

## A Study of IoT based Solar Panel Tracking System

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### Abstract

A sunlight based framework is the device for orienting solar photovoltaic modules and solar thermal collectors toward the sun. Thinking about the state of the art of the innovation, successful strategy, robust control philosophy and the potential added benefit of different research work which can be employed on an extensive scale in maintainable manner. Presently we are entering in a new period of processing innovation i.e. Internet of things (IoT). IoT is a sort of “universal global neural network” in the cloud which associates various things. The IoT is a intelligently connected devices and framework contain brilliant machine connecting and communicate with different machines, environments, objects and infrastructures and the radio frequency identification (RFID) and sensor network technologies will rise to meet this new challenge. Furthermore the investigation gives the different related works on iot empowered solar panel monitoring modules for the proficient way of gain power from the solar radiation.

**Keywords:** Internet of Things (IoT), Electricity, Solar panel, Photovoltaic (PV), Cloud.

### I. INTRODUCTION

In this modern world, Electricity is also added to the most basic needs in everyone’s life. The graph of energy consumption is getting increased day by day where as the energy resources are diminishing parallel. In order to balance the scarcity for electricity, various sources are used to generate electricity. For the generation of electricity, there are two ways: one is by conventional method and other one is non-conventional method. Some of the energy carriers like fossil fuels and nuclear fuels are also used, but they are not renewable resources (i.e., they are not ‘refilled’ by nature) and it is said to be non-conventional. In its broadest sense, sustainable power

source can be achieved by using the solar power as source. Solar energy has the wide availability throughout the world. Even The sun has produced energy for billions of years. The sun's rays may cat as an important source for the generation of electricity by converting it into a electric power. Such application is called as solar thermal energy, which is conventional.

Even though various sustainable sources are available such as wind, rain, tides and geothermal, natural based bio fuels and conventional biomass, solar power have huge benefits.

Nowadays in India, frequent power cut is very common. For that it is primary to use the renewable energy and monitoring it secondarily.

The rapid growth in renewable energy applications have been empowered by a critical drop in cost over the earlier decades and specialized change in their productivity, unwavering quality and lifetime. And by means of monitoring the energy forecasting, households and communities, the productivity gets increased.

In case of India's development and economic growth, electricity plays a vital role. In energy consumption, India is the fourth biggest country after China, USA and Russia. India has an installed capacity of 278.7GW with a per capita total electricity consumption of 1,010 kWh in 2014–15. Despite a growth of 5.54% over 2013–14 and also having cheaper electricity tariffs, the per capita consumption is low when compared to many other countries. The country accounts for around 21% of the world population with no access to electricity. The overall electrification rate in India is 64.5%, while 35.5% of the population still lives without access to electricity.

Internet of things means simply the network of Physical objects. This provides the connection of each and every object in the world by means of wireless sensor network. Some of the devices, buildings, vehicles and other objects embedded with software, sensors, electronics and network connectivity can enables these objects to collect and exchange data.

This IoT (Internet of Things) is achieved by wireless sensor networks, sensor networks, 2G/3G/4G, GSM, GPRS, RFID, WI-FI, GPS, microcontroller, microprocessor, etc. Empowering advancements for the Internet of Things are considered and gathered into 3 classifications. They are

- Advance that empower “things” to accept contextual information.
- Advance that empower “things” to process the relevant data, and
- Innovation to enhance security and protection.

Accepting the information and processing the relevant data can provide an understanding which is needed to build the “intelligence” into “things”. This is the highlighted feature that differentiates IoT from standard internet.

The need for using IoT concept in this solar tracing system is to overcome the major disadvantages of electricity generation from the solar energy. The range of sun's radiation that reaches the ground surface is not in a fixed value. Because the range

may varies according to location, time and climatic conditions. For that the solar panel can be completely exposed to the sun's radiation always. And hence the solar panel can be monitored by using Internet of Things. There are several Techniques which have been studied for the solar panel tracking system by using IoT. And the analyses about few techniques are delivered as follows.

This paper uncovers two more segments. Segment II provides the detailed explanation about the various related works in this area. Segment III reveals the conclusion and finally, references utilized as a part of this zone.

