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SOLAR PARAMETER MONITORING & ALERT USING IOT

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Abstract: In solar energy, solar panels are the main generation elements. Whereas gained power from the photovoltaic solar panel is a main factor & reflects the panel performance. This affects by many parameters like dust density, light intensity, ambient temperature. To generate energy at full efficiency timely maintenance like cleaning & solving electrical issues is must. Delay in maintenance causes reduction in generation & even damage to the system. Also by knowing the expected amount of generation of energy from solar panels, it is also possible to manage the utilization & consumption of power in better way. In this project, a current and voltage sensors will be use to measure generating power from solar panel. By detecting generation deficiency, we can found defective panels & improve the generation by completing maintenance on-time. By measuring amount of sunlight, a generation can be predicted for the day so that energy can be manage in efficient way. With the help of IOT all the parameters & alert will be shown on webpage. Arduino Nano board will control all the operation here.

Index Terms **– Solar, IOT, Power monitoring, Arduino**

I. INTRODUCTION

Solar energy has been recognized as the most promising source of renewable energy all over the world. Solar energy possesses the potential to replace highly carbon intensive technology [1]. As per the recent IEA declaration renewable is not a niche fuel any more it has become a mainstream fuel. Solar and wind is surpassing the other renewable energy sources, to be the largest share in renewable market. The drastic decline in the cost of solar PV modules has accelerated its growth and has led the energy enthusiasts all over the world to consider it. Because of the increasing demand for solar energy, the efficiency of solar panels is more important than ever. However, solar panels are very inefficient. Soiling of PV panels drops the panel efficiency even farther. This accumulation of dirt on the panels is a well-documented effect that can cause a loss of efficiency [1]-[6].

Many factors are affecting the solar panel performance. Some factors are proportional positively on the obtained electrical power, while other factors are affecting negatively [1]-[4]. Light intensity level represents an important parameter with respect to the effectiveness of the solar panel, the collected solar energy which converted to the electrical power is proportional with the instantaneous level of light intensity [5]-[7]. Dust density level is the other parameter which represents an obstacle between light beams and the front surface of the solar panel. The dust's particles deposits on the panel which will reduce the amount of radiation falling on the PV cells from the sun light [6]. Besides the variety of dust density in every region, the angle of the surface can collect more dust. The more horizontal is the surface, the more dust particles will be collected on that surface [9]. Ambient temperature has high priority effect on the solar panel effectiveness. In other word, increasing panel temperature value is leading to reduce the delivered power from the panel. Ambient humidity also affects negatively the panel performance [11].

Many electronic monitoring systems are proposed in literature for continuous measuring, recording, and/or controlling functions [12]-[14]. Microcontroller unit is used for the mentioning/controlling functions in many studies due to the easy programming and connection with the personal computer for interaction activities, i. e. programs loading, data collecting and analysis. Since solar energy generation system is high cost investment, it must be run at full efficiency. In this project, an automation is performed with the help of sensors to make sure that solar farm run at full efficiency and detect situation in case of any maintenance. IOT technique is used to visualization and alert.

II. NEED OF PROJECT

Solar energy is the best available option to solve the energy crises. Where as to enhance the generation capacity and frequent maintenance is very important to get uninterrupted power. Generation of solar panels affects due to dust which settle on panel surface, of any electrical fault. Since solar panels are costly, any damage in the structure or ground surface may cause to break panel or change the direction of panel which may reduce the amount of sunlight collected by panel. Electrical maintenance is also important for solar systems due to fluctuating amount sunlight throughout the day and year, solar panel generated wide range of voltages. With this, changing environmental conditions may damage the wiring. Since the solar energy generation is limited for day time, prediction of generating solar power may help to manage the consumption.

III. OBJECTIVES

Since solar energy generation system is high cost investment, it must be run at full efficiency. In this project, an automation is performed with the help of sensors to make sure that solar farm run at full efficiency and detect situation in case of any maintenance. Objectives of the project are:

- Measure & monitor power (V*I) generation of each panel.
- Find the faulty panel by comparing generated power with panel capacity.
- Find faulty panel and provide maintenance alert.
- Show all the parameters & alert on webpage using IOT.

IV. LITERATURE SURVEY

In "Monitoring Of Solar Panel Based On IOT"[1], panel surface temperature is measured along with voltage generated by panel. By measuring generated voltage panel is rotated into the direction where maximum output is obtained.

"Online multi-parameters electronic monitoring system for solar photovoltaic panel applications"[2] Here author studied effect of dust density, light intensity as well as ambient temperature on panel effectiveness through designing and implementing a simple and easy use electronic monitoring system.

"Design of Solar Panels Efficiency Monitoring System"[3] describes a software based on system architecture for continuous monitoring of solar panels efficiency. The system collects various data, including the surface temperature of the solar panels, degree of power charge, weather information, and other technical data.

