Smart Real-Time PV Surveillance Network with IOT

P Maniraj\textsuperscript{1}, A Lathika\textsuperscript{2}, C M Ravina\textsuperscript{3}, E Pradeebha\textsuperscript{4}, M Suresh\textsuperscript{5}, S Sundar\textsuperscript{6}

\textsuperscript{1} Assistant Professor, M.Kumarasamy College of Engineering, Department of Electrical and Electronics Engineering, Thalavapalayam, Karur, Tamilnadu, India.
\textsuperscript{2,3,4} UG Student, M.Kumarasamy College of Engineering, Department of Electrical and Electronics Engineering, Thalavapalayam, Karur, Tamilnadu, India.
\textsuperscript{5} Assistant Professor, Kongu Engineering College, Department of Electrical and Electronics Engineering, Perundurai, Erode, Tamilnadu, India.
\textsuperscript{6} Assistant Professor, Bannari Amman Institute of Technology, Department of Electrical and Electronics Engineering, Sathyamangalam, Tamilnadu, India.

maniraj.angu@gmail.com, lathikaajay397@gmail.com, ravinaamurugesan@gmail.com, mailtopradeebha@gmail.com, msureshcit@gmail.com, sundars@bitsathy.ac.in

Abstract. The photovoltaic panel’s network must stay in its extreme state to handle continuous energy efficiently. In the event of weather change, reliable energy yield changes. So, constant maintenance and monitoring will be needed. In this paper, we have projected an innovative real-time monitoring system to monitor the environmental conditions that are affecting the performance of panel such as fault, dust coverage or shading surfaces. Through this monitoring device, the deterioration of photovoltaic panel can also be defined and it also gives the information about the causes of current fault. An android app cayenne is interfaced with the system that will show the information about the temperature, rain and dust condition.

Keywords: IOT, Arduino UNO, Sensors, LCD Display.

1. Introduction

Rapidly rising needs for energy and global environmental issues involve the use of renewable energies. Solar panels are of the greatest future projection among renewable energy-generating technologies. Compared with the previous four decades, the involvement of solar Photovoltaic energy enlarged unusually. Solar PV nowadays represents the third-largest renewable energy source after wind and hydro.
Because of the huge electricity demand, India nowadays faces many power cuts. While a large number of renewable resources such as tidal, wind, geothermal, natural biofuel, and traditional biomass are present. But solar energy alone has enormous benefits. The rapid growth of society would increase the consumption of electricity. The only source for feeding such a mass population will be renewable energy.

After China, the USA, and Russia, India ranks fourth in energy consumption. India's consumption of electricity is 70\%, whereas for 30 \% of the population there is no electricity\textsuperscript{(1)}. With the aid of the IoT, this issue can be solved.
Owing to the interconnection of different technologies, real-time data visualization, machine intelligence, product sensors and embedded devices the idea of the Internet of Things has evolved. Embedded systems, wireless sensor networks, monitoring systems, robotics (including home and building controls) enable the IoT and a lot more.

An IoT ecosystem involves smart web-enabled devices that store, communicate and use embedded processors, sensors and communication hardware to acquire records they receive from their environments. IoT systems share sensor data collected by linking it from an IoT access point or other edge devices in which data is either transmitted to the server to be analysed or localised. These devices also interact with related devices and rely on each other's data. A great deal of analysis is done by computers without human intervention, while people can connect with it.

The internet of things provides organizations several advantages which enable them to:

- Track product development as a whole
- Allowing customer service better
- Save money and time
- Increases productivity for employees
- Build-in and evolve business models
- Make better choices
- Plus sales production

This paper consists of certain fragments: Division II describes the analysis of literature in this field. Division III presents the current effort and proposed method which has been done and Section IV encapsulates the outcome.

2. EXISTING MODEL

A low-cost server uses ESP32 with physical system power for present collection of photovoltaic statistics. A data collection program for solar thermal parks. Data were gathered from PV park devices, dimension systems in the parking area (climate stations), and information bases information on the web. In terms of IoT (Internet of Things) spreads, there is a massive rise in uses in the smart city, smart parking, and so on. IoT reduces humanoid involvement by implementing system-to-system interaction, which is used to ease the analysis of multiple device modules. For this purpose the aforementioned surveillance system uses internet to link to remote services and provide a cloud platform for data collection to ensure the reliability and accuracy of the expected model. This makes the online monitoring and recording of ecological and knowledge conditions of the PV panel in real-time. It will also make the potential changes to the system smoother. For this cause, researchers have built further techniques in modern years to help gather and analyse PV data for the initial identification of faults. Built a control unit for synchronised monitoring of four PV screens. For the identification of faults the mean power of the PV boards and the voltage descent limit are used. Premeditated a mathematical method to track photovoltaic conditions and detect the hotspots. They follow the aspects \( (C_p \text{ and } R_p) \) in the PV panel's equivalent method and use these limit projections to forecast when the PV board is part of the details or under hot-spot conditions.

