

# Monitoring and Measurement of Solar parameters using IOT

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**Abstract** - In the proposed work, monitoring, and measurement of photovoltaic panel is done on wireless basis. Voltage, Current, Power and light intensity are four parameters to be measured. Sensors are used for measuring purpose of the parameters. This system gives monitoring and measuring on continuous basis on real time monitoring. All the parameters are controlled and monitored through IOT.

**Keywords:** Arduino, Wi-Fi module, Current sensor, Voltage sensor, LDR, Solar panel.

## 1. INTRODUCTION

The solar panel performance is being affected by many factors. Today, amongst renewable energy, solar energy is the important source of renewable energy and this energy can replace other energy in generation of power. The efficiency of PV panel can get reduce due to environmental factors as dust, dirt, solar irradiation, etc. Energy generation from solar panels needs to be in accurate value and maintained and there must be seen decrease in power loss. Therefore, the energy output through PV panels will not make reduction in output and efficiency. Monitoring and measuring the output of individual panel will help in increasing power generation and ultimately increase in overall efficiency in an array.

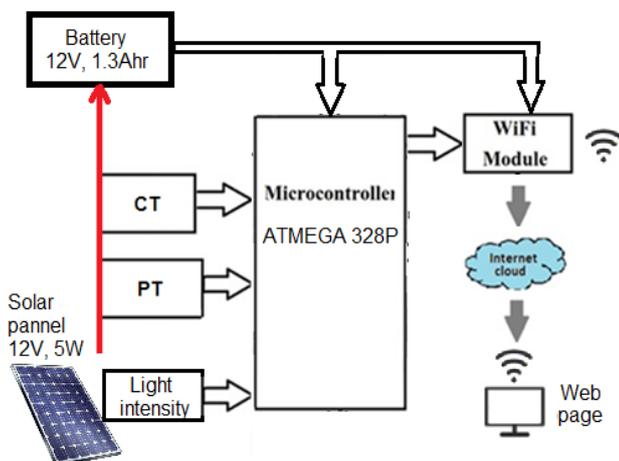


Figure 1 - Block diagram of the system

## 2. SOFTWARE DEVELOPMENT

In the software part, we have used two softwares these are-

- a) Arduino IDE
- b) ThingSpeak webpage

### 2.1 ARDUINO IDE

Arduino IDE is a program coding tool on which we can run programs. The IDE (Integrated Development Environment) is java based application that runs on multiple platforms. The programming language for IDE is not tough.

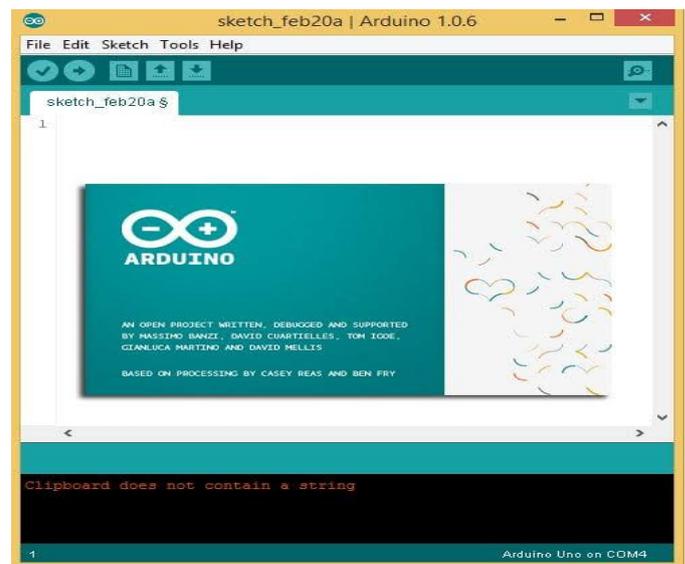


Figure 2 - Arduino IDE

### 2.2 THINGSPEAK WEBPAGE

ThingSpeak webpage is not a close source webpage. Also, this webpage does not cost any price for starting. This ThingSpeak webpage shows graph of measured parameters like Voltage, Current, Light intensity and Power on the basis of real time monitoring we can get actual graphical curved nature of power used(consumed) and generated. This real time monitoring is continuously varying its data after every 30 seconds. i.e., after every 30 seconds, new data gets updated



**Figure 3-** ThingSpeak webpage on phone

### 3. HARDWARE DEVELOPMENT

Hardware used are-

- a) Battery- sealed lead acid battery (12V, 1.3Ah)
- b) CT- ACS712, 30A
- c) ATMEGA328 microcontroller
- d) Wi-Fi module- ESP8266
- e) Solar panel

This way of determining real time measurement of photovoltaic panel will display values on screen of computer and real time measurement graph can be displayed on webpage of ThingSpeak which can be displayed / observed on phone.