Pritam Pokhra[4] deals with the design & analysis of the Automatic Sun Tracking Solar Panel based on open loop concept. The main objective of the project is to harnesses the maximum amount of sunlight from sun and converting it to electricity so that it can be easily used and transferred. This can be done by aligning the solar panel perpendicular to sun rays so that maximum sunlight can be converted into electrical form. As this system give maximum efficiency. The main feature of this tracker is that it is independent of the intensity of sunrays. It directly takes the coordinate of the sun according to its position and align itself according to that. As well as it gives higher efficiency, high reliability. The advantage of this project is to provide access to an everlasting and pollution free source of energy. This project can be used in form of decentralized generation. And when connected to big battery banks then can independently fulfill the needs of local areas.

In Solar Panel Cleaning Robot[5] its stated that the dust particles accumulating on the solar panels will prevent the solar energy from reaching the solar cells, thereby reducing the overall power generation. Power output is reduced as much as by 50%, if the module is not cleaned for a month. In order to regularly clean the dust, an automatic cleaning system which removes the dust on the solar panel is developed. In this paper, the problem is reviewed and the method for dust removal is discussed. A robot cleaning device is developed and it travels the entire length of the panel. A PIC microcontroller is used to implement robots control system. The robot provided a favorable result and proved that such a system is viable by making the robotic cleaning possible, thus helping the solar panel to maintain its efficiency.

"Solar Energy Monitoring System by IOT"[6] shows that the Internet of Things has a vision in which the internet extends into the real world, which incorporates everyday objects. The IoT allows objects to be sensed or controlled remotely over existing network infrastructure, creating opportunities for pure integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. This technology has many applications like solar cities, smart villages, micro grids and solar street lights and so on. As Renewable energy grew at a rate faster than any other time in history during this period. The proposed system refers to the online display of the power usage of solar energy as a renewable energy. This monitoring is done through raspberry pi using flask framework. Smart Monitoring displays daily usage of renewable energy. This helps the user to analysis of energy usage. Analysis impacts on the renewable energy usage and electricity issues.

V. BLOCK DIAGRAM

A current and voltage sensors will be used to measure generating power from solar panel. By detecting generation deficiency, we can found defective panels & improve the generation by completing maintenance on-time. With the help of WIFI module all the parameters & alert will be shown on webpage. All operation will be controlled by arduino Nano. Complete system will be powered through solar panel

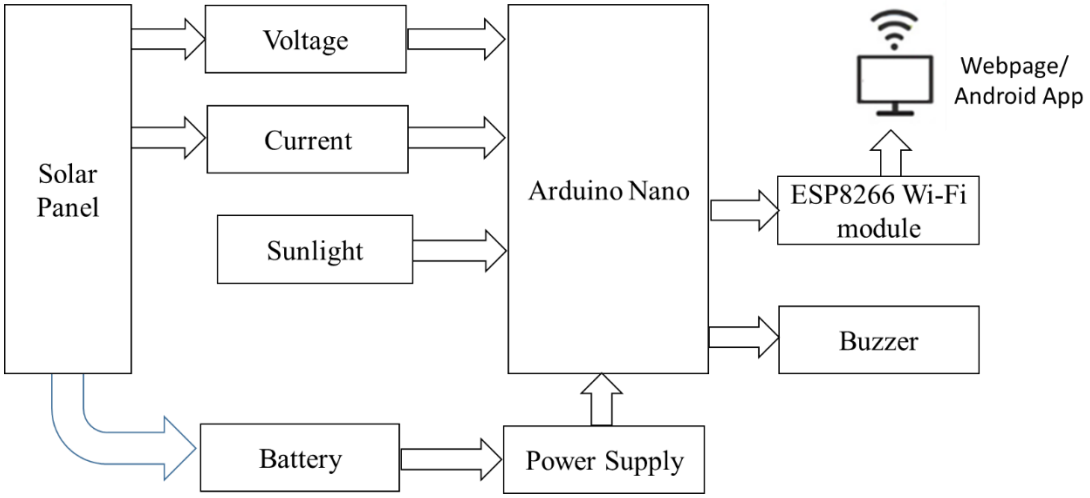

Figure 1: System Block Diagram

VI. Design of Solar Charge Controller

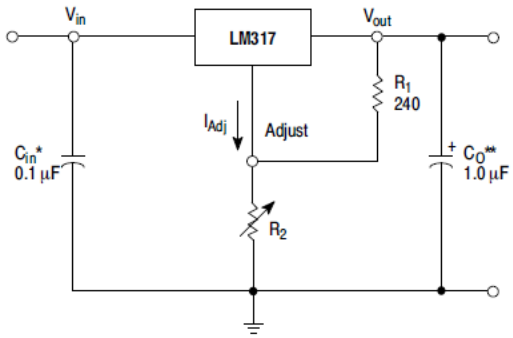

Figure 2 LM317 Basic Configurations

Figure 3.1: System Block Diagram

Output of solar panel depends on amount of sunlight fall on it. More sunlight gives more voltage whereas less sunlight cause reduction in output voltage. Maximum output voltage of panel we are using is 18V. Whereas as per the battery requirement, we need constant 13V dc to charge the battery. To satisfy this requirement, an variable voltage regulator IC as shown in figure bellow.

