AI POWERED IOT APPROACH FOR PHOTOVOLTAIC MONITORING AND CONTROL SYSTEMS

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Abstract

Conservative gas supply affects emissions from traditional energy sources such as carbon dioxide (CO2). These gas emissions will endanger global warming and affect the environment and biodiversity. These traditional structures are limited; then a question arises about the energy crisis. Because the sun is the highest source of energy production in the universe. Furthermore solar energy does not damage free and unlimited parameters and can be used for more refined soils. Solar energy also helps improve grid security. Many companies currently look to the solar cell industry as an economic support. The solar power generation scheme needs this facility to help in the disposal of power generation and in a systematic way. The proposed method is a real-time technique that helps control and monitor solar power plants using the IoT. Solar energy production activities are not accessible and monitored with traditional PLC technology. This is why Internet of Things (IoT) and Machine Learning approaches have been introduced to manage solar energy systems. The Internet of Things is a combination of physical technologies that use the cloud. The main requirement is a heterogeneous network of fabricated object communications required for each object and the processing power and security of each object / data processor for each of the IoT elements. Solar energy systems can be monitored and improved using this new method. The rotation of the solar panel can be controlled by slave according to the direction of the sun. thus increasing the efficiency of electricity production. This was achieved by creating photovoltaic systems that build analog circuits for specific resolutions and currents and by creating web servers that monitor the data used on a graphics device. The web server is on the WAN (Network Area) and you can access it anywhere in the world with an internet connection.
Keywords: *IoT, Solar Energy, Machine Learning, PLC, SCADA etc.*

1. Introduction

Solar energy is solar heat. This technology is called a passive solar system or an active solar system. They change the way solar energy is captured and distributed. [1] Active solar devices include central photovoltaic systems and energy use solar water heaters [2]. The abundance of available solar energy makes it a very suitable power source. In the 2000 World Energy Assessment the United Nations Development Program placed annual solar energy at 1575-49837 Joules (EJ). This is several times more than the total global energy consumption

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generated in 2012 EJ5598. In 2011 the International Energy Agency stated that the continued development of clean and low-cost solar energy technology has long-term benefits [4]. Renewable energy is currently the fastest growing alternative energy source to meet the current energy needs of the International Energy Agency (IEA). Wind and solar retrofit options are widely available. Passive solar technology involves conditioning building materials to the sun to create a ventilated space with either selective heat or light properties. Monitoring is essential to monitor performance and keep control panels in good condition so all solar panels should be inspected to determine their current status. Currently this power plant is controlled by PLC. Therefore all energy data can only be monitored by SCADA devices at the station or facility. The biggest difference between observing the Sun and observing a star source from the user's point of view is that one or more transients must be provided so that one or more solar targets of interest can be observed. In this respect solar observations are similar to observations of other solar system objects such as planets and comets. Most of the details related to hardware modifications required for solar observations such as applying a 20 dB attenuator change delay correction setting of the step attenuator level and referencing the solar PCL signal to the solar signal. Invisible to users.

