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Analysis of Solar Panel Parameters using Internet of Things

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Abstract:- The requirement for energy is increasing day by day throughout the world. Renewable energy plays a crucial role in fulfilling the energy requirement over non-renewable energy due to its eco-friendly nature. Among different sources of renewable energy, solar acts as a major source due to its abundant availability. Due to the lesser efficiency of solar photovoltaic (PV) systems, an appropriate maintenance and monitoring is required. In recent years of research Internet of Things (IoT) is used to monitor and detect faults in solar PV systems. In this article, an IoT based solar monitoring and fault detection system is proposed. In the proposed system, voltage, current, and power of the solar PV system is continuously monitored and stored in the cloud for future and further analysis. From the monitored values, if any deviations found means it will be tracked and intimated to the operating personnel. The faults are identified and resolved immediately. In future, the proposed system is further can be improved for automatic fault rectification.

Keywords:- *Renewable Energy, Solar Energy, Photovoltaic, Internet Of Things, Fault Detection.*

I. INTRODUCTION

Energy is the most prominent component in the world. Human lives can't run without energy. In the technologically developed world, all the living beings and industrial machines depend energy for their life. Different sources are available to produce the energy in different forms. Energy resources are broadly classified into two types namely non-renewable (conventional) and renewable (non-conventional). Conventional energy resources like petroleum products, nuclear energy, natural gas etc., are widely used for energy production in the world to fulfilling the energy requirement. The major setbacks associated with them are availability. Due to the continuous usage, the availability of conventional energy resources is getting reduced in quantity which results in huge hike in their prices. Another major setback of conventional energy resources is production of harmful gases which affect the environment heavily. Due to these reasons for past few decades, the usage of renewable energy resources like solar, wind, biomass, tidal etc., occupies many areas. Plenty of research works are going on these resources. Each renewable energy resources have their own pros and cons. Wind energy provides more power in world wide. But major drawbacks associated with wind energy are seasonal dependency. Solar energy occupies many places for energy production. From the literature it is found that each and every day solar have many times of power required to the world. Solar energy is available in major parts of the world and eco-friendly in nature [1-3]. If solar power is properly trapped means no other energy sources needed for power production [4,5]. Due the eco-friendly nature of solar energy, many governments provides lots of schemes like subsidy for installing the solar energy from home roof top to large industrial applications [6]. Indian government constitute a ministry for renewable energy in the name of Ministry of New and Renewable Energy (MNRE). From this MNRE, common people to big industries can avail many subsidies for installing renewable energy resources for the energy production from watts to gigawatt range. The basic concept of solar energy power production is converting the solar light in electrical energy. Two basic types are used in this power conversion namely concentrating solar thermal power (CSTP) and solar photovoltaic (PV). Among these two methods solar PV is widely used power production from mW to GW ranges. Based on the power requirement, solar cell or solar panel or module or arrays are utilised. Even though solar power productions are used world-wide, the efficiency of solar PV cells is very small. Due to this, a proper conversion should be used in solar PV. A concept of maximum power point tracking (MPPT) is used capture maximum power from under partial shading conditions [7-9].

The performance of solar PV systems gets affected by different types of faults while working. To identify the faults in solar PV systems, the concepts Internet of Things (IoT) is integrated with solar PV systems [10,11]. By integrating this, voltage, current and power produced by the solar systems are continuously measured and stored in the cloud for further analysis. The measured values are regularly compared with threshold values. If major drop in yield voltage, current or power, it will be noted and intimated to the systems admin. From this the system admin looks into the problem and solve it immediately. In this work, an IoT based solar PV parameter extraction and fault detection scheme is proposed. The major issue associated with solar PV techniques is instalment cost. The cost of panels, batteries, and inverters are high. Different types of inverters are available in solar PV techniques. Among them, multilevel inverters attracts many researchers [12-15]

II. PROPOSED SYSTEM

The main objective of the proposed system is to monitor voltage, current, and power from the solar PV panel to be continuously monitored with help of sensors [16-18] and arduino board. The data collected from the voltage and current sensors are stored in Thingspeak. Thingspeak is the employed server for this proposed system. The continuously monitored data's from the solar PV panels through the arduino board are displayed in the webpage. The proposed system contains ATmega328P microcontroller, voltage sensor, current sensor, and intensity sensor etc. Figure 1 indicates the IoT based solar PV panel parameter monitoring system.