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In above figure, C_{in} is required if regulator is located an appreciable distance from power supply filter. C_o is not needed for stability, however, it does improve transient response. Since I_{Adj} is controlled to less than 100 uA. The error associated with this term is negligible in most applications. As per the requirement of 13V output, consider R1=240 ohm. So as per the equation,

$$V_{out} = 1.25\text{V}(1 + \frac{R2}{R1})$$

$$13 = 1.25\text{V}(1 + \frac{R2}{240})$$

$$R2 = \left(\frac{13}{21.25} - 1\right) * 240$$

R2=2256 Ohm

R2=2.256 KOhm

As there is no resistor of this value, a variable resistor of 10KOhm can be used.

VII. CIRCUIT DIAGRAM

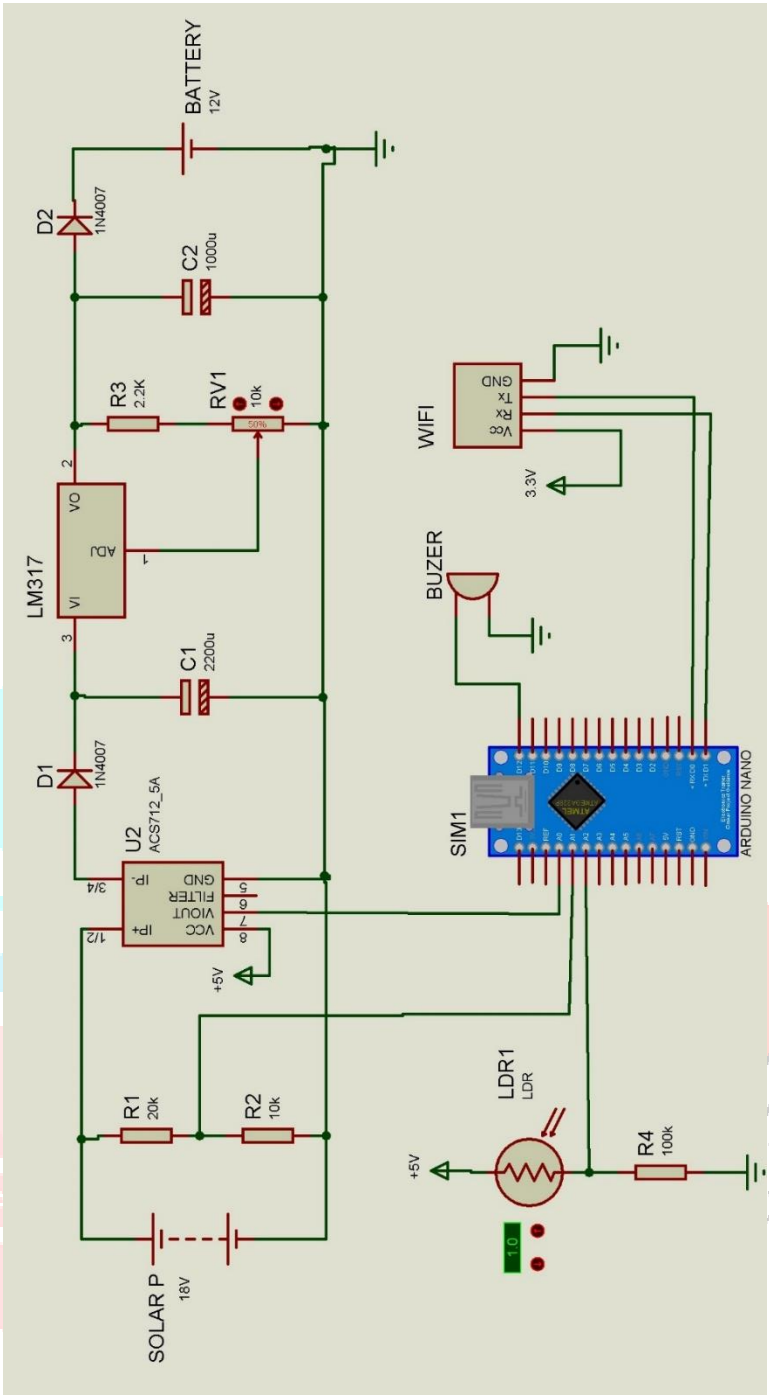

Figure 3: Connection Diagram

VIII. RESULT:

Bellow image shows the system results uploaded to thingspeak server. Panel used in system is of 12V, 5Watt. Whereas system measures the value of 4.6 watt power which is near to the panel rating and hence there is no fault. When the panel output goes bellow set value of 4.5Watt, System generates fault alert and the red indicator of fault turns on.

