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Solar Power Plant Monitoring Systemusing Python Programming

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Abstract: This paper presents a Python programming for monitoring and controlling of Solar power plant. Inthe hilly areas SCADA system is used for monitoring of Solar power plant instead of that we are using raspberry pi. It is essential to frequently monitor thesolar panels to ensure optimum operation and a longer lifespan for the solar system.

The solar potential of a photovoltaic (PV) system can be maximised by a clever monitoring and regulation system. The monitoring system has quickly gained acceptance due to its user-friendly graphical interface for data monitoring and measuring. Inorder to track the operation of the installed system,particularly for applications using renewable energy sources like solar photovoltaic (PV), data- acquisition systems were utilised to collect all the information about the system. In this study, we analysed solar plant architecture and talked about solar plant monitoring systems.

I. INTRODUCTION

Most people use fossil fuel-based electricalenergy to live fulfilling daily lives. Clean and renewable energy sources can be thought of asthe best option for sustainable energy suppliesbecause fossil fuels are still depleting and harming the environment. As a result, the usage of solar power plants, which produce abundant, clean, and renewable energy, has been developed. Photovoltaic modules are used in solar power plants to convert solar energy into electrical energy. However, the measuringof electrical quantities for current and voltage in solar power plants needs to be optimised. This is currently done with a multimeter and byhand calculations.

In order to effectively monitor every condition,it is necessary to measure the electricity produced by solar power plants on a regular basis. Using a real-time measurement system isone practical and efficient technique to getaround this. Currently, solar power plants are so advanced that the general population is using them in their own homes.

Given the availability of other activities outside thehome, it is impossible to properly monitor the stateof the installed solar power plants.

Therefore, a real-time online measurement system is required inorder to use a smartphone or personal computer with an internet connection to check on the health of solar power plants outside the home. As a result,a solution to this issue is developed. "Solar Power Plant Monitoring System Using Python" to measure values of Voltage, Current, Temperature and Humidity through ThingSpeak and local storage is the research's invention.

Scope of research:

[1] Fault is detected before hazardous.
[2] Enables data acqision at remote site.
[3] Information of fault occurrence is got via email.
[4] Online monitoring system.
[5] Daily data of performance is stored in excel sheet.
[6] Graph of measured parameters is obtained throughThingSpeak.

Keywords:
Solar panel; Monitoring; ThingSpeak; Raspberry Pi.

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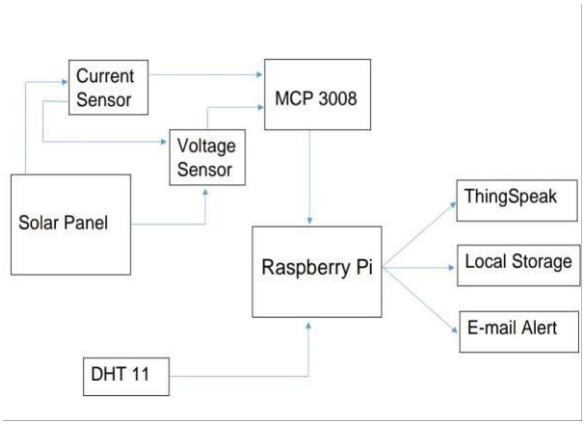
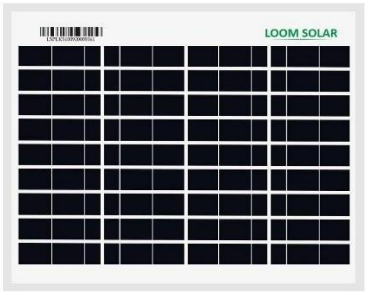
Block Diagram:



Hardware Requirements:

