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IOT BASED SOLAR POWER MONITORING SYSTEM

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Abstract: This paper propose a solution and method to monitor dust accumulated on solar panel to get maximum power from for actual use. Always output power of the solar panel depends on energy reached to solar cell. System also display malfunctioned solar panel list and whether electrical appliances are working straight on the solar panel or the load is on battery. All panels are connected, and sensors are directly associated to central controller which monitors loads and panels. By incorporating IOT technology the data received from panels and appliance are send to cloud from through internet for the future use as well the remote user can monitor parameters of connected devices. Users can view present, previous, and average parameter like temperature, voltage, current, and sun light using a graphically user interfaces GUI.

Keywords: Internet of the Things (IoT), NODE MCU, GSMA, PV, Solar panel, LCD, Things Speak.

1. Introduction

Internet of the things is playing a major and important role in daily life of humans by enabling the connectivity of many and most of physical devices through internet to exchange data for monitoring and monitoring the devices from a remote location, where the devices are becomes intelligent [1]. This technology can connect a wide range and varieties of things such as animals, humans, smart transport, smart grids, virtual power grids, smart cities, vehicles, heart monitoring systems, environmental sensing, shopping systems, automated homes, energy management, assistances for disable and elderly individuals, cochlear implants, tracking of things, equipment manufacturing, agriculture, emergency monitoring systems, electronics tool collection systems, vehicle control etc. according to the survey there is increase of 31% i,e 8.4 billion internet connected devices from 2016-2017. The connected device may increase to 30 billion by 2020 and which makes the business market around 7.1 trillion dollars by in 2020 [2]. By using IOT we can enable the machine to machine communication M2M or device to device communication without human intervention. In the modern life electricity became the important and essential part of life. For any work now, a day we required electricity like lighting, heating, refrigeration, cooling, transportation systems what not all the home appliance work on the electricity. In daily life the consumption of electricity is increased but not decreased. To compete with the requirement of the public more and more power is to be generated and give to the end users. As the population increases the consumption also increases. The power is generated in three methods generators, electro chemistry, and photovoltaic effect.

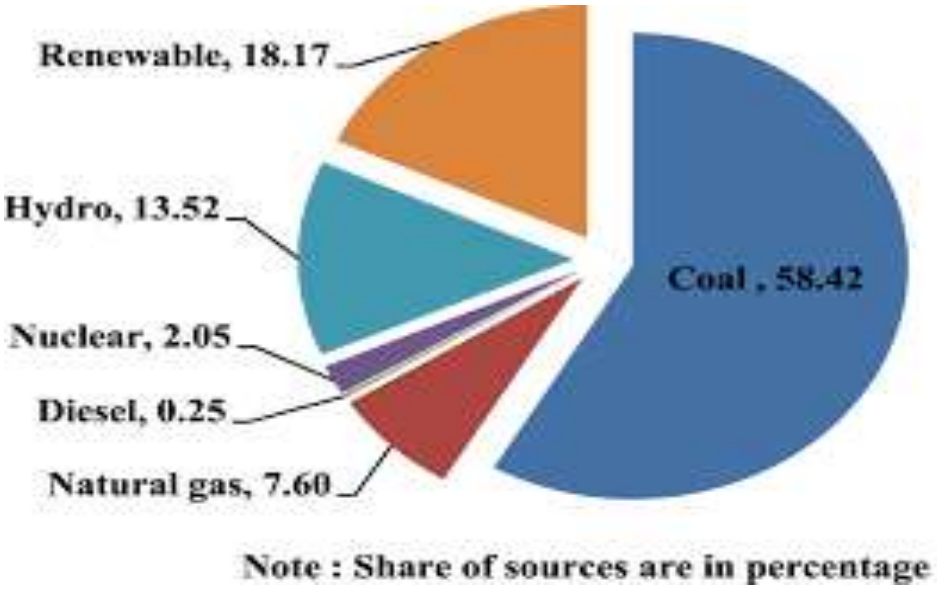

Fig. 1: The percentage of power sources installed

The electric generator is most used form to generate the electricity which based on faraday's law of the electromagnetic initiation by transforming the mechanical energy in to the electrical energy. Storing the electricity in batteries is called electro chemistry which transforms the chemical energy to electrical power. Other source to electricity is renewable energy which transforms the light energy in to electrical power which is known photovoltaic effects we call this as solar energy. In this the power are generated from free, abundant sunlight. The mechanically generated powers are cheaper than compared with solar power to produce in large quantities due to of photovoltaic solar panel. In remote location where there are no commercial powers solar energy becomes the source for the home and other things. In the recent era the solar panels are deployed dramatically, and subsidies are given. Due the environmental conditions like global warming the all countries reduced production of electricity by burning the fossil fuels. Typical solar components consist of 6x10 photovoltaic the solar cells which can generate the power for residential applications. If requires the more power than more number of the panels to installed. The panel produces DC output power in range of 100 to 365 Watts.