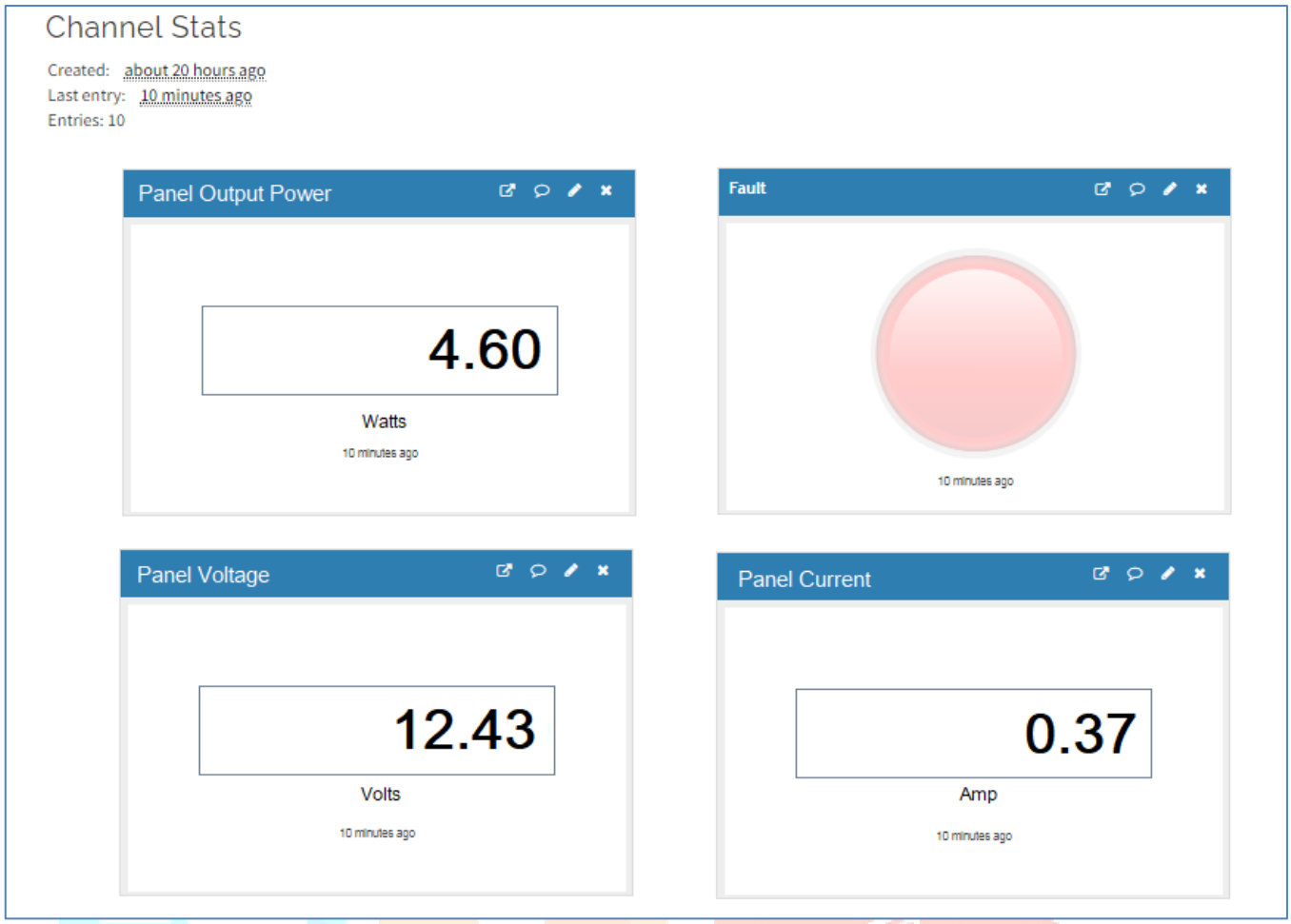

Figure.4: Webpage Result

IX. Conclusion

We believe that this project will be extremely helpful for increasing the efficiency and maintenance alert for solar power plants. This will ultimately reduce the troubleshooting time and manpower needed for maintenance work. Also with the features of energy generation prediction and cleaning time prediction, it will be easy to manage things. Due to use of IOT, a remote monitoring is possible.

In this project by considering all the situations and possibility, we decided the objectives for project and chosen components which are helping to achieve the desire target. Though, design of circuit is critical due to non-availability of some of module in Protius software. Whereas due to the use of Arduino development tools, reduce difficulties during programming & troubleshooting was reduced.

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