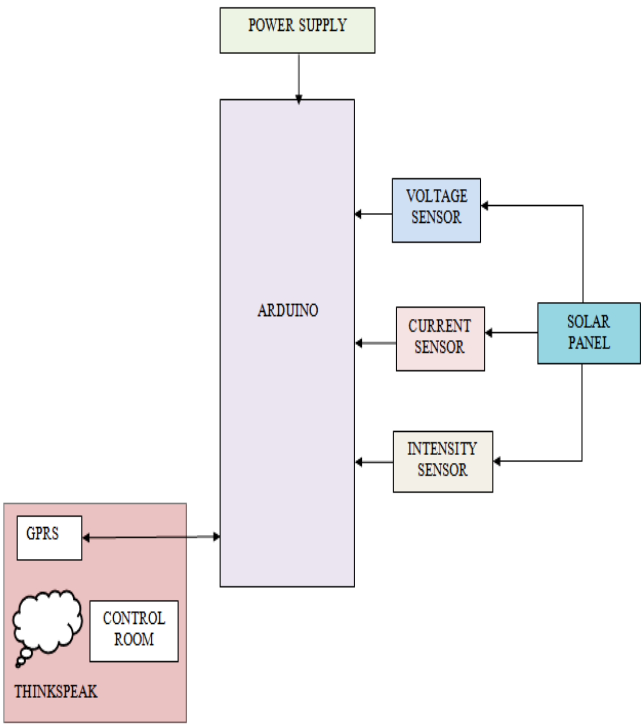


Fig 1. IoT based solar PV panel parameter monitoring system

III. RESULTS AND DISCUSSION

The proposed system is working under falling of sun light and measure the voltage, current, power and intensity from the solar PV panel. These measured data's are stored in Thingspeak web space with the help of IoT. Figure 2 represents the IoT based solar PV panel parameter monitoring system with Thingspeak environment. Figure 3 explains the working flow of the IoT based solar PV panel parameter monitoring system. In figure 4, prototype of IoT based solar PV panel parameter monitoring system is given.

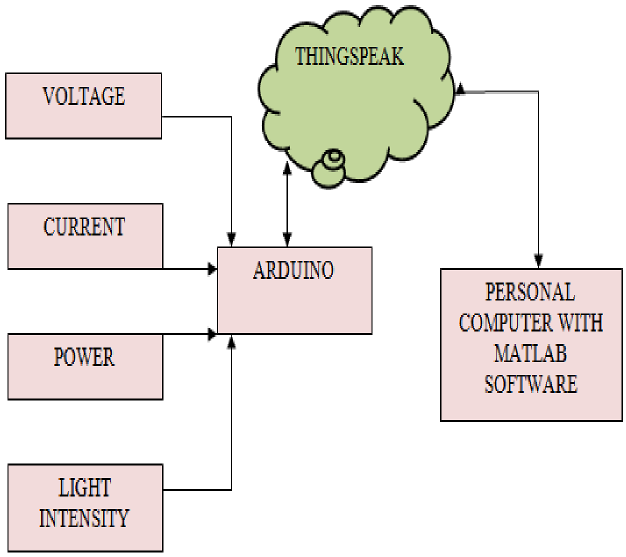


Fig 2:- IoT based solar PV panel parameter monitoring system with Thingspeak environment

Figure 5 shows the measured data's of voltage, current, power, and intensity from the solar PV panel. From this figure 5, it very clear that at a particular time a sudden high in voltage (figure 5a), a constant drop in current (figure 5b), a sudden drop in power (figure 5c), and deviations in intensity. This sudden change indicates that there may be a working fault or wrong working condition in the solar PV panel. This kind of changes can be continuously monitored through IoT and make some indications about the faults to the system administrator. From that, the identified faults may be rectified immediately and avoid disturbance in the power production.