## **II. RELATED WORK**

This literature study reveals the elaborate work on various strategies used for monitoring the solar panel position by using Internet of Things (IoT) for effective conversion of solar energy into electrical energy and automation in solar panel's position tracking.

### *i . Using Hybrid PV cells:*

Design of solar power system for the supply of usable solar power through photovoltaic(PV).the design may comprises of various component, among that there are two major components used. One is the solar panels which can absorbs the radiated solar energy and convert such sunlight into the electricity. The second major component is solar inverter; it is used to alter the direct current into alternating current. Some minor components are used for mounting, cabling and also various electrical accessories.

In case of the solar tracking system having two-axis (dual -axis), the panel can be tilted front and to get the maximum absorbance of sun's rays. However this accurate tracking of the sun rays can be improved by applying MPPT (Maximum Power Point tracing) mechanism.

Even though the panel can be architected as dual-axis, the inverter used along with it will be act much smarter to transmit and receive the information rapidly as well as share the data with user. The framework starts with solid, tough and proficient silicon-driven equipment, which can be controlled by a versatile programming stage fusing a complex execution technique.

Such framework permits installers and administration experts to analyze operational and support issues-including anticipating conceivable inverter or module issues-and remotely update certain parameters in minutes. More or less, the useful stream embraced would be

- **Use in off grid mode:** (without network) with the likelihood of connecting to a generator. The inverter must be connected to a battery bank and must have valid off grid capacities- not all Hybrid inverters accepted for off-grid applications.

- **Use in on-grid or grid-tie:** (connected to the network) with the likelihood of offering validity or abundance vitality. There is a need to have the standard protection and decoupling.
- **Use in hybrid mode:** the inverter performs with a battery bank, yet in addition associated with the grid. This dual specialty enables energy management which is consider as a highlight of hybrid inverters (smart grid).
- **Use in Back-up mode:** or storage mode keeps power outages by changing from on-grid to off-grid mode and prevents blackouts by switching from on-grid mode to off-grid mode right now of electric blackout, subsequently disposes of network cuts.

### *ii. Using Micro grids-Dependable control*

The following module incorporates photovoltaic boards (PV) used for gathering sun's radiation and move systems with two degrees of flexibility used to control the azimuth and height of the boards. The movement can be controlled by either an inherent or a remote controller. The data communication is directed via a gateway which converts signals from Modbus Serial to Modbus TCP protocols. The gathered energy is amended and put away in two 50 kWh stream innovation batteries. By means of inverters and isolators, the AC yield is encouraged onto a isolate building micro grid, utilizing standard 3 Phase 415 VAC, that is associated with specific gadgets and power points set all through the building.

For observing and wellbeing, Tigo frameworks are actualized to record the solar panel status. The information is then collected by algorithm implemented in an application server to break down the power use, assess the reaped energy and identify unusual occasions. The aftereffects of this progress, from one viewpoint, give references to ideal and control modules in type of organize based application program interfaces (APIs) and, on the other hand, joined with other building information to make vitality profiles being put away in databases.