Fig. 2: Solar Panels

Produce huge electricity for the commercial and business purpose no of panels are placed in array which are called solar plants. Always produce power of the solar panel depends on the radiation reached to the solar cell that converts into electric energy. If the dust is more on panel then the less electricity is produced where the effectiveness of solar panels decreases. To increase the efficiency of solar panel some improvement must be done. In paper we propose a system that monitors the dust formed on the panels. Systems consist of controller incorporated with Node MCU, LDR sensor. The controllers check the predefined conditions that are programmed and detects whether dust is from through the output voltage and give the alerts to the users or the maintenance in charge. It also use things speak cloud to show the received data from sensor and GUI to monitor [9].

2. Literature of the Existing Method

Many researchers had made many studies in this major problem and proved that 50% of PV solar panel performance reduces by the dust accretion on prepared panels.

Fig. 3: Solar module covered by heavy layer due to the dust accumulation before cleaning

The studies made on the effects that causes to the solar panel due dirt the by well-known organization in world Google of 1.6 MW solar plant in there California headquarters [3]. 4.7% average loss is recorded in the pioneer"s investigations by impact of dust in solar systems that is made by the authors Hottel e.l. [4]. The authors Salim et al made an investigation on dust accumulation and stated that there is a 32% reduction of solar power in a span of eight months in a solar village near Riyadh [5]. An experiment is conducted by the authors Dirk GooseNet. Author Garg of Roorkee made an experiment and discovered that panel would reduce 8% average transmittance by the accumulation of dirt on 45-degree slanted glasses plates after a 10-day period [7]. Due to buildup of dust on panels it is observed that useful energy is reduced by 30%. The common methods used to clean the dust are by spraying water on panels with cleaning agent. Vibrating the panels with motors as the cell phone vibrates so that the dust goes off from panel. The dust jumps off from panel by creating a positive charge. By using brush manual, we must clean the PV panels. Solar panel monitoring is important. It is vital that the solar panel is monitored regularly in one way or another. You need to make sure they are operating correctly, and the system is generating as much as predicted. If you have the solar panel installed, you should at the very least check the generation meter once a week and take a note of the reading [8]. And should go to place of the panels arranged and note the readings every time. It is a manual checking procedure, always should go to place of the solar panels system arrangement to note down the readings. So, it's not possible to take readings all the time, whenever required should go to place of system arrangement. And optimum power cannot be obtained due to any proper alignment of solar power.

3. Proposed Method

Main purpose of this project is to get optimum energy output from solar panels during dust are accumulated on it. Also, if there is any broken of solar panel will displayed on and we can also get info about whether solar or battery connected for loads. The system detects and alerts the user or the administrator when is fall below the predefine conditions, and display on the GUI. Solar panels are used that keep a monitoring sunlight's. Here different limits as a voltage, present and temperature are displayed on LCD by using IOT technology.