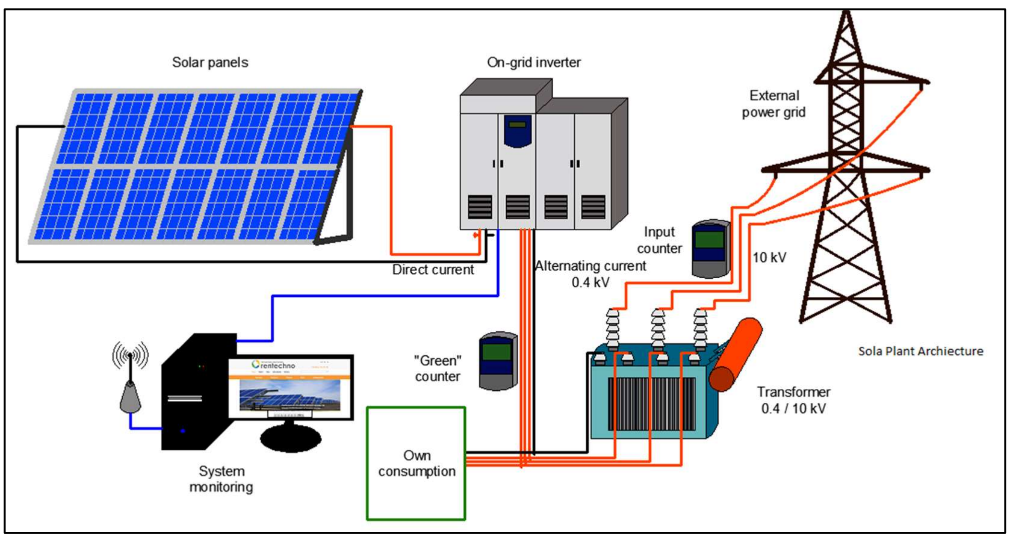

Figure 1. General structure of Solar Power Plant Monitoring system

Figure 1 shows the general architecture of the PV system monitoring system. Solar cells are usually arranged systematically according to environmental conditions to produce maximum energy and increase the efficiency of power generation. The box is connected to the back panel and solar connection. An inverter is a basic electronic device that converts DC to AC. Transformers can convert this energy into PVC photovoltaic assemblies or switchgear. EMS providers specializing in SMT are constantly striving to meet diversity and opportunity. Photovoltaic solar modules are becoming a popular way to achieve these goals. PV cell leads in solar cell module assemblies are fabricated using very simple SMT materials and processes. Solder flux and traditional processing technology create electrical interconnects in AC and C-C optoelectronic assembly techniques. Electronic manufacturing services (EMS) providers specializing in surface mounting technology (SMT) are looking to expand and add capacity.

2. IOT and AI approach for Controlling Solar Plant

The design and development of remote monitoring system methods for Internet of Things & AI based control system interfaces is described in this paper. Efficiency depends on the efficient harvesting of energy from solar panels to ensure optimal investment in solar power plants. This is only possible if the solar panel follows the path of the sun and efficiently produces energy during the day. In this sense IoT-based solar monitoring enables monitoring of various situations and provides useful feedback. The downside of current solar trackers designed to harvest energy during the day is that they follow a single direction. This orientation means that the orientation (payload) of the solar panel will not be adjusted even if the position of the sun changes from dawn to dusk. The result is lower energy production than the estimated annual energy production. With IoT-based solar trackers you can significantly increase your PV by creating solar panels that adapt to the sun. In addition to IoT-based solar monitoring for better energy production solar monitoring systems help monitor the performance parameters of various solar plants.

Figure 2. Tilt angle Adjustment for More power generation

We will get more power generation only if our PV panels are in sync with sun direction. There are major two ways for the adjustment of PV panels, one is we can install panels in fixed order or another is we can have some amount of tilt with solar panels. If we consider the fixed panel method, the efficiency of the power generation is approximately 40% more in case of summer season and it is 10% more in the case of the winter season. The power generation efficiency is also based on the location factor. If the power plant means PV panels are located in the northern hemisphere, at that time the direction of the solar panel should be facing true south. And in the case of solar panels located in the southern hemisphere, at that time panels should be arranged in order to face true north.

3. Design of Digital Control Photovoltaic System

This article presents a study of urban environments and other markets from an industrial perspective. With the Internet of Things (IoT) approach it explains market trends in another effective way. Manh Duong Phung and co-authors presented a reliable control system [31] based on the Internet of Things (IoT) to control and manage renewable energy collected from solar panels in micro grids. Data for optimal control includes real-time weather information from local sensors as well as online sources. A fully distributed control system consisting of multiple controllers controls the tracking performance of the PV array in real time to capture solar radiation and maintain system flexibility and reliability with one or more redundant controllers for system fault tolerance. And reliable controllers are designed to adapt.