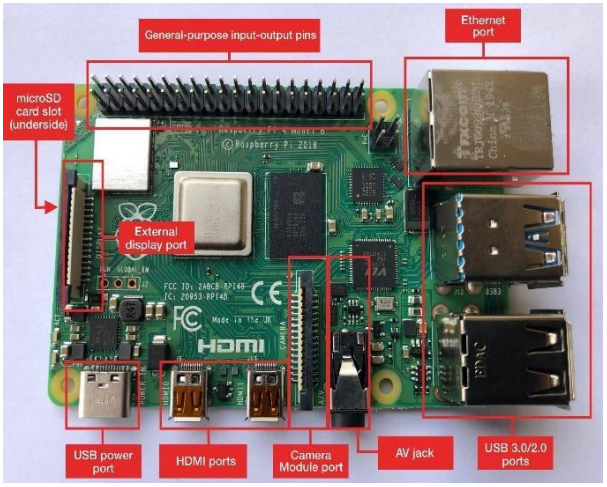
Solar Panel



The solar panel is a module made up of several solar cell configurations. The photovoltaic effect is used by solar cells to absorb solar energy and induce currents toflow between two charged layers that are in opposition to one another. solar panels with a number of solar cells. The solar panel module can take in electromagnetic or photonic energy from sunlight. An electric current forms, when the photon energy in sunlight converts to kinetic energy, which can liberate electrons from the valence band and release them into the conduction band.

Specification of Panel –Pmax – 10w
Voltage (Vmax) – 19.41vCurrent(Imax) - 0.53A
Open circuit voltage - 22.96vShort circuit current- 0.56A

Raspberry Pi



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Raspberry Pi 3 is a mini computer module that has an digital input output port like the microcontroller board. Raspberry Pi 3 is the first output that has additional features namely Wi-Fi and Bluetooth. The processor is also updated using the ARM CortexA53 from Broadcom with the 1.2GHz 64-bit quad-core specification. Raspberry Pi 3 was released on February 29, 2016 which is equipped with various operating systems (such as Windows, Linux, Mac, Unix, etc.) which are run from an SD card on the Raspberry Pi Board. Raspberry Pi 3 is also arecommendation for use in schools or other general use. Theresearch project will use Raspberry Pi 3 model B.

ThingSpeak

A platform offering a variety of services specifically designed for the development of applications is called ThingSpeak. It gives the ability to collect data in real-time, visualise the data in charts, and build plugins and apps for interacting with online services, social networks, and other APIs. An application platform for the Internet of Things is called ThingSpeak. You can create an application using ThingSpeak that uses sensor data. Real-time data gathering,data processing, data visualisations, apps, and plugins are some of ThingSpeak's features. A ThingSpeak Channel serves as the foundation of ThingSpeak. You send your datato be stored through a channel.

MCP3008

The MCP3008 device is an on-board sample and hold circuitry 10-bit successive approximation analogue-to-digital converter. Raspberry Pi boards use MCP3008 ADCs for analog-to- digital conversion. Since the MCP3008 has 8 channels and10 bits of resolution, it can measure 8 distinct analogue voltages. It communicates the value of the analogue voltage, which ranges from 0 to 223, to the Raspberry Pi.

Voltage Divider Circuit

Alternatively referred to as a potential divider, a voltage divider is a passive linear circuit that generates an outputvoltage (Vout) that is a subset of its input voltage (Vin). The distribution of the input voltage among the divider's parts produces voltage division. Two resistorslinked in series with the input voltage applied across them and the output voltage emerging from the connection between them serve as a straightforward example of a voltage divider. By connecting across thepanel terminal, we may sense the voltage of the panel or power plant by obtaining Vout as a fraction of Vin by applying the required resistors. There are two resistors: one is 7.5 k ohm in resistance and the other is33 k ohm in resistance.

Sensors:

For monitoring purpose current, voltage, temperature and humidity parameters are selected. So the followingsensors are used to detect the parameters.

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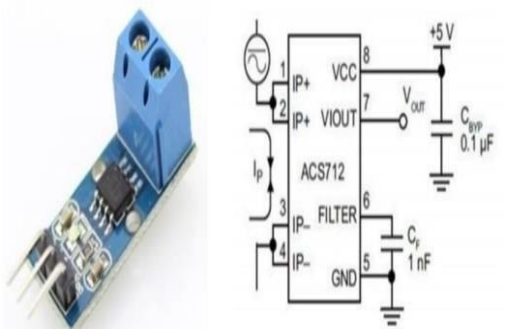
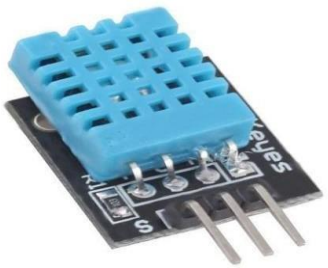
Current sensor



The compact integrated circuit (IC) ACS712 is used asa current sensor in place of a current transformer, whichis a sizeable device.

