An IOT Based Smart Solar Photovoltaic Remote Monitoring and Control unit

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Abstract- **A smart solar photovoltaic grid system is an advent of innovation coherence of information and communications technology (ICT) with power systems control engineering via the internet. This thesis designs and demonstrates a smart solar photovoltaic grid system that self-healing, environmental and consumer friendly, but also with the ability to accommodate other renewable sources of energy generation seamlessly, creating a healthy competitive energy industry and optimizing energy assets efficiency. This thesis also presents the modeling of an efficient dynamic smart solar photovoltaic power grid system by exploring the maximum power point tracking efficiency, optimization of the smart solar photovoltaic array through modeling and simulation to improve the quality of design for the solar photovoltaic module. In contrast, over the past decade quite promising results have been published in literature, most of which have not addressed the basis of the research questions in this thesis. Using the Internet of Things Technology for supervising solar photovoltaic power generation can greatly enhance the performance, monitoring and maintenance of the plant. The discussion in this paper is based on implementation of new cost effective methodology based on IOT to remotely monitor a solar photovoltaic plant for performance evaluation. This will facilitate preventive maintenance, fault detection, historical analysis of the plant in addition to real time monitoring.**

Index Terms- **face track; kalman filter; courier management; optimal node selection; wireless sensor network**

I. INTRODUCTION

With advancement of wired and wireless network technologies, internet-connected mobile devices such as smart phones and tablets are now in widespread use. Thus resulting in a new concept, Internet of Things (IoT) , was introduced and has received attention over the past few years. In general, IoT is actually an information sharing environment where objects in every-day life are connected to wired and wireless networks. Recently, it is used not only for the field of consumer electronics and appliances but also in other various fields such as a smart city, healthcare, smart home, smart car, energy system, and industrial security. At present, the solar photovoltaic (PV) energy is one of the pivotal renewable energy sources. The solar energy is becoming a potential solution towards sustainable energy supply in future. As more and more Rooftop Solar Photovoltaic systems are getting integrated into the existing grid, there is a growing need for monitoring of real time generation data obtained from solar photovoltaic plants so as to optimize the overall performance of the solar power plant and to maintain the grid stability. As local monitoring is not possible for the installer therefore monitoring remotely is essential for every solar power plant. At this juncture harnessing the power of IoT for monitoring solar power plants by using digital technologies and more advanced computational facilities is promising. Power generation from Solar Photovoltaic plants is variable in nature due to changes in solar irradiance, temperature and other factors. Thus remote monitoring is essential. For developing remote monitoring system for solar photovoltaic power plant, IoT (Internet of Things) approach is taken in nthis work which actually envisions a near future where everyday objects will be armed with microcontrollers and transceivers for digital communication.

II.LITERATUTRE SURVEY

There is not much literature in existence that explores the specific concept of remote monitoring as an open-source problem or one that should be considered in the context of international development. However, literature on the core concepts of remote monitoring and existing implementations can be found as well as information on the technological realities of operating in developing countries.

Existing Monitoring Systems

The industry leading monitoring system is the Sunny Web box, a remote monitoring device maintained by SMA Solar Technology, a German solar energy equipment supplier. The Sunny Webbox is essentially a glorified modem that plugs into an inverter and allows system overseers to remotely monitor the output of a given solar power system over the Internet. Unfortunately, the communication protocol between the Sunny Webbox and an actual SMA inverter is not well documented or supported by SMA so it is difficult to program against. Furthermore, the Sunny Webbox requires wired Ethernet in order to remotely transmit data, which is an obviously crippling dependency if we intend to monitor devices operating in truly remote environments or in places without adequate internet infrastructure.

Internet Resources and Hardware Choices

The solar controller that I designed this project to be compatible with (at least as a proof of concept) is the Morningstar TriStar-45 solar controller. This is on account of several factors, including my personal 6 experiences working with Morningstar solar controllers in the past, the availability Morningstar controllers internationally, and the fact that applications can be easily developed to work with Morningstar controllers because they use the open Modbus hardware communication protocol. The Modicon Modbus protocol reference guide is freely available online, and also includes sample code for more tedious implementation details such as the creation of a working Cyclic Redundancy Check (CRC) function. I used this specification to implement the software required to interrogate the TriStar-45 controller. Morningstar offers all of the required documentation to develop applications in conjunction with their controllers online. The “TriStar Applications Guide”, for instance, describes sample configurations for data acquisition and remote monitoring of solar power systems. The other major technology that is utilized in this project is the Arduino electronics prototyping platform. Arduino is an open-source hardware platform intended mostly for hobbyists and casual hardware enthusiasts. All hardware part listings, board schematics, and documentation required to build Arduino clones can be found and downloaded online.