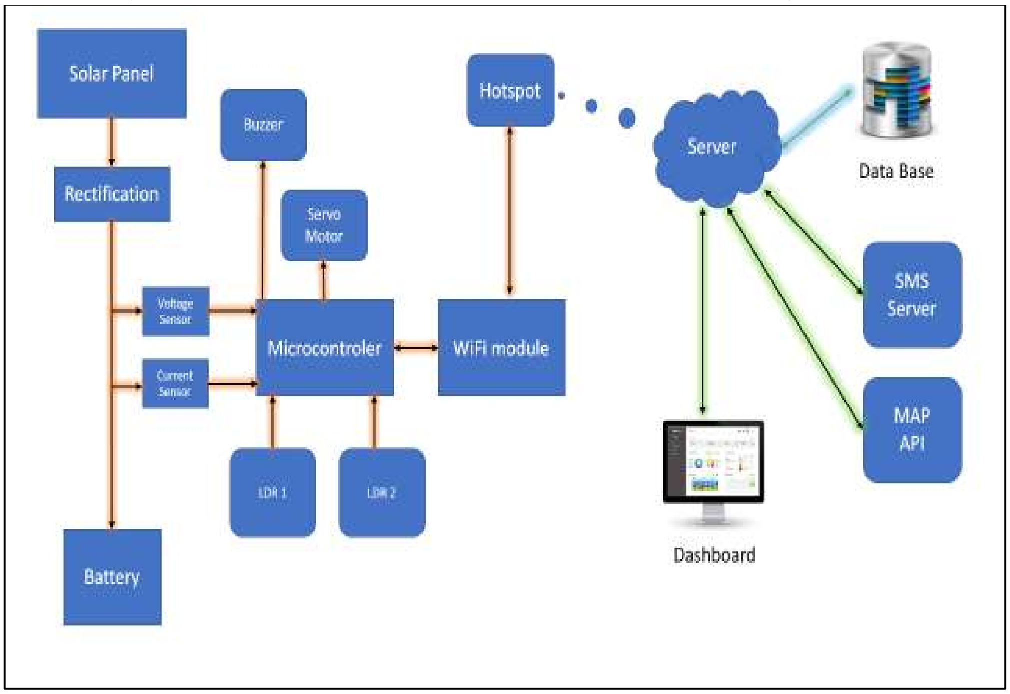

Figure 3. Digital control System for Solar Power Using IOT

The AtMega element comes with an open monitor and corporate icon and is handled using a mod microcontroller that does this. The LCD (Liquid Crystal Display) allows you to see the overall value and performance of the asset name. After the product is placed in the cart it shows the technology to see the voltage and values of the power repair mode. All data in the Mega is still being archived from the Wi-Fi module to IoT or cloud servers. The Mega eight-bit AVR microcontroller is associated with thirty-two kilobytes of software providing 32 and eight bits of memory-related information. Solar panels are a system of electrical appliances that generate electricity using the light we use to power our homes or workplaces reducing the amount of carbon in our environment. Electrical equipment consists of many small components known as solar cells. The function of the factory voltage is to identify and exist AC or DC voltage levels. After the voltage is detected the device provides an analog voltage signal in the form of the connection device. The device may be a current device that senses current through a wire and creates a proportional display. The generated signal can be the same as current or digital voltage. The servo motors operating signal receives a collision signal which defines the position of the servo on the shaft and applies DC power to the motor until it moves the shaft into position. The ESP8266 Wi-Fi module can be a stand-alone SOC module with a built-in TCP/IP protocol that provides no modest Wi-Fi network access. The ESP8266 can implement all Wi-Fi network loads flowing from any application process. The 8051 microcontroller has 4K of memory or software memory followed by 4Kb of ROM and dedicated memory (RAM) of 128 computing units. An LDR can be a resistive element that involves adjusting the amount of solar radiation that falls on them. This allows them to work around the sun. The data is stored on a physical server located in the cloud. Computing is the use of computer tools and code to provide servers on the network.