3. PROPOSED MODEL

The system of solar cells is flattering a general choice as an energy source. To use sustainable electricity proficiently, the PV panel system must endure in the best possible circumstance. This device consists of a sensor such as a temperature sensor, a dust detector and a rain sensor. The temperature sensor is used to sense the temperature value and the dust detector is used to detect dust intense. The rain sensor is used to measure the rain value and all the parameters are displayed through LCD. The values will be uploaded to IoT.
A. Arduino UNO

In Arduino UNO has 14 digital pins and is used as input or output with 6 analogue pins. As the specified operating situation, the rising pin can supply or receive 20 milliamperes, and also have an internal pull-up resistor (default detached) of 20-50 k ohm. Indeed, certain pins have different functions:

- **Serial / UART**: Receiving (RX) TTL serial data. Pin number 0 and transmitting (TX) TTL serial data pin number. These terminals are linked to the respective ATmega8U2 USB-to-TTL Serial Chip pins.
- **Peripheral interrupt pins**: 2 and 3. These pins can be designed to initiate a low-value interruption, an increasing or decreasing power, or a change in value.
- **PWM pins**: Pulse Width Modulation pins are 3, 5, 6, 9, 10, and 11. It will arrange for 8-bit PWM performance through analog Write() feature.
- **SPI pins**: Serial Peripheral Interface pins are 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK). These pins provision Serial communication through the SPI library.

B. Solar panel
The photovoltaic cells are assembled in solar panel and assembled on structural support. The solar unit may be used as a part of a broader PV network to produce and provide energy for business, domestic purposes under STC. Each unit is rated with its DC output power, which typically ranges from 100 to 320 watts. A small amount of electricity will be produced by a single solar module, so most of the systems have several modules. A PV system usually involves a panel or series of solar panels, an inverter and a battery and/or solar sensor and wiring link.

C. Battery

The specification of battery used in our system is given below.

- Input power: 120V AC 50/60Hz 0.4A Max.
- Battery voltage rating not less than 5.5V
- Rating output: 12V DC 1.5A
- Battery type: lead-acid battery
- Maximum charge voltage: 14.4V
- Maintenance charge voltage: 13.2V~14.0V
- Operating environment: -10~40 °C

![Battery](image)

**Figure 4:** Battery

D. Temperature Sensor

The humidity sensor detects, measures and regularly reviews the relative humidity levels. The sensor tests both the humidity and the temperature. Relative humidity expressed as a percent, is the ratio of actual humidity in the air to the maximum amount of humidity at which the temperature can be maintained. The warm air can hold the more water content in it. So the humidity levels changes with temperature variations.

Humidity sensor measures the relative moisture of the local areas in which they are situated. It calculates the temperature and relative humidity in the air and describes relative humidity as a proportion of the ratio of humidity to the average level that can be sustained in the mid-air at the actual atmospheric condition. As the air gets warmer, more water vapor is kept, so the humidity level changes with the atmospheric pressure.
Figure 5: Temperature sensor

E. Rain Sensor

It provides a digital module and a programmable logic controller that "collects" droplets. As water drops are gathered on the power cord, parallel resistance paths are created which are measured by an op-amp. Lesser the resistance or more water is collected; the output voltage produced will be lesser.

F. Dust Sensor

Dust Sensor is a basic dust detection kit which can detect small particles greater than 0.8μm in diameter, much like the tobacco smoke. The analog signal sensor output is constant with dust intensity. Air Quality is an abstract concept which typically involves measures of many indicators: dust rates – calculated in μg / m³, with various scale particles such as Volatile Organic Compound Gasses (VOCs) – formaldehyde, benzene, and more – calculated in ppm (parts per million) of CO2 – measured in ppm.

Figure 7: Dust sensor

Sharp's GP2Y1010AU0F is an air feature sensor or optical pollution tracker. This Dust sensor is used to detect powder molecules. The IR emitting diode and the phototransistor are diagonal
directions organized in this device to sense the light reflection of dust in the air. This is particularly efficient in identifying extremely small elements such as tobacco burn and is widely used in air filter systems.

4. Output

![Figure 8: Hardware Setup](image)

The data’s from various sensors are given to controller. Based on the data’s, the output voltage produced is displaced in LCD. Through Cayenne mobile application the real time data can be viewed by using mobile.

![Figure 9: Output representation](image)

The picture (figure 9) shows the various values of solar panel during normal condition. The values which are shown are lower than the ideal values that need to be given manually. The output shows the temperature, dust and rain are in normal value.
The figure 10 shows the output, when the temperature is high and raining condition. The values are shown in LCD and also represented in mobile app.

The figure 11 shows the output, when there is a raining condition. The values are shown in LCD and also represented in mobile app.

5. Conclusion

Through this monitoring system, any individual PV panels that require maintenance can be identified. The reason for low output voltage (temperature or rain or dust) can be easily identified. The temperature, rain and dust data can be viewed through mobile. So, user can monitor the performance of solar panel at any place.

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