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Data Acquisition of Solar Power Plant Using Scada System

Narayan Lal Purohit[#1], Anshika[#2],
[#1]*M.Tech (Power system), Jaipur institute of Technology, Jaipur*
[#2]*B.Tech (EE), Institute of Engineering and Technology, Alwar*
Rajasthan Technical University, Kota

ABSTRACT

In this paper we have developed a SCADA system for monitoring & accessing the performance of parameter such as voltage, current, humidity on real time basis. For this we have used the infrastructure of the existing industrial network, which is based on plc, Supervisory Control and Data Acquisition (SCADA) is a field of constant development and research. This project investigates on creating an extremely low cost device which can be adapted to many different SCADA applications via some very basic programming, and plugging in the relevant peripherals. Much of the price in some expensive SCADA applications is a result of using specialized communication infrastructure. The application of infrastructure, in the proposed scheme the cost will come down. Additionally the generic nature of the device will be assured. A SCADA deals with the creation of an inexpensive, yet adaptable and easy to use SCADA device and infrastructure using the industrial network, in particular. The hardware components making up the device are relatively unsophisticated, yet the custom written software makes it re-programmable over the air, and able to provide a given SCADA application with the ability to send and receive control and data signals at any non predetermined time. From the SCADA system which is proposed in setup the battery voltage of 12v could be sufficiently recorded from remote location. The properly designed SCADA system saves time and money by eliminating the need of service personal to visit each site for inspection, data collection /logging or make adjustments.

Main concept of our paper is data acquisition & controlling by using SCADA software and PLC. Here PLC is a medium between electrical system & Personal Computer for SCADA to take input and output bits. . Automating electrical distributions systems by implementing a supervisory control and data acquisition (SCADA) system is the one of the most cost-effective solutions for improving reliability, increasing utilization, increasing efficiency and saving costs. Nowadays consumer requires more reliable & efficient power supply. So we can use automation systems as per the consumer requirement.

KEYWORDS: Remote monitoring system, SCADA, networking cards, PLCs, Sensors, Microcontroller, solar PV.

"PLC and SCADA Based Power Distribution Monitoring" the name itself says that the electrical parameters (voltage, current and power factor) can be monitored in Computer (PC) by using SCADA Software. In this paper the PLC works as a mediator between L.T. power distribution and PC at second level. PLC will collect data related to electrical power and build a link with the consumer side i.e. the Windows OS based PC then it gives the continuous power monitoring according to the used load on SCADA.

