Solar Monitoring System using LABVIEW

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***Abstract*: The objective of this system is to Power of the system can be monitor using the current and voltage value sensed by the arduino. This system helps to implement in solar system for efficient usage. The electricity generated by capturing the sun light is called as solar energy which is used for business and home purpose. The atoms lose the electrons when the photons hit the solar cells. A solar panel is made of multiple panels that wired together, more electricity is generated by the more panels we deploy. Silicon like semiconductors are used to make the PV photovoltaic solar panels as shown in figure. Direct Current is generated by the solar panels. Most of the electrical appliance works on AC supply can AC can be less expensive for transmit to long distances. Many energy companies are expanding to offer solar, which is among the most energy-efficient and lucrative sources of renewable electricity on the market.**

***Keywords*: Solar Panel, Monitoring, Renewable Energy, Solar Panel**

I. Introduction:

The term solar panel is used colloquially for a photo-voltaic (PV) module. A PV module is an assembly of photo-voltaic cells mounted in a framework for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

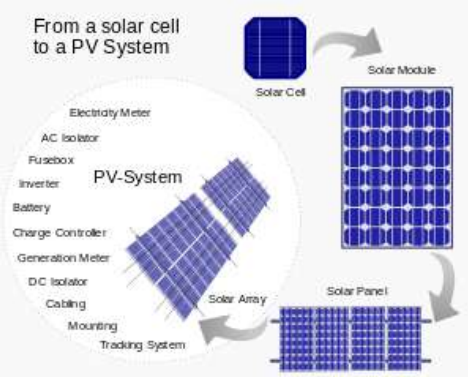

Figure 1.1: Photovoltaic system

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer. Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells are connected electrically in series, one to another to the desired voltage, and then in parallel to increase amperage. The wattage of the module is the mathematical product of the voltage and the amperage of the module. The manufacture specifications on solar panels are obtained under standard condition which is not the real operating condition the solar panels are exposed to on the installation site.

A PV junction box is attached to the back of the solar panel and functions as its output interface. External connections for most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. A USB power interface can also be used. Module electrical connections are made in series to achieve a desired output voltage or in parallel to provide a desired current capability (amperes) of the solar panel or the PV system. The conducting wires that take the current off the modules are sized according to the ampacity and may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated. Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.

II. Methodology:

The basic device of a PV system is the PV cell. Therefore, in order to study and design the whole PV system, it is important to build a model for the PV cell. A reliable and accurate mathematical model of PV cell is important to design and test other parts of a PV system and to design the control algorithms of the PV system. This model is useful in studying and designing the MPPT algorithm, the inverter, the control strategy and the synchronization algorithm. Moreover, datasheets of the PV modules provide the module parameters at only Standard Test Condition (STC), so the mathematical model should use that information to predict the device's behavior at any condition accurately.

- **Ideal PV Cell Model:** Figure 2.1 shows the equivalent circuit of an ideal PV cell. The current output of a PV cell (I) is related to its voltage (V) by equation 1.1:

$I = I_{ph} – I_s (e^{(qV/AkT)}-1)$......................................(2.1)

$I_D = I_s (e^{(qV/AkT)}-1)$...(2.2)

where I_{ph} is the photo current (depends on the solar irradiance and cell temperature),
I_D is the diode current, I_s is the diode saturation current,
q is the electron charge, k is the Boltzmann constant,
T is the PV cell temperature in Kelvin, and A is the diode ideality constant.
Figure 2.1 shows the I-V characteristic curves of PV cell at constant isolation and temperature.

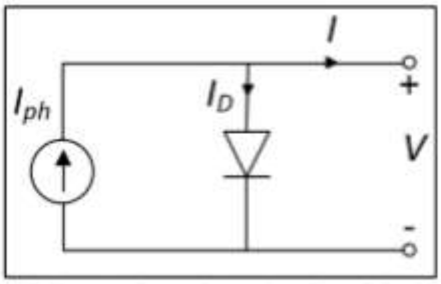

Figure 2.1: Equivalent circuit of an ideal PV cell

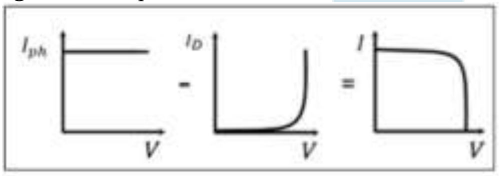

Figure 2.2: I-V characteristic of an ideal PV cell

- **Practical PV Module:** A PV module is built up of several PV cells connected in series and parallel. The practical model of the PV module shown in Figure 2.4. The new parameters in the practical model are a shunt resistor (Rsh) to express a leakage current, and a series resistor (Rs) to represent an internal resistance of PV module and wiring. The current-voltage of a PV module is described by the relationship:

$I = I_{ph} – I_s (e^{(q(V+IRs)/NsAkT)}-1) - (V + IRs)/Rsh$ ....(2.3)

where Ns is the number of series connected cells,
Rs is the equivalent series resistance of the module,
Rsh is the equivalent parallel resistance.

