IoT based Solar Field Monitoring and Control

Kanchan B. Jawale[1] Prof. Dabhade R.G[2]
[1]Student [2]Assistant Professor
[1,2]Department of Electronics & Telecommunications Engineering
[1,2]Pune University/ SND & RC College, Yeola, Maharashtra India

Abstract— The Internet of Things (IoT) is the system network of physical object devices, vehicles, buildings and other items embedded with sensors, electronics, software and network connectivity that enables these objects to collect and exchange data. IoT is expected to generate large amounts of data from diverse locations. IoT is one of the platforms for today's smart city and smart energy management systems. In this paper, we are interested in Photovoltaic systems (PV) which generate electricity from solar radiation. More precisely, our contribution consists in the implementation of a remote monitoring and control PV system for standalone applications located in an open environment. The novelty of our approach relies on the fact that it is operational even in the case of a huge spread deployment of PV system. Monitoring systems provide 24/7 data log of the system, which maximizes the benefits of early-warning systems, trending and performance reporting as a part of their routine of monitoring. In addition, they use systems for monitoring news, weather and spot-market pricing to ensure all issues are included in the monitoring process. Our solution aims to be a good replacement of manually module checking which is not recommended because of time-consuming, less accuracy and potentially dangerous to the operator. Then, we introduce, as a communication technology, a full duplex digital system using the infrastructure of the following system. The result of our demonstration shows that the system can monitor and control the remote communication between the monitoring center and the PV station. Thus, the remote monitoring functions are realized in real-time.

Key words: Internet of Things (IoT), Photovoltaic Systems

I. INTRODUCTION

Monitoring systems provide 24/7 data log of the system, which maximizes the benefits of early-warning systems, trending and performance reporting as a part of their routine of monitoring. In addition, they use systems for monitoring news, weather and spot-market pricing to ensure all issues are included in the monitoring process.

Control center operators can remotely reset most systems as soon as the event occurs, which returns the solar farm to full potential and makes the PV cells available at sunrise for all potential energy generation. This results in revenue that would otherwise be deprived.

For issues such as grid outages or curtailments, control center operators respond according to approved protocols with the grid managers. With the emergence of nodal-based electrical-grid-reliability systems, ISOs are requiring advanced energy projections for the day-ahead market. When issues arise that result in lower production, these same entities are requiring hour-ahead projections, another task easily handled by the 24/7 control center.

Monitoring systems today can provide intelligence and data at many levels – some monitoring systems can detect problems at individual panels level. Of course, the depth of intelligence depends on the monitoring system you select. Some monitoring systems can indeed provide alerts if solar panels are not generating as much power as they should.

Like any monitoring system collecting distributed data, solar power monitoring systems also collect data from various points in a solar PV farm. Depending on the depth of intelligence and monitoring you require, a solar monitoring system could be just one system that is provided at the inverter level, or it could further comprise small sensors and data collectors fixed to each panel, if panel level monitoring is required.

Some of the roles performed by the solar monitoring systems include

- Detailed performance data down to the individual solar modules
- Continuous comparison of actual system performance data against expected performance data.
- Remote diagnosis and resolution of issues impacting system performance

In this paper, a new method of solar feild monitoring system based on a WI-FI technology is proposed.

II. LITERATURE SURVEY

It provides information related to survey on IOT in various fields such as home, city, environment and enterprise and also conveyed the existing level to IoT system. However to proposed it in some other efficient way. They based on timely manner and also includes data logging based on WSN (Wireless Sensor Nodes).The limit it can accept is 146V and 15.5A Systems.it can be further enhanced [1]. It uses ZigBee wireless communication for multi modal power converters between solar PV cells .It combines as a single host and perform monitoring process. According to MPPT (Maximum Power Point Tracking) algorithm each module collects its details and stores in a reference parameters accordingly. Hence the overall system is centralized [2]. In this paper they will analyze and study a solar power plant of a linear parabolic type after introducing it. They discuss the quality and effectiveness of each internet parameter in order to explain the Internet behavior. They studied delayed behavior by using previous results. Once studied delay behavior, dynamics related to the delay in the Internet are modeled by using system recognition Technique and they used Wave Variable method is chosen as the best monitoring Method on remote monitoring methods. Finally solar power plants monitoring system via the Internet is finally designed [3]. In this paper they have defined certain problems in solar panel related to following factors mean time to repair, inflexibility, poor manageability and difficulty in maintenance .so they proposed a system model embedded in solar panel with GSM internet connection to update everything in a smart system using IoT [4]. A huge amount of users in internet makes IoT (Internet of Things) easier and smarter to implement communications quickly. IoT means storing all those related things since early days solar energy are in use and also human believe that solar energy provides energy for future.[6]

III. WHY SOLAR FARMS REQUIRE 24/7 COVERAGE

Photovoltaic based solar farms only produce power during daylight hours. The issue that is causing concern among stakeholders is not the PV cells themselves, but the BOS components— including combiner boxes, inverters, step-up transformers and the accompanying medium/high voltage substations that are on line and in service around the clock. The presence of this associated equipment and the opportunity for alarm or even failure during non-daylight hours has given rise to requirements from North American Electric Reliability Corp. (NERC), ISOs and local utilities. Additionally, environmental events such as inclement weather causing fouling by snow, sleet, ice or even mud can become issues in non-daylight hours.