4. Experimental Setup and Results

Through this website and android app we can remotely access all energy sources and monitor solar parameters and devices. The image above shows a website demo of a solar power plant controlled by an Android application used on a mobile tablet or PC. The voltage and current power parameters are displayed on the website. Authorized users can also access graphical visualization and analysis on the website. IoT machine learning can predict the weather and energy output of this type of solar power plant.

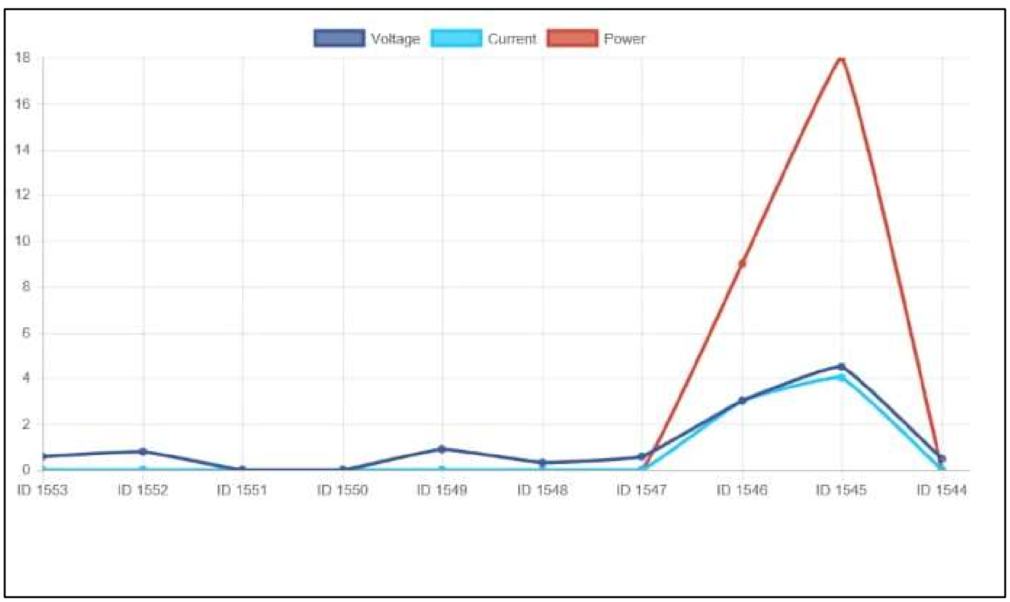

Figure 4. Graph of Voltage, Current and Power

This figure is a graphical representation of the voltage and current strength of different IDs. Also known as a project prototype. The Y-axis of the graph shows the different IDs over time and the X-axis shows the magnitude of the current and voltage levels. The dark blue line represents the voltage value The light blue line represents the current and power values calculated from the current and voltage values and shown by the red line on the graph.

Solar energy production in August during the same period corresponds to daily temperature and wind speed of net solar energy export of global solar radiation production in kwh.

Table 1: Energy records at solar power plant

Sr. No.	Date	Daily average Wind Speed (km/h)	Daily average Ambient Temp (degC)	Daily average global solar radiation (sunshine Hrs) kwh/m2	Total daily solar power generation kwh	Net exportable power(kwh)
1	01-Aug-21	12	25.1	2.562	2277	2250
2	02-Aug-21	8.1	24.7	1.92	1744	1725
3	03-Aug-21	14.6	23.1	1.875	1495	1425
4	04-Aug-21	13.3	23.7	2.89	2747	2775
5	05-Aug-21	8.2	23.8	2.19	2245	2175
6	06-Aug-21	8.6	23.4	2.249	1966	1950
7	07-Aug-21	7.2	24.2	2.314	1815	1725
8	08-Aug-21	8.7	25.4	2.404	1966	1950
9	09-Aug-21	15.4	24.3	2.402	2306	2325
10	10-Aug-21	16.3	26.9	4.679	4321	4275