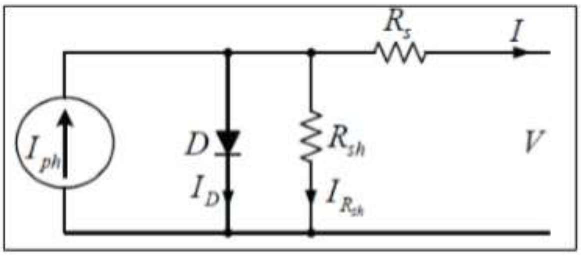

Figure 2.3 Practical PV Module

Figure 2.4 shows the I–V characteristic of the practical PV module.

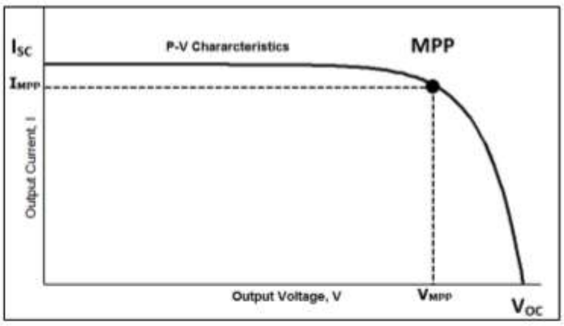

Figure 2.4: I-V characteristic of the practical PV module

Maximum power point tracking (MPPT):

The highest power point tracking (MPPT) or often a power point tracking (PPT) is a practice that is used basically with wind turbines and some photovoltaic (PV) solar systems as to increase up power taking out under all the conditions. Even though the solar power is the particularly covered, the standard that processes up to is commonly to the sources with a different power: Such as, the optical power conduction and the thermo photo voltaics. Solar cells had a composite relationship among the temperature as well as the overall resistance emits the non-linear output competence that could be a overall examined on the basis of I-V curve. This is a method of MPPT system aim to sample the output of Photo voltaic cells and relate to the proper resistance (load) to get the highest power for a given environmental conditions. The MPPT equipments were basically upgraded to any electric power changer system which in all enables voltage or current conversion, altering, and regulation of the driving different loads, adding up the power grids, batteries, or motors.

III. Experimental setup and Results:

Figure 3.1: Gears and bearings

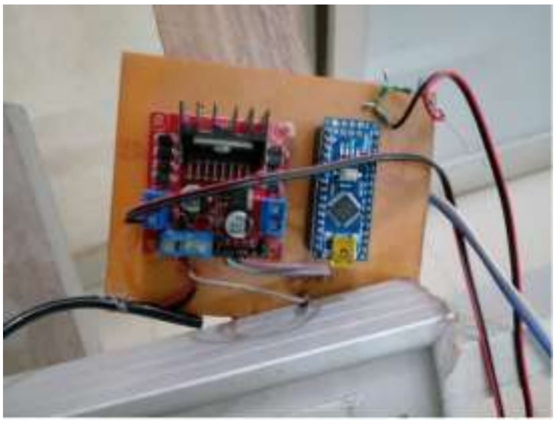

Figure 3.2: Controlling element

Figure 3.3: Solar panel

Figure below shows different voltages obtained at different angles.