In order to convert the magnetic field around the currentinto a linear voltage as the current varies, the ACS712 current sensor makes use of the Hall Effect sensor principle. The current is calculated by the ACS712 current sensor via indirect sensing. On the copper conduction path, on the sensor's surface, is the IC. A magnetic field that can be sensed by the Hall effect sensor is created as current passes via the copper conduction route. In order to measure current, a Hall effect sensor must produce a magnetic field that isdirectly proportional to the voltage.

DHT11



Digital Temperature and Humidity Sensor is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure thesurrounding air and spits out a digital signal on the data pin (no analog input pins needed).

[7] Operating Voltage: 3.5V to 5.5V
[8] Operating current: 0.3mA (measuring) 60uA(standby)
[9] Output: Serial data
[10] Temperature Range: 0°C to 50°C
[11] Humidity Range: 20% to 90%
[12] Resolution: Temperature and Humidity both are16-bit
[13] Accuracy: ±1°C and ±1%

Working:

The Raspberry Pi and other components receive power fromthe solar panel initially when the system is turned on. Dual sensors The Raspberry Pi receives voltage values from the current sensor, the voltage dividing circuit, and the MCP 3008 (an analogue to digital converter), which transforms the analogue values into digital ones.

The third sensor, the DHT 11, also provides temperature andhumidity values to the Raspberry Pi because it has a digital output. Data is processed there, and power is calculated. as the sum of the four factors, voltage, current, and Current, voltage, temperature, and humidity are relayed to an LCD display by Wi-Fi as well as to a ThingSpeak server.

Every 15 seconds, the same will be repeated. ThingSpeak will display this information as a graph so that trends and values may be seen quickly. Additionally, this information is displayed in the form of a CSV file containing date, time, temperature, humidity, and voltage for comparison purposes. If a fault or an overvoltage occurs, the response istripped, and a letter is sent to the plant owner for modification.

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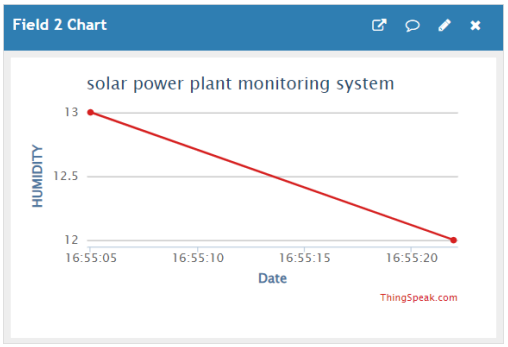
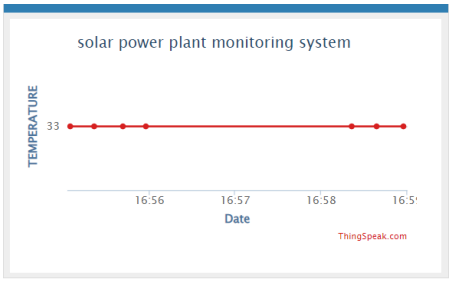
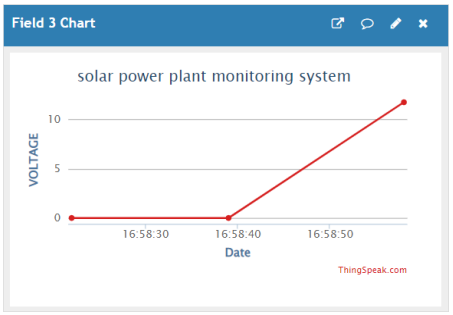
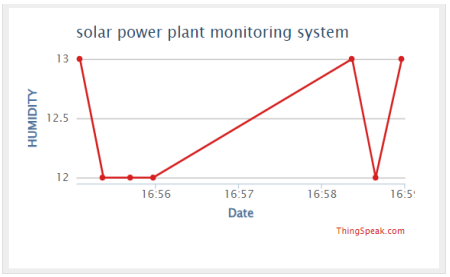
RESULT



Humidity vs time graph







Advantages:

[14] Easy Monitoring
[15] Greater reliability
[16] No manpower is required
[17] Easy fault detection
[18] Low maintenance

Limitations:

[19] Expensive Energy Storage.
[20] High Initial Cost.
[21] Skilled employees required.
[22] Internet facility required.

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