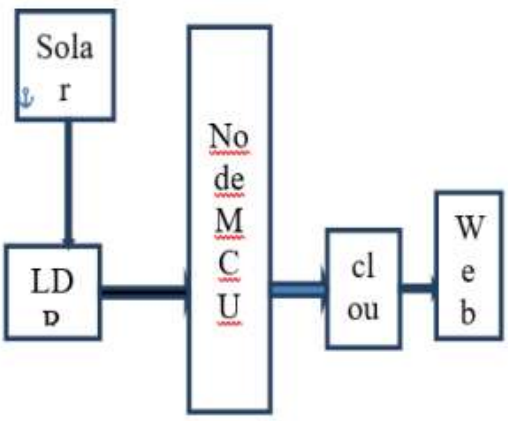

Fig. 4: Block diagram of proposed method

4. Hardware Implementation of Proposed Method

The most conspicuous part of housing solar power system is solar panel. Thin-film semiconductor or glassy silicones are used make P V solar cell for many of residential applications. These PV devices cover semiconductor that produce electricity nonstop from sunlight. The electrical devices are powered, or it is send to grid when electrons are made free by the solar energy in these materials. One of most important aspect of receiving your solar panels to produce electrical energy optimum efficiency are keeping them in full and direct sunlight. DC voltage present is made when the Photovoltaic solar panel is exposed directly to the sunlight. Solar panels generate the DC were the home appliance work on AC power, so the result of panels is given as input to the invertor. The entire appliance works through the invertor. The invertor entails of a battery. The battery gets charges when the appliance is not in used and gets discharged when require the supply. Solar monitoring system will track amount of the electricity your solar panels have produced and donated to power grid. For the sensing the light we have used light reliant on resistor is component varies the resistance with light strength that fall it and can different a night and a day There is many potential ways of monitoring solar panels. There are high tech solutions which upload data continuously to a web portal which consents you to monitor your systems performance from anywhere in the world. In this proposed system we have an open source cloud[10] platform application think speak is used. Which retrieve and store data from sensor or the things linked to systems done internet that uses the HTTP from local network to cloud? It update all data logs conventional from the sensors, tracking location applications, and the status application giving to the users and taken from the users. To use this user has create an account which contains different channels for monitoring of different parameters in the system or in the monitoring the paraments in a remote device. This cloud enables the administrator or the user to visualize the data in graphical representation. With internet-based monitoring, energy output data are transferred to a router, making it available through an online interface. The main advantage of systems like these is that your solar panel output information are readily available anywhere you can get an internet connection The node MCU acts like a key processing element for the proposed system like shown figure 4 and figure 5 which are developed by ESP8266 open source community of micro-controller on single board that can be programmed using the Arduino IDE having a RAM size of 128Kbytes and program storage capacity of 4 Mega Bytes. It can powered by a USB cable, having a operating voltage of 3.3 to 5 volts and an in built Wi-Fi SoC Architecture. The figure 6 show that Node MCU

Fig. 5: Node MCU

Solar Panel electricity generated by capturing the sun light is called like solar power which are used for business and home purpose. Natural nuclear reactor is sun which releases the energy with tiny packets called photons. The atoms lose the electrons when the photons hit the solar cells.

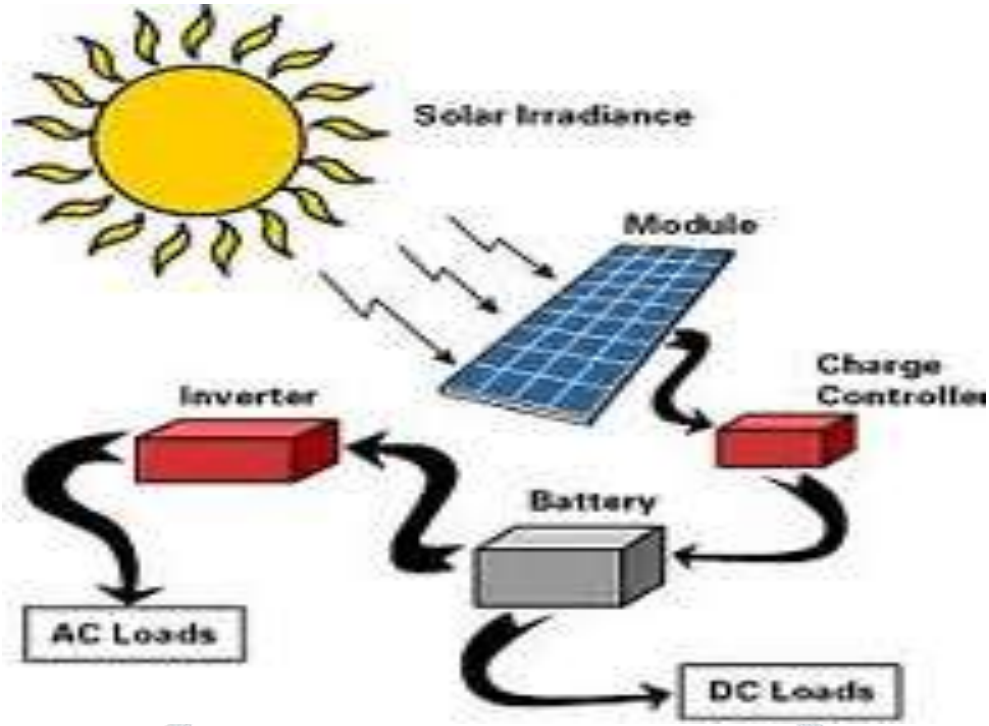

Fig. 6: Solar Energy Conversion

LDR Photo conductivity are main working principle of a LDR or light dependent resistor. All electrons in semiconductor of the valance band excites when the light or photos fall on resistor. When the light falls on LDR resistance gets decreased and increase in dark or called as dark confrontation. Basing on materials the LDR‟s are classified in to two types Intrinsic Photo Resistor and Extrinsic photo resistor.