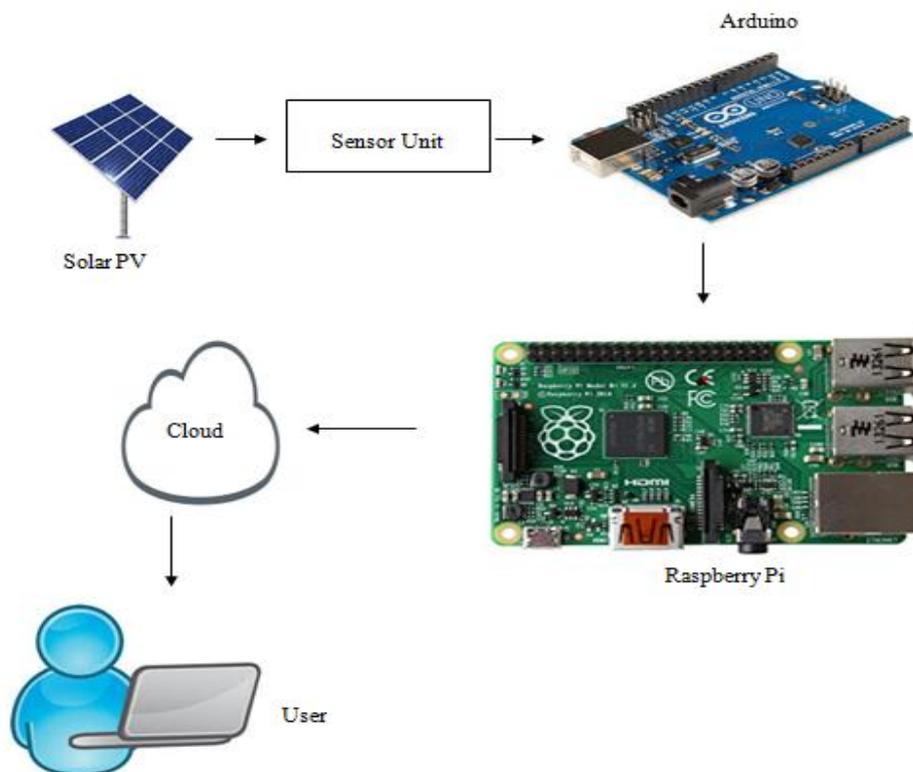
At the center of the framework are IoT-based controllers. They are in charge of solid control of sunlight based trackers under circumstances of equipment disappointments and correspondence interferences. The controllers are implanted PC sheets introduced tried and true control calculations. The sheets are interconnected what's more, when joining with other handling units frame a private cloud system to control and deal with the micro grid.

The term "cloud" here suggests a deliberation of control equipment acquainted with the actuator gadgets, for example, a detachment between the solar tracker and its controller leading through institutionalizing signal arrangements and control conventions gave by means of system administrations. Therefore, an actuator gadget does not have to know which controller is controlling it or how numerous repetitive ones are utilized for unwavering quality. This deliberation consequently enables one controller to at the same time control various sunlight based trackers and gadgets

while in the meantime demonstration as a repetition for different controllers. It likewise permits on the web assets, for example, continuous meteorological and cosmic information to be recovered and coordinated into the framework so that a worldwide enhancement can be directed bringing about better energy gathered.

**iii. Using Arduino and RPi**

Strategy used in this segment is to exhibit the framework plan of the Solar Energy Monitoring System. The observing information transfer to the cloud through RPi as appeared in the figure 1.



**Figure 1:** System Design

**a. Arduino & Cloud Setup**

Remembering the economic constraints and the effortlessness of the framework, Arduino Uno has been utilized which lessens the programming activities. Arduino sense the current and voltage esteem through Simple pins. With the assistance of these qualities, Arduino programming ascertains the power and vitality.

Raspberry Pi Raspberry Pi is utilized as a part of the venture as a focal observing framework. As Raspberry pi board is a compact and minimal effort. Thing Speak is an

open source IoT application and API to store and recover information from things utilizing the HTTP convention over the Internet or through a Local Area Network. Thing Speak empowers the making of sensor logging applications, area following applications, and an informal organization of things with announcements. The client ought to make the record first.

### *b. Work process*

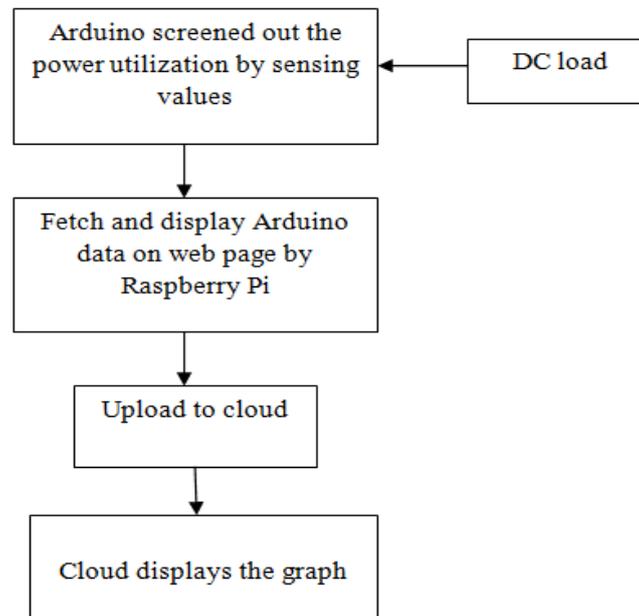
Figure 2 speaks to the procedure of proposed framework from load to the checking framework. The work stream of the sun oriented vitality checking framework is exhibited as venture underneath:

**Stage 1:** Arduino show the power use utilizing detected values through current sensor and voltage divider.

**Stage 2:** Raspberry pi bring the arduino yield information through serial port and show on the web page through python content.