11	**11-Aug-21**	**11.1**	**27**	**4.966**	**4241**	**4125**
12	**12-Aug-21**	**6.2**	**26.9**	**3.622**	**3450**	**3450**
13	**13-Aug-21**	**7.2**	**32.3**	**3.508**	**3360**	**3300**
14	**14-Aug-21**	**6.6**	**26.7**	**4.23**	**4061**	**3975**
15	**15-Aug-21**	**6.2**	**25.9**	**3.97**	**3580**	**3525**

The sensor systems, which are used in this work, have errors. So, these errors are calculated with calibrated instruments as listed in Table. As shown in table 2, the measurement error of current sensors is highest among the others. Error percentage of PV-current sensor and Battery-current sensor are about 11.3% and 9.04% respectively. While error percentage of both voltage sensors (voltage dividers) is low and they are closer to calibrated instrument.

Table 2. Measurement Error of Sensors System

No	Sensor Module	Value	Calibrated Instrument	Value	Error %
1	PV-Voltage Sensor	13.0V	Standard Voltmeter	13.67V	1.71%
2	Battery-Voltage Sensor	13.2V	Standard Voltmeter	13.39V	0.75%
3	PV-Current Sensor	2.19V	Standard Ampermeter	2.47V	11.30%
4	Battery Current	2.17V	Standard	1.99V	9.04%

			Ampermeter		
	Sensor				

The user interface has four real-time trends and four display icons that show numerical values. It also has two buttons and a container.

