is the path used for current sensing, the output of the ACS712 has a positive slope (>VIOUT (Q)). This conductive path has an internal resistance of 1.2 m. During an over-current condition, the conductor thickness ensures that a device survives.

### ACS712 Pinout & Description

Table No 2. ACS712 Pinout & Description

| Pin | Type | Parameters |
|---|---|---|
| Pin 1 | Vcc | INPUT 5V supply. |
| Pin 2 | Output | OUTPUT (proportional to current) |
| Pin 3 | Ground | Ground Purpose |

*Fig 7.* Solar Panel

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Voltaic Systems, a manufacturer of high-quality solar-powered bags and packs, provided us with these panels. These are scratch-resistant, waterproof, and UV-resistant. They use a monocrystalline cell with a high efficiency. They have a 3.5mm x 1.1mm DC jack connector that outputs 6V at 330 mA. The substrate is an aluminum/plastic composite that was created with the goal of being both strong and light. They can easily withstand common outdoor abuse, such as being dropped and leaned on. They're of excellent quality and are recommended for projects that will be exposed to the elements.

**Blynk operation**

Blynk was designed with the Internet of Things in mind. It can control hardware from afar, display sensor data, store data, visualise it, and do a lot of other cool stuff.

Three major components make up the platform:

• Blynk App - By combining our widgets, you can create stunning interfaces for your projects

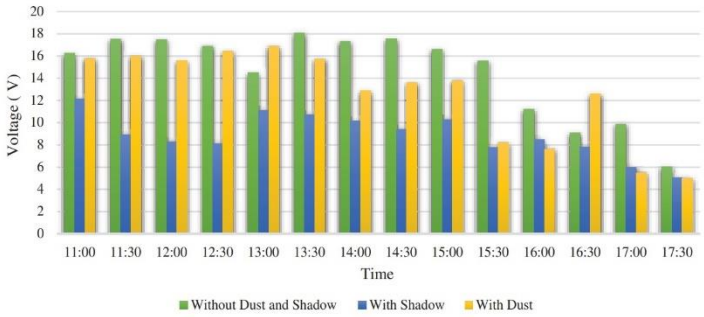


Fig: 8 Comparison of voltage of cleaned panel, with shadow and dust

All communication between the smartphone and the hardware is handled by the Blynk Server. You have the option of using our Blynk Cloud or setting up your own Blynk server on your own computer. It's free and open-source, with the ability to support thousands of devices. It can even run on a Raspberry Pi.

• Blynk Libraries enable communication with the server and execute all incoming and outgoing commands on all popular hardware platforms.

Consider this: anytime you hit a Button in the Blynk app, the message is transferred to the Blynk Cloud, from where it is delivered to your hardware in a magical way. It works in the opposite direction in the same way, and everything happens in the blink of an eye.

**Arduino IDE Definition**

1. The Arduino IDE is a free and open-source software that allows you to write and compile code for the Arduino Module.
2. It is official Arduino software that makes code compilation so simple that even non-technical people can learn the basics.
3. It is based on the Java Platform and is compatible with MAC, Windows, and Linux operating systems. It comes with built-in functions and commands for debugging, editing, and compiling code in the context of the environment.
4. There are Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro, and a slew of other Arduino modules to choose from.
5. Each of them has a microcontroller on the board that has been programmed to accept data in the form of code.
6. On the IDE platform, the main code, also known as a sketch, will eventually generate a Hex File, which will be transferred and uploaded to the board's controller.
7. An editor and a compiler are the two main components of the IDE environment. The editor is used to create the necessary code, and the compiler is used to compile and upload it to the Arduino Module.
8. The C and C++ programming languages are supported in this environment.

## V. Experimental Setup and Procedure

There is a small arrangement or arrangement of experiment of solar panels whose voltage variation is to be measured or is to be investigate. A panel is oriented to receive solar radiation for the maximum number of hours based on Thanjavur's latitude. A 50rheostat connected to the PV module was used to measure the IV characteristics. Under standard test conditions (STC) of AM 1.5, 25°C, and 1000 W/m2, the solar panel was put to the test. Experiments were carried out in the open air with solar panels partially obstructed by shadow and soil dirt. The experimental setup for the cleaned PV module, shadowed PV module, and dust PV module is shown in Fig. 11. Figure 11 shows the solar panel with and without dust. The entire experimental study is presented in this document

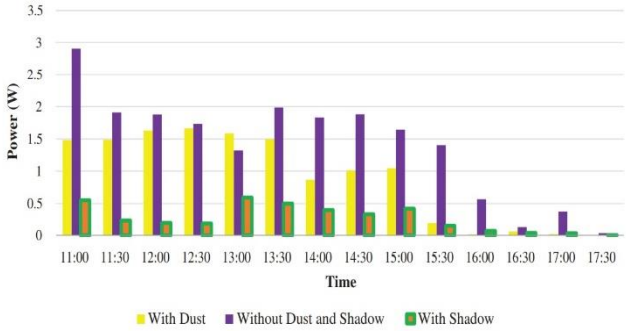


Fig: 9 Comparison of current of cleaned panel, with shadow and dust

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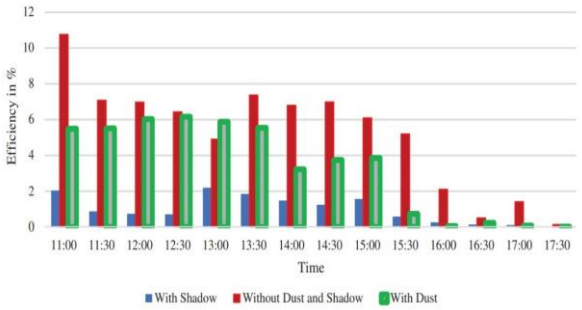


Fig: 10 Comparison of efficiency of cleaned panel with shadow and dust

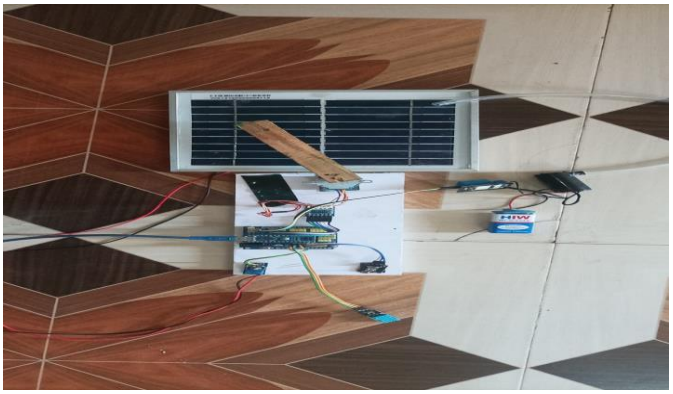

Fig. 11. Hardware Implementation

## CONCLUSION

From this project we can easily overcome the problem of performance falling of solar panels due to dust accumulation on the solar panel by using IOT based arrangement along with wiping mechanism on it so that user can get data over internet to monitor the health or performance of that solar plant, we can implement this system in big plant also where the problem of dust is more which causes to reduction in efficiency of solar plant.

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