**Stage 3:** Raspberry sends the checking information on to the cloud.

**Stage 4:** Cloud show the information as chart, which is obvious to the whole client.



**Figure 2.** Workflow of Arduino based solar panel Monitoring

### *iv. Using IOT module*

This design configuration is utilized for remote observing of current and voltage estimation of PV cells. The transmission among the photovoltaic boards and server is

performed by IoT (Internet of Things).The current and voltage information is handled by Microcontroller unit (MCU).

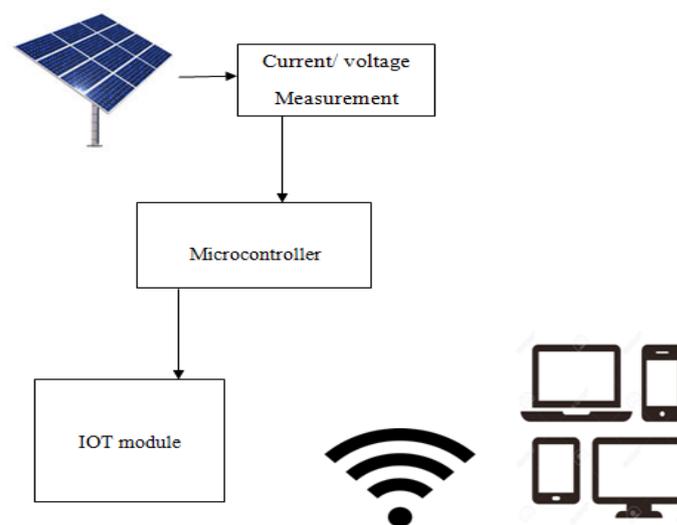
The deliberate information is exchanged to facilitating server utilizing remote transmission. The estimation of current and voltage are checked and sent to the IoT Module, at that point the IoT module stores the current also, voltage perusing with date and time.

The framework is additional time effective than existing strategies for remote checking framework for photovoltaic boards.

The framework incorporates remote checking framework intended for Photovoltaic boards. This module is utilized for remote checking the Photovoltaic board .The current and voltage estimation of the photovoltaic board are estimated with the assistance of current and voltage sensor. These yields are in simple information compose. so it changed over into computerized shape utilizing Analog to advanced converter. The estimated information are given to the microcontroller unit. The microcontroller send the deliberate information to the IoT.

The Internet of things (Esp8266) is the system of physical gadgets which empowers these Modules to associate and trade information. The subtle elements of the deliberate information will be transmitted to the AWS S3 container remotely through IoT module. The photovoltaic board voltage and current can be seen in the AWS S3 container anyplace and whenever from this server.

The fundamental reason for this undertaking is to screen the photovoltaic boards and putting away the information in the Amazon S3 container. the put away information can be examined ,seen later in whatever kind we need to see. Along these lines from this venture, we can productively screen the photograph voltaic boards remotely and put away the deliberate information. The microcontroller unit(MCU) reports are shared to IoT.



**Figure 3:** Framework of panel monitoring using IOT module

### III. CONCLUSION

In this investigation it has been assessed various procedures that are used for the tracing of solar panel. It can be manipulated anywhere such as house-hold activities in office even in industrial purposes. The cost of the implementation of this task can be fluctuated by various methods. If the user's consideration is on cost, then the method of using arduino in the module can be a agreeable one. For this it is also a low power consuming project. Today world is confronting intense power emergency. We require a better power system to give benefits to those people who live in remote area. And also the efficient monitoring systems for acquiring of complete energy conversations. Under this circumstance these various types of project can give a decent outcome when vitality emergency is a standout amongst the most fundamental issue on the planet.

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