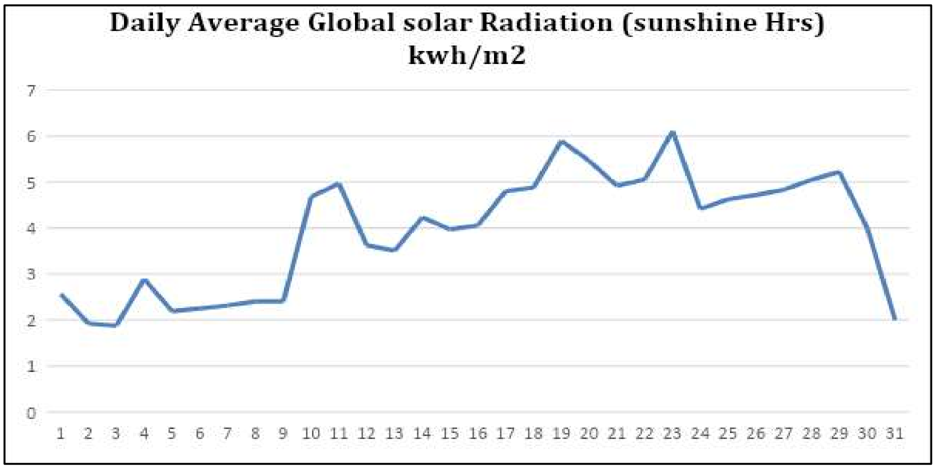

Figure 5. Effect of Daily Average Global Solar Radiation (sunshine Hrs) kwh/m2

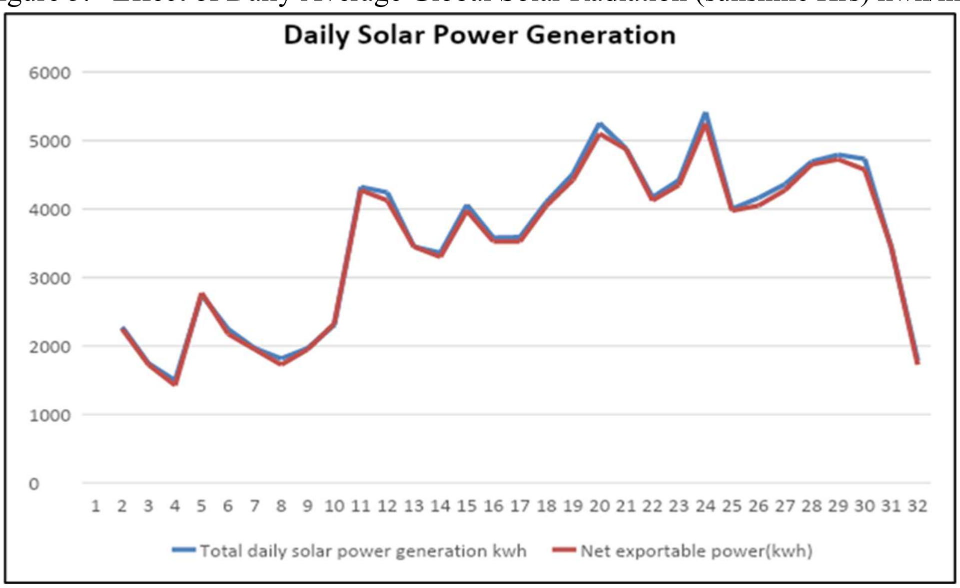

Figure.6 Day wise solar power generation

Figure 5 shows the monitoring results of overall parameters monitored by the photovoltaic system as global average daily solar radiation. It can be seen that the intensity of solar radiation is less on August 2 and 3. Solar radiation is at its highest on August 23. Figure 6 shows the monitoring results as daily solar energy production is one of the other important parameters monitored by the PV system. It can be seen that the daily solar output is lower on August 4 and 8. Daily solar production peaks on August 23-24.