Fig. 7: LDR

Things Speak Cloud setup

An open source cloud platform application think speak is used. It updates all the data logs received from the sensors, tracking location applications, and the status application giving to the users and taken from the users. To use this user has create an account which contains different channels for monitoring of different parameters in the system or in the monitoring the permanents in a remote device. This cloud enables the administrator or the user to visualize the data in graphical representation. With internet-based monitoring, energy output data is transferred to a router, making it available through an online interface. The main advantage of systems like these is that your solar panels output information is willingly available anywhere you can get an internet connection

5. Results & Conclusion

In this project IoT based systems are designed to get an optimum power output from the solar panels during dust is accumulated on it. And, a monitoring system is designed for there is any malfunctioning of solar panels will be displayed on and we can also get information about whether the solar or battery connected for the loads. It now displays these parameters like shown in figure 9 to the user using an effective GUI and alerts user when the output falls below specific limits. Solar panels are used that keeps monitoring sunlight. Here different parameters like voltage, current and temperature are displayed on LCD by using IOT technology. Now we are getting only information we can see it in cloud but in future we can control whole system through IoT which Distant is a way.

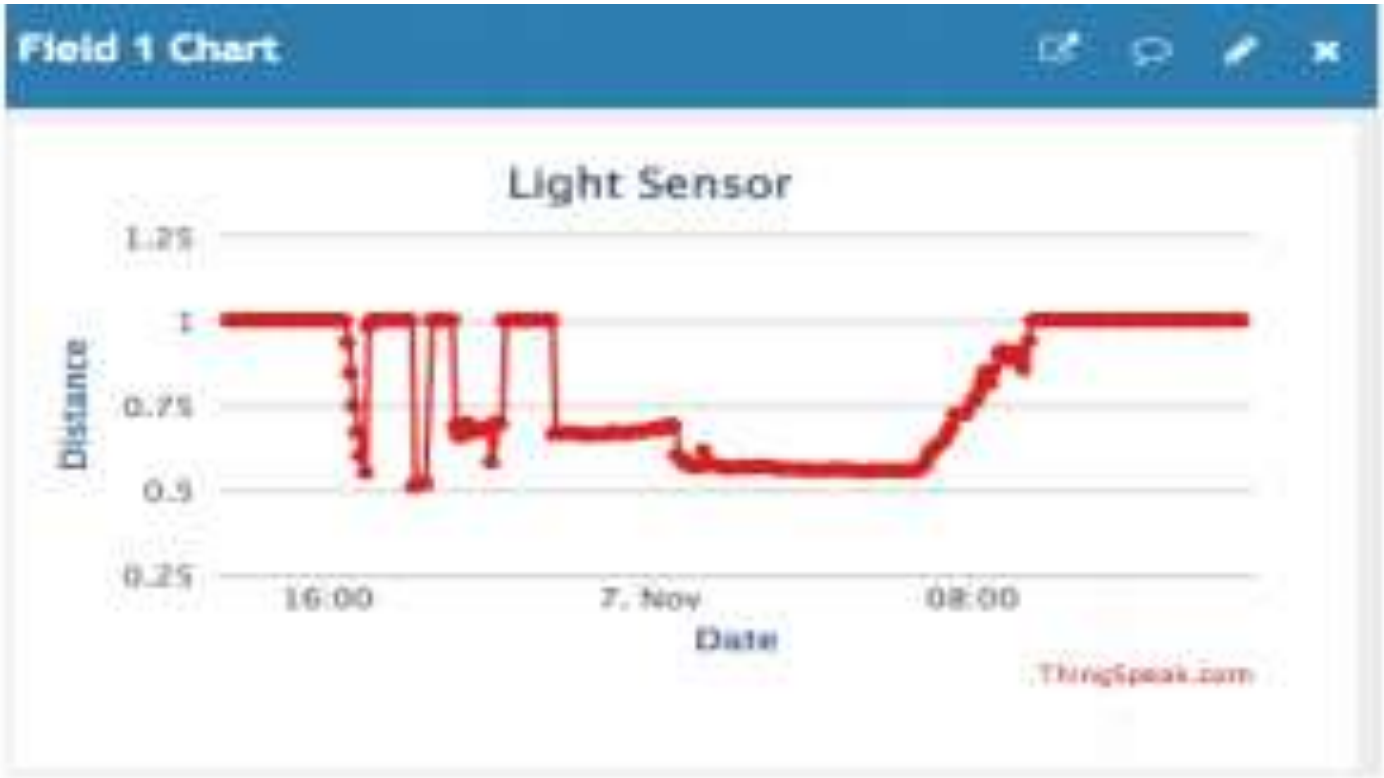

Fig 9: LDR values transmitted from the working location to the cloud