When an issue occurs during hours when the PV is not producing electricity, the common practice is to wait until sunrise to address it, possibly dispatching resources to the field to resolve the issue. This practice creates production and revenue losses, because at sunrise, NERC, ISOs and local utilities expect electricity production and not phone calls explaining why the solar farm is out of service.

For NERC, ISOs and local utilities, this is a reliability issue for which procedures have been in place for all other generation assets, both traditional and renewable (wind and hydro) power plants. It is a sign of the maturity of the solar industry and its impact on system capacity and reliability that is driving this requirement across the United States electrical regional grids.

IV. IOT BASED 24/7 MONITORING AND CONTROL CENTER

Real-time monitoring and control are commonplace in most electric power generation companies and traditional utilities. But the use of such control centers, staffed by NERC certified operators, has not been common among solar generation facilities. As the number of solar farms continues to increase, the industry is rising to the challenge of integrating solar power into the larger power grids and recognized the value of around the clock monitoring. Without 24/7 monitoring, solar farms miss the simple and most effective way to ensure production is maximized.

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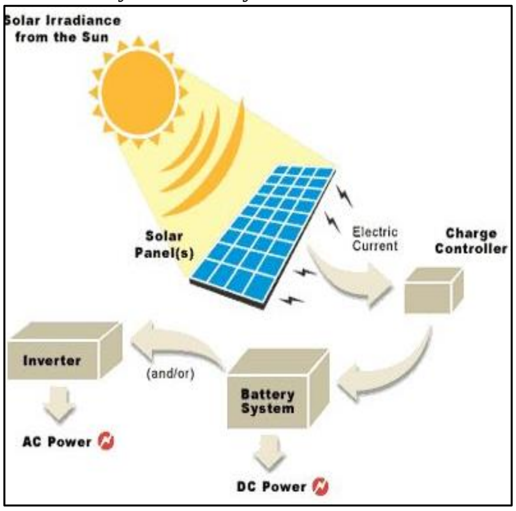

Fig. 1: Solar Panel System

V. SYSTEM BLOCK DIAGRAM

Fig.2. Shows block diagram of system. It consist of controller which provides all controlling platform for whole system by using inputs. It sends out data according to the intensity of sunlight and the rotation of servo motor to the controller. The controller stores the information obtained. Controller links data towards the servers display and again it is carry forward to the webpage via GSM/ WI-FI network.

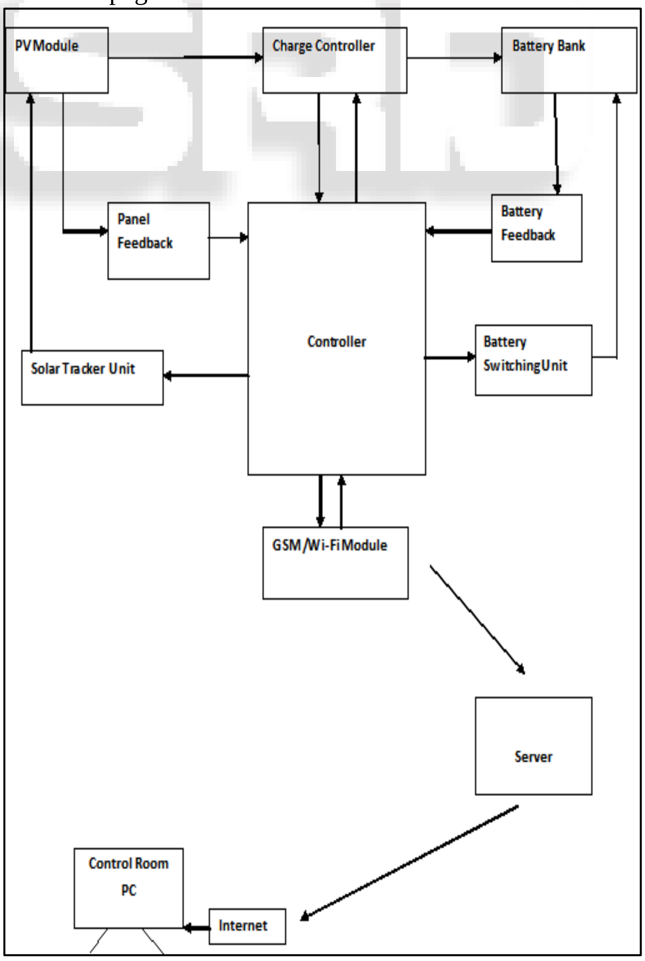

Fig. 2: System Block Diagram

VI. Safety

Finally, a critical benefit is the enhanced safety for personnel as a result of having 24/7 monitor and control centers available to them. When a control center is in use, each service provider is required to check in with the center prior to performing any maintenance. The center can participate in the safety protocols such as "lock out and tag out, "using remote operations and document the personnel entering the area and the activity being performed. When the work is complete, the service provider contacts the center and gives the "all clear "signal. The control center helps close out the "lock out and tag out "process and then documents the completion of work. Upon the safe exit of all personnel, the control center operators restart the equipment and systems remotely. This makes the process—and the service providers—safer by creating a protocol for verification prior to action

VII. Conclusion

There are much more areas improved by defining problems in the solar panels related to various factors, provides information related to IOT , also implemented the low cost monitoring system for obtaining the defected solar panels. Finally they designed, developed and trail work of a performance monitoring system of distributed solar panels along with automated data logging. The proposed system consists of Light sensors. This platform gives flexibility, reusability & optimization of sensors. These parameters are remotely manipulated with GSM modem.

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