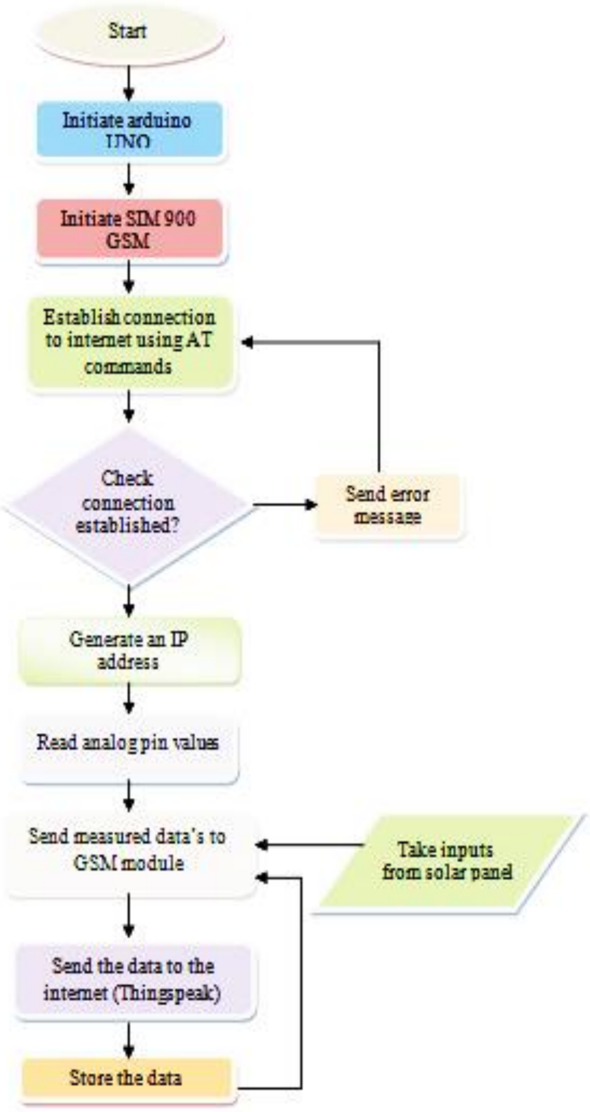


Fig 3. Flow chart of proposed system

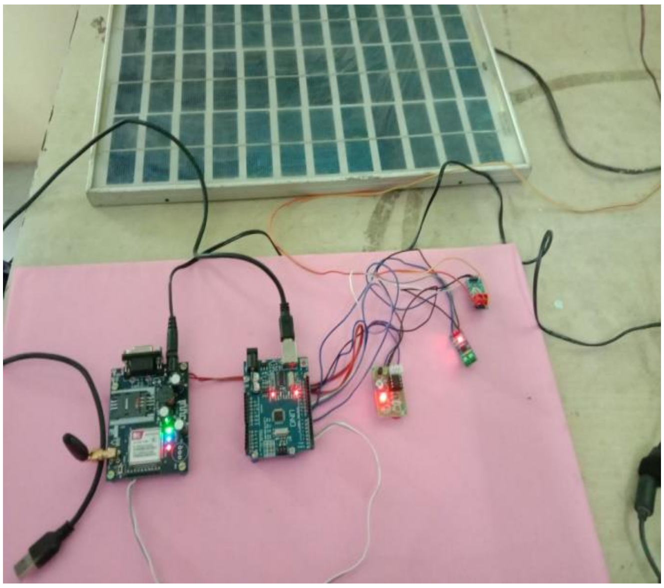
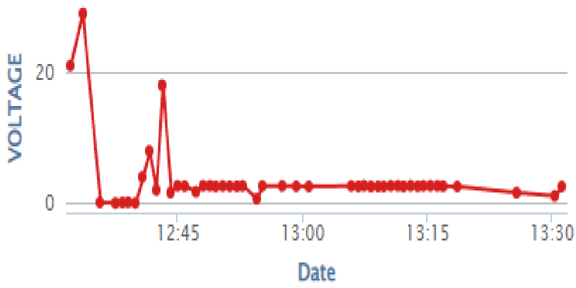
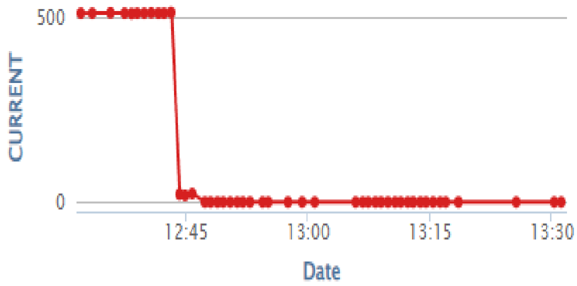


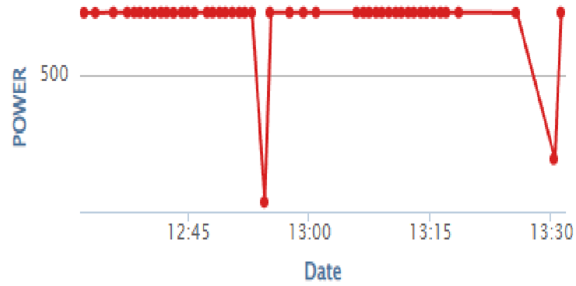
Fig 4. IoT based solar PV panel parameter monitoring system - prototype



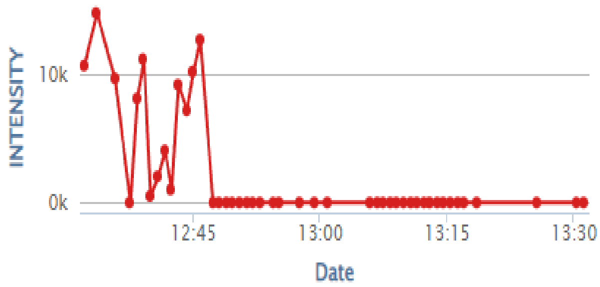
(a) Voltage



(b) Current data



(c) Power



(d) Light intensity

Fig 5. Solar PV panel parameters

IV. CONCLUSION

In this article, an IoT based solar PV system monitoring and fault detection is proposed. With the help of arduino, voltage sensor, current sensor, and intensity sensor, the voltage, current, power, and intensity from solar PV panel are measured and stored in Thingspeak webpage with the help of IoT. From the continuously monitored values, if there is any sudden change in measured values, it will be indicated to the system administrator. Then system administrator can rectify the fault immediately and thus power production takes place continuously.

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