This will also help in recognizing faults and detecting it on an immediate basis, which will not require a longer time. Light intensity level represents an important factor in solar panel performance i.e., the energy which is to be converted into an electrical power output is varying constantly with making a proportionality graph with intensity of light. Many sensors are being used for collecting data from PV panel and display it on screen.

### 4. SYSTEM DEVELOPMENT

The output of solar photovoltaic panel has variable range which can produce up to 5W of power, The light is sensed by light dependent resistor (LDR), Current is sensed by current sensor and for voltage, voltage regulator has been used. The maximum output voltage of panel is up to 18V but Arduino (microcontroller) has the sensing value of voltage limited up to 5V only and not greater than that. Hence to drop the voltage from 18V, we have used voltage divider circuit. We have used current sensor here for the reason, the Arduino is

unable to sense directly current and hence current sensor will convert current value in voltage form and then display it on the screen.

**a) BATTERY-** Battery operates in a wide range of temperature  $-15^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  when it is not in discharged condition. Battery should be of the best quality, so it will not damage or reduce its life. Also over the life of battery power will be remain properly. It has low discharge rate 2-3% per month compared to 20-30% for more common batteries.

**b) CT- ACS712-** The current is conventionally measured by current transformers but ACS712 is available in market with lower cost and smaller size. The ACS712 is Hall Effect current sensor that accurately measures current when induced. The magnetic field around AC wire is detected which gives equivalent analog output voltage. The analog voltage output is then processed by the microcontroller to measure current flow through the load. It has following benefits and features-

- Low noise analog signal path
- 80khz bandwidth
- Nearly zero magnetic hysteresis
- Device bandwidth is set by new FILTER pin
- Factory trimmed for accuracy
- Extremely stable output offset voltage

**c) ARDUINO-** Arduino is open source, single board microcontroller that you can use for many different applications. Arduino use either an Atmel AVR or Atmel ARM microcontroller chip, and some versions have a USB interface. They also have six or more analog input pins and fourteen or more digital input/output pins that are used to connect sensors, actuators, and other peripheral circuits to the microcontroller.

For this project we are using ATmega328P microcontroller which has 14 digital input output pins (of which 6 provides PWM output) and 6 analog input pins. Its operating voltage is 5v and clock speed is 16 MHz.

**d) Wi-Fi module ESP8266-** ESP8266 is highly integrated Wi-Fi soc available in compact size and provides reliable performance. It has complete self-contained Wi-Fi networking capabilities, ESP8266 can perform as a stand-alone application or as slave to host microcontroller unit. ESP8266 can be applied to any microcontroller design as Wi-Fi adapter through SPI/SDIO or UART interfaces.

**e) Solar Panel-**Each panel is constructed in heavy duty anodized aluminum channel frame that provides convenient mounting location and adds strength to the panel. The specifications of solar panel which we are using for this project are as follows-

- Maximum power 5watt
- Open circuit voltage- 21 v
- Short circuit current- 0.31 A
- Voltage at maximum power- 18 v
- Current at maximum power- 0.28 A

## 5. IMPLEMENTATION

Internet of things (IOT) is basically a platform which expands data and acts as a very superfast communication network to share valuable information with different kind of applications and needs.

Along with IOT, platform like ThingSpeak and cloud etc. we can easily get point to point information which is required and remove which can be ignored. This smartly collecting of information picked using sensor makes us to make decisions on real time monitoring, which saves time and reduces in man efforts. The work flow of the system is in the form of steps below:-

- Arduino displays the data of power, current, voltage, light intensity using sensed value through current sensor, voltage divider circuit, light intensity sensor.
- Wi-Fi module fetches the data from Arduino and display on the webpage through program.
- Wi-Fi module sends the monitoring data on the cloud.
- Cloud will display the data in the form of graph, which is accessible from anywhere using phone or computers

## 6. APPLICATIONS

- For household applications
- Solar street lights
- Garden lights
- Rooftop solar
- Solar cities

## 7. CONCLUSIONS

Using IOT for monitoring solar plant guides the user in analysis of renewable energy usage. The monitoring values obtained are also helpful for predicting future values of parameters considered. This will help for future decision making process for large scale power plant.

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