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Development of and IOT Based Open Source SCADA System for PV System Monitoring

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A B S T R A C T

The main objective of this paper is development of a low cost ,open source Supervisory Control and Data Acquisition (SCADA) system for photovoltaic solar system monitoring and remote control. The proposed SCADA system is based on the Internet of Things (IoT) SCADA architecture. Which is incorporates web series with the conventional SCADA for a robust supervisory control and monitoring. It comprises of analog voltage and current for acquiring the desired data from the solar PV system. Arduino Uno microcontroller which serves as a remote terminal unit to receive the acquired data. This developed SCADA system set up to monitor and control a 12V,260W solar PV panel in the computer and electrical engineering laboratory at some of the created dashboards and charts showing the acquired data on Emoncms server where an operator can monitor the data in the cloud using both a computer with the internet access and Emoncms mobile app are presented in this paper. This system is advantages i.e. low cost.

Keywords: Arduino UNO, Open source SCADA, Raspberry Pi

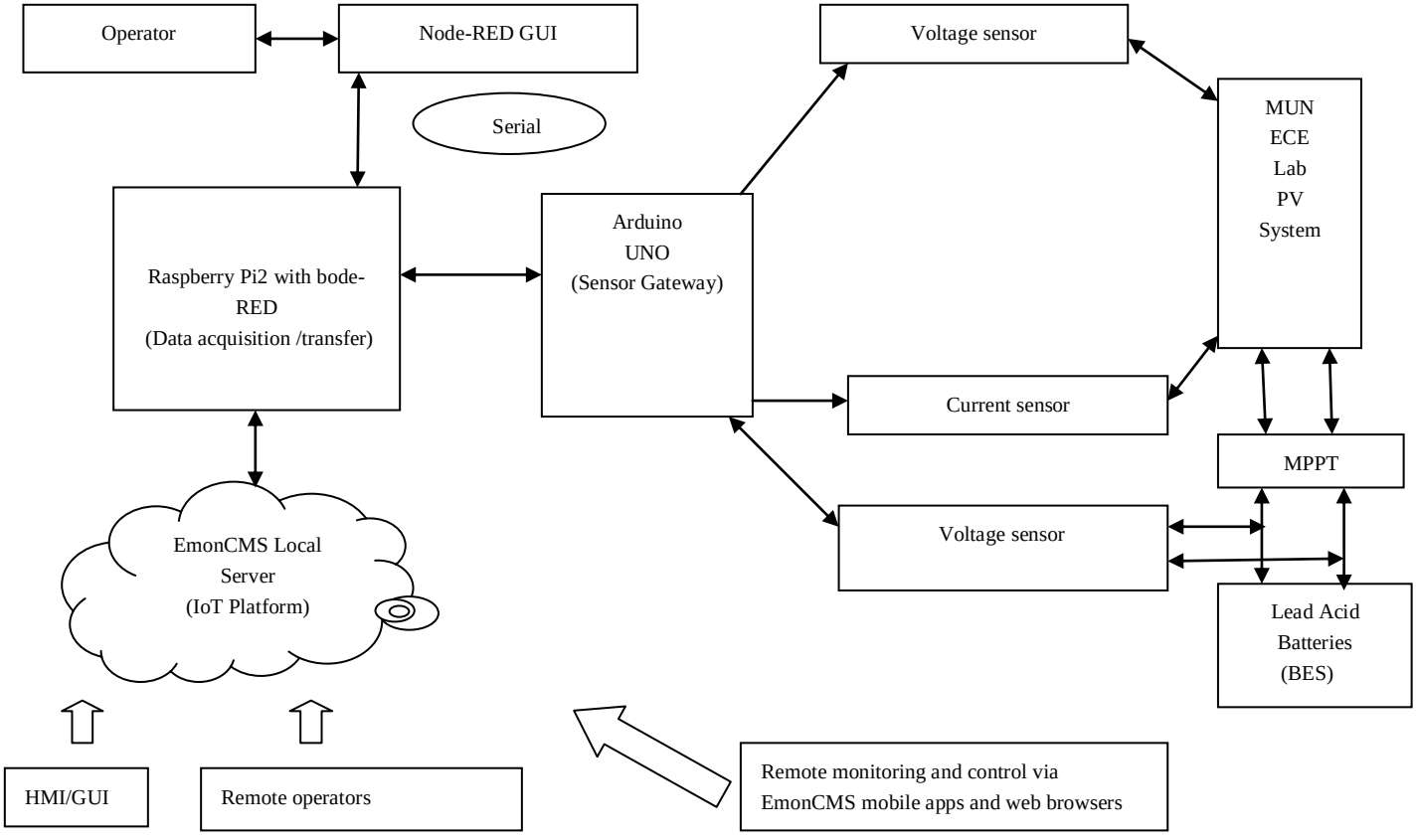
1. Introduction

The SCADA is an produced from first letters of Supervisory Control and Data Acquisition. The main function of SCADA is collecting data from the remote devices like batteries, pumps, valves, transmitters, etc. It provides overall control and monitoring remotely from a SCADA host software platform. SCADA system is the most advantageous. SCADA system software performs the basic functions such as data acquistision, networked data communication, data presentation, remote monitoring and supervisory control. If the operator cannot reach the exact location then SCADA system software can reach the location and within the less time we know the all information. SCADA software have main advantages such as reliable, flexible, cost effective. This system is essentials field instrumentation such as actuators and sensors connected to the systems being managed. Hardware and software has two classes of the SCADA ;open source and proprietary. All major components of the proprietary system is manufactured and the standards are often specific to that system by the single manufacture. In the proprietary SCADA system the responsibility of the system security and reliability rests solely with the manufacturer,which leaves the user vulnerable to a single supplier as the supplier could be slow to respond technological changes in the SCADA subsystem. The customer is also in risk if the supplier goes out of the business so the solution is very expensive. There are problems of flexibility with the already existing in the network and devices. Mix and match components and choose the most appropriate from the several suppliers is allows in an open source system. It means no single supplier is responsible for whole system performance. An open source system represents the most cost effective solution as the user is not beholden to a single supplier. In the open source of SCADA system major components adhere to certain standards which allows them to be interchanged with similar components manufactured by others to the same standards. So in this paper we proposed the solution of an open source SCADA system.

SCADA is an acronym formed the first letters of the Supervisory Control and Data Acquisition. It is the technology which enables a user to collect the

data and information from one ormore distant facilities and send the limited control instructions to those facilities.

2. Block Diagram



Working

2.1 Sensors

This proposed system three analog sensors are used named as one ACS 712 Hall effect current sensor, and two MH electronic voltage sensor modules. Sensor is a field instrumentation device in this system. They are connected to the PV system being managed to acquire the desired data. The properties of these sensors are described below:

a) ACS 712 Hall Effect Current Sensor: Allegro MicroSystems are manufactured and supplied the ACS 712 Hall Effect current sensor. It is fully integrated sensor, it is a low cost and hall-effect based linear current sensor IC with a low resistance current conductor. In this proposed system we used 30 A model to measure the DC current from the solar PV system. To achieve this, its VCC pin is powered with 5V on the arduino Uno board. Out pin is connected to the analog pin A0 on the arduino and its ground terminal is connected to the GND pin on the arduino. The two input pins used to measure the Dc current flowing through the system, so it is connected in series to the PV system.