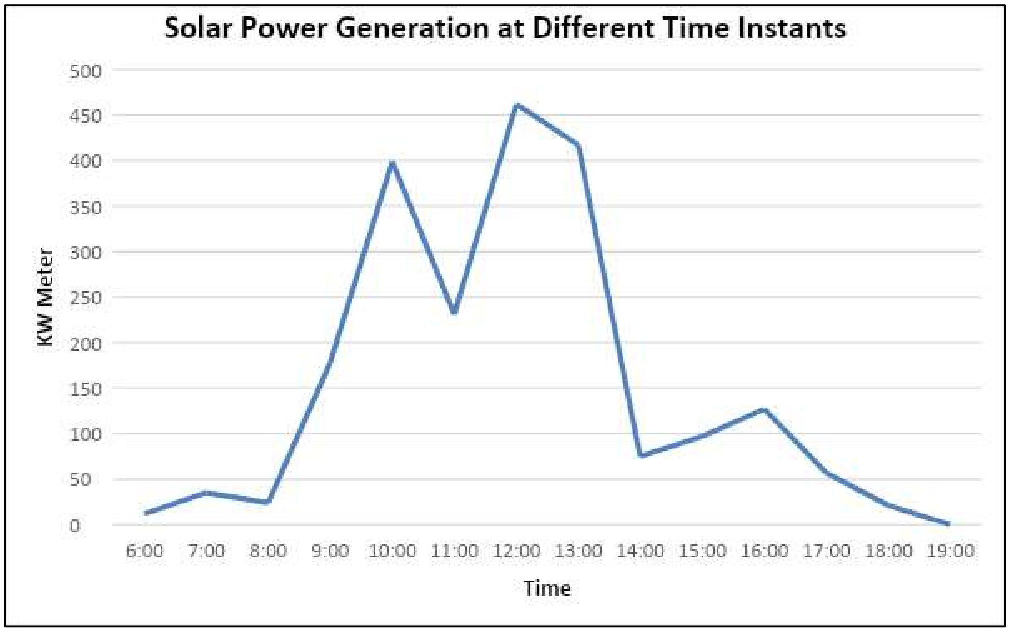

Figure.7 Solar Power Generation at Different Time Instants

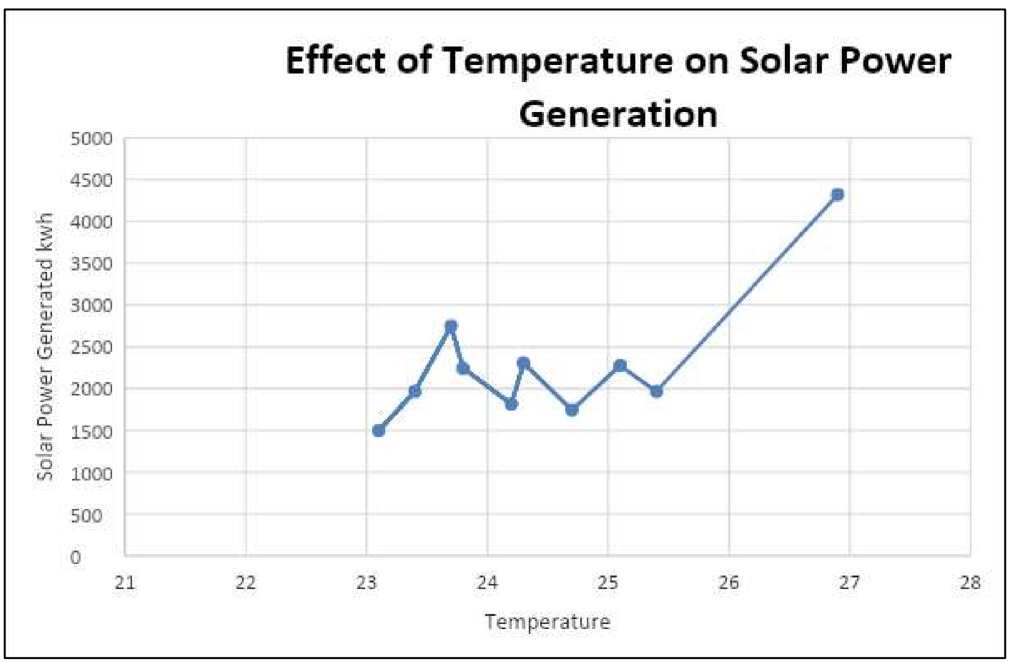

Figure 8. Effect of Temperature on Solar Power Generation

Figure 7 shows the monitoring results based on one of the other important parameters of monitoring a solar power plant based on the solar production by time of day. You can see that solar production is lower at different times between 6:00 and 8:00. Daily solar power generation peaks at 12 noon. Figure 8 shows the effect of temperature on solar energy production, one of the other important parameters for monitoring the solar system. Solar energy production can increase as temperature increases. When the temperature is about 27 degrees Celsius the solar power output is 4500 kWh. On the other hand when the temperature is 231 degrees Celsius the output of solar energy is 1500 kWh. Therefore temperature has a great impact on solar energy production.

5. Conclusion and Summary

The proposed work will include a demonstration of the use of solar energy as a renewable energy source on the Internet. This monitoring is done using the Wi-Fi module of the balloon frame. Physical objects are no longer disconnected from the virtual world but can be managed remotely through Internet services. Smart factory monitoring will further increase the use of renewable energy. Assist in assessing the impact of renewable energy use and energy use analysis on energy issues. Visualization of the data collected at the control station is done using the created website. The monitoring system is used in smart solar micro-grids on solar roofs and solar cell street lights in solar villages. In this era there are many applications such as solar urban village smart micro grids and solar street lights. Alternative energy is based on remote monitoring and control of business parameters that change the IoT experience by changing lifetime parameters such as speed voltage temperature current pressure to supply gas from sensors and their outputs to IoT modules through megastimulation. Wherever the user wants. Read the parameters measured by the user unit which will send the data to the supercontroller through the IoT module to control the unit. So with an efficient electronic implementation the sensor has good high power so the power requirement is very low.

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