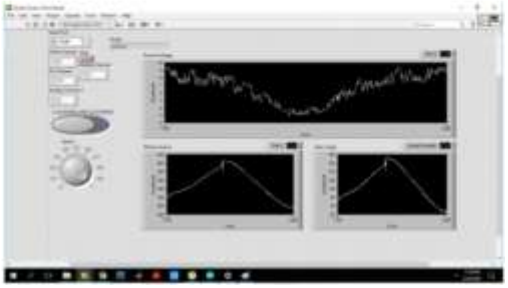

Figure 3.4: 9.2V at 25.8125°

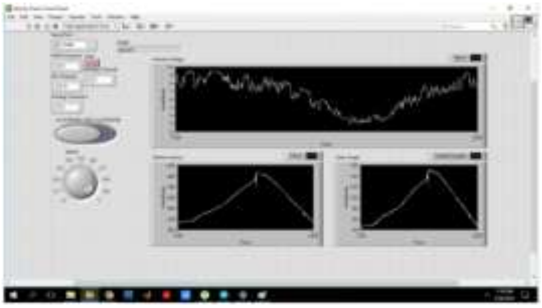

Figure 3.5: 9V at 48.6473°

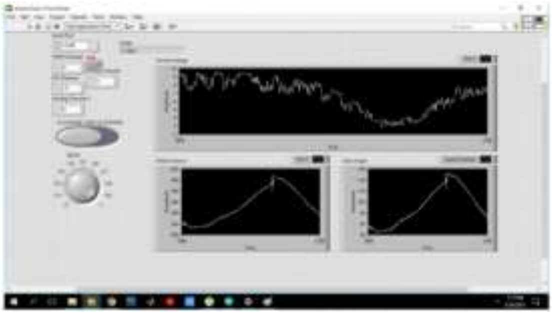

Figure 3.6: 9V at 71.4821°

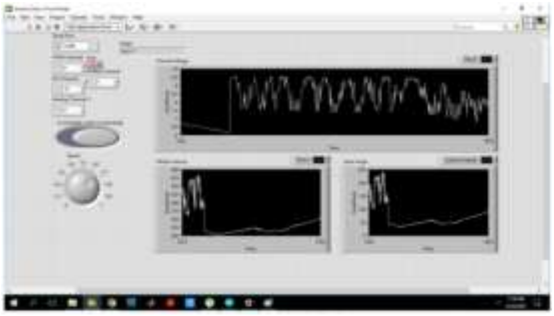

Figure 3.7: 9.5V at 94.317°

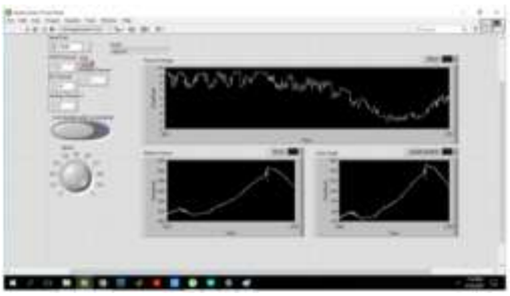

Figure 3.8: 9.5V at 108.018°

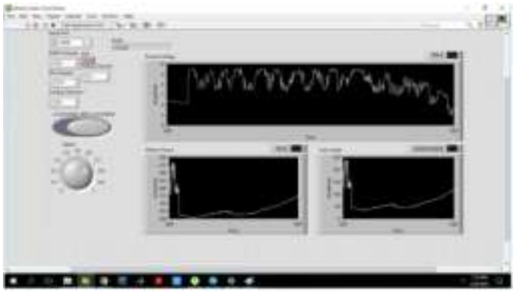

Figure 3.9: 9.5V at 118.294°

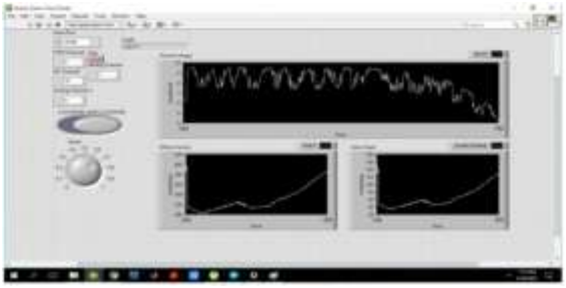

Figure 3.10: 9.4V at 129.711°

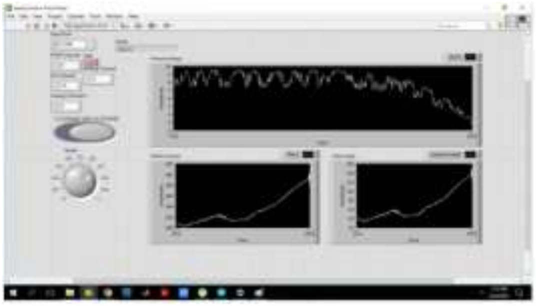

Figure 3.11: 9.5V at 143.412°

Table 3.1: Voltages at different angles

Sno.	Angle	Voltage(Volt)
1.	25.8125°	9.2V
2.	48.6473°	9V
3.	71.4821°	9V
4.	94.317°	9.5V
5.	108.018°	9.5V
6.	118.294°	9.5V
7.	129.711°	9.4V
8.	143.412°	9.5V

IV. Conclusion:

The use of solar system is increased in the last two years. The objective of this system is to Power of the system can be monitor using the current and voltage value sensed by the arduino. This system helps to implement in solar system for efficient usage. The electricity generated by capturing the sun light is called as solar energy which is used for business and home purpose. The atoms lose the electrons when the photons hit the solar cells. A solar panel is made of multiple panels that wired together, more electricity is generated by the more panels we deploy. Silicon like semiconductors are used to make the PV photovoltaic solar panels as shown in figure. Direct Current is generated by the solar panels. Most of the electrical appliance works on AC supply can AC can be less expensive for transmit to long distances. Many energy companies are expanding to offer solar, which is among the most energy-efficient and lucrative sources of renewable electricity on the market.

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