b) Arduino Uno Board:
Arduino is a low cost microcontroller board and it is a based on ATmega328P. It has the 6 analog inputs (A0 TO A5), 14 digital input/output pins. A 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and reset button. In this project the voltage and current sensors are connected to the arduino board. Arduino is not only used to calculate the PV power output from the voltage and current values but also separately measure the voltage stored in the battery via the sensors is written in the arduino IDE and uploaded to the board. We uploaded the program in the arduino board so the arduino board is connected through USB port on the Raspberry Pi2 to the power the arduino. Finally measured and calculated sensor data to the raspberry Pi using the specified baud rate.

c) MH Electronic Voltage Sensor Module:
This type of sensor is low cost sensor. It uses the concept of voltage divider to measure the supply voltage across which is connected. In this proposed system we used two voltage sensors. First voltage sensor is connected in parallel to the PV system for measuring the voltage across it and also second voltage sensor is connected in parallel across the lead acid battery system to measure the stored battery voltage. The first voltage sensor Pin S is connected to analog pin A1 the arduino board. Pin is connected to a GND pin on the arduino and its VCC and Ground terminal is connected in parallel across the PV panel output to measure the voltage across the PV system. Second sensor is connected to the battery in a similar way using analog pin A2 on the arduino board.

d) Raspberry Pi Board:
In this proposed system Raspberry Pi control is an important part. The 85*56mm single board computer device with the BCM2836 quad core ARMv7 processor is used in this project. The raspberry Pi Control is connected to the MUN network using an Ethernet cable it means that any other machine on the network with the right authorization. Node-Red installed on the Raspberry Pi because to communicate by using the EmonCMS server. Node-RED is programming tool nedded to send the acquired data to EmonCMS IoT platform which is installed in the Raspberry Pi.

e) EMONCMS Local Server IoT Platform:
This is the main part of this project. It works efficiently and plays very important role. EMONCMS is a very powerful web-app open-source processing, visualizing and logging energy, other environmental data and temperature. It is very advantageous. It has low cost and highly flexible.The main thing is that it is the part of the open energy monitor.org project. It has the local server option where a user purchases the hardware and installs it on a standalone or Linux based or networked windows machine for proper management.

3. Advantages

1) Low maintenance of project.
2) Easy to handle.
3) Improved public safety.
4) Simple construction.
5) Low cost.
6) Advanced technology is used so it is time consuming.

4. Disadvantages

1) It requires professional operator.
2) In rural areas network problem is occur .
3) Arduino program creation is hard.
4) Basic knowledge is important.

5. Application

1) In communication systems.
2) It is used in those areas where impossible to find the exact location.
3) They are used in Industries, factories.

6. Conclusion

In this paper, open source Internet of Things based SCADA system has been presented. The development of low cost SACADA system is also presented. Field instrumentation devices, remote terminal units, SCADA communication channel and master terminal units are all the basic elements needed in developed SCADA system. The experimental setup of SCADA system was carried out in the MUN ECE Laboratory. It was used to remotely monitor, to acquire control a 260W, 12V solar PV panel system. The developed SCADA system is also used in other industries. It was used to remotely control and monitor critical infrastructures like as transmission and distribution systems, buildings, oil and gas facilities, electric power generation, water and sewage systems and traffic signal systems.

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