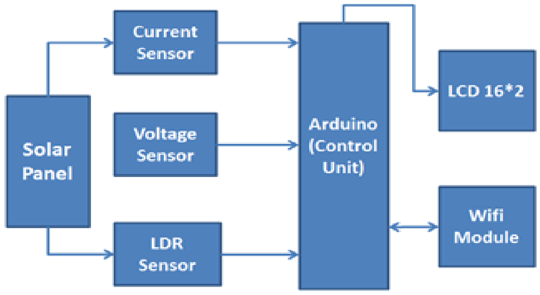
Academic Background and Personal Experience

It would have been impossible to come up with the idea for this project without significant personal experiences prior to this point. I have studied solar power systems independently and have a certification 7 in photovoltaic design and installation from Solar Energy International. Furthermore, the inspiration for this project came as a result of an international project that I myself worked on. During the spring and summer of 2007 I worked as an engineer on a school-building project in The Gambia, which employed solar technology as a way to generate electricity and pump water. My job was to design and implement the solar power system for both of these applications, and impart the knowledge required to maintain them to local project stakeholders. While an exhaustive discussion of the successes and failures of this project is well beyond the scope of this paper, I will suffice it to say that during the course of this project that the issue of remote monitoring became something of significant concern. The semester prior to my departure to The Gambia was spent studying literature on the experiences of various international development organizations that employed solar technology in their projects. This study revealed that the vast majority of such projects fail after their initial completion because of lack of follow-up and failures to incorporate local communities into the maintenance process in any significant way. One thing in particular that is almost always present in accounts of the failure of solar power systems in rural and poor communities is the lack of resources and knowledge required to maintain them. If we consider the components required for the effective maintenance of a solar power system, the problem begins to take on the shape of an information technology problem.

III.REASEARCH METHODOLOGY

Battery current, PV voltage, PV current, Grid Voltage, Grid current, Solar isolation and temperature.

In proposed system, we use IOT (Internet Of Things) concept to monitor solar (photovoltaic) parameter like voltage current and battery voltage and for the measuring sun intensity LDR is used we measure or monitor. All parameters anywhere in the world using IOT. For this we used ESP8266 module (wifi module) which is used to connect to upload sensor information (output data) on blink server.



Voltage sensor used for solar voltage and battery voltage measure and current sensor used to measure current. To measure light intensity we used LDR light dependent resistant. All sensor output in Analogue form but all other microcontroller work Digital. For this we used Atmega328 (Arduino board). So we can connect sensor output directly to the microcontroller.

Atmega328 is the main control unit in our system which is used to read input sensor value and process it and sever through wifi module.

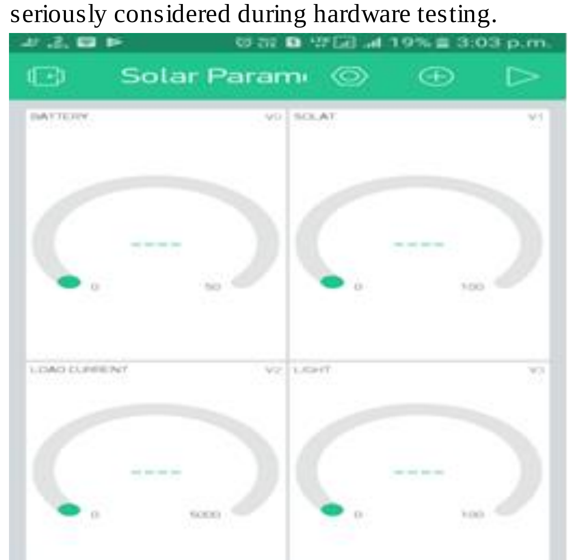
In which LCD 16*2 display to used which is show solar voltage, battery voltage, current and light intensity. We design power supply for converting +12v battery supply to +5V, because output present all component ESP8266 work on +3.3volt for this we used variable DC voltage regulator IC LM317. We set output to 3.3volt this Voltage Divider Rule used for this 100ohm resistor connected.

IV.RESULT AND CONCLUSION

In IOT based solar parameter monitoring system consist of two section one is the transmitter section and another one is receiver section. In transmitter side solar panel maintaining sensor connected to the solar panel like voltage sensor, current sensor. That sensor read the value from solar panel and send to the microcontroller. That value from microcontroller micro rated anblynk android application using android phone authorized person monitor solar parameter wirelessly from all over the wallet. For tracking purpose LDR sensors used when light falls an particular LDR, solar panel move in to the particular direction .Because of this maximum power tracking possible. Total data lifted on blynk android application using instance. Instance ace an in to the hardware embedded using ESP8266 wifi module.

Testing of project

The system is focusing on the controller design. The constructed system has been tested and some data from hardware measurement have been collected and discussed. Typical solar panel has been used and the purpose only to prove the designed system is able to operate accordingly. Therefore the surrounding effects, for instance, weather condition are not seriously considered during hardware testing.



RESULT OF PROJECT

Usage of IoT for checking of a sun situated power plant is an basic walk as well ordered renewable essentialness sources are getting facilitated into utility grid. Along these lines robotization and intellectualization of daylight based power plant watching will overhaul future essential initiative handle for broad scale sun fueled control plant and cross section blend of such plants. In this paper we proposed an IoT based remote watching system using raspberry pi for sun based power plant, the approach is thought about, completed and viably refined the remote transmission of data to a server for supervision. IoT based remote checking will upgrade imperativeness efficiency of the system by making utilization of low power eating up impelled remote modules thusly decreasing the carbon impression. Web Console based interface will through and through decline time of manual supervision and help amid the time spent arranging task of plant organization. A game plan of advance remotely manage the Solar PV plants of various operations like remote shutdown, remote organization is to be join with this system later.

V.FUTURE SCOPE

The data populated about generation, irradiance profile, ambient temperature of a plant in database can be used for historical analysis. This approach has to be modified in future by using sophisticated database technologies and equipped with much more embedded intelligence for faster data processing and computation.

This system can be further equipped with GPS modules for tracking plant locations when deployed in large numbers that will further enhance the operation and maintenance of the plants in real time.

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