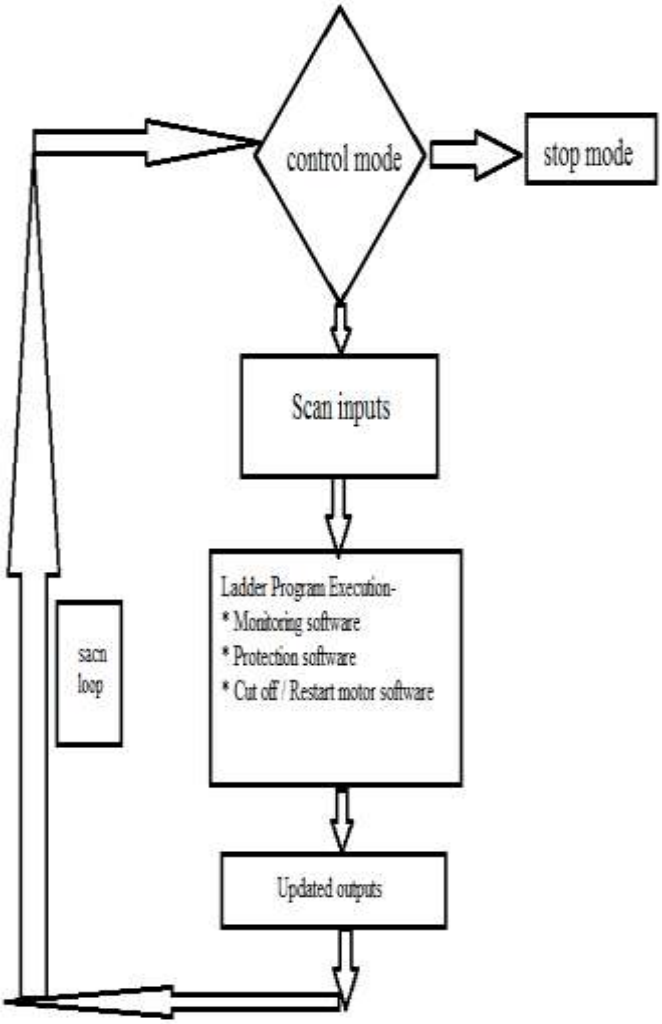

Fig.1 figure show the program execution in plc for process control.

OVERVIEW OF SCADA SYSTEMS

SCADA is a software process control system that enables a site operator to monitor and control processes that are distributed among various different sites. SCADA system is often referred to as telemetry importance.

1. A properly designed SCADA system saves time and money by eliminating the need for service personnel to visit each site for inspection, data collection/logging or make adjustments to increase process reliability. SCADA systems are computers, controllers, instruments, actuators, networks, and interfaces that manage the control of automated industrial processes, PLCs and allow analysis of those systems through data collection. They are used in all types of industries; from electrical distribution systems, to food processing, to facility security alarms and power plants. Traditionally, SCADA systems have made use of the Public Switched Network (PSN) for monitoring purposes to save time. Today many systems are monitored using the infrastructure of the corporate Local Area Network (LAN)/Wide Area Network (WAN) and industrial networking. Another common term used to describe a SCADA system is just like to Human Machine Interface (HMI). It is used to describe any system that provides an interface between a person and a piece of machinery in a field. The Industrial SCADA System falls into this category for monitoring. It provides an HMI by displaying process variables to the operator and allowing control of the plan. A. Functions of the SCADA System A SCADA system has two basic functions, the first of which is to display information about the current operating conditions of a plant in an informative and graphical interface/trends and the second is to allow supervisory control of the plant by personnel/data acquisition. Larger commercial systems may also have other features, such as historical trending/graphically of data to allow the past operation of the plant to be recorded for future reference and for faultfinding. These other features are secondary to the main purpose of the SCADA [1].

2. Components of SCADA System the components of SCADA can be broadly divided into hardware and software based.

Hardware Components:

It refers to the physical components that make up the SCADA. These are the filed data interface devices (IEDs), remote terminal units (RTUs), communications medium, master station (central host computer) and operator workstations. Field Data Interface Devices (IEDs): Digital or analogue intelligent electronic devices and control relays that

directly interface with the managed system. Remote Terminal Unit (RTUs): Gathers information from their remote site from various intelligent electronic devices. They are primarily used to convert electronic signals received from field interface devices into the language used to transmit the data over a communication channel. Communications Medium: The devices used to connect the SCADA master unit to the RTUs in the field. The Master Station: Initiates all communication, gathers data, stores information, sends information to other systems, and interfaces with operators. The major difference between the master station and RTU is that the master station initiates virtually all communication between the two. Operator Workstations: Operator workstations are most often computer terminals that are networked with the SCADA central host computer [4].

Software Components:

SCADA software is divided into two types; proprietary or open. Companies develop proprietary software to communicate to their hardware. The main problem with these systems is the overwhelming reliance on the supplier of the system. Open software systems have gained popularity because of the interoperability they bring to the system.

Key features of SCADA software include user interfaces, graphics displays, alarms, trends, RTU (and PLC) interface, scalability, access to data, database, networking, fault tolerance and redundancy, and client/server distributed processing.

SCADA Protocols:

SCADA Communications protocols define the method by which data is transmitted along a communication link]. The data representations in a SCADA network are identified not in any fashion other than by unique addressing. The addressing is designed to correlate with the SCADA master station database. Each protocol consists of two message sets. One set forms the master protocol, containing the valid statements for master station initiation or response, and the other set is the RTU protocol, containing the valid statements an RTU can initiate and respond to. In most but not all cases, these pairs can be considered a poll or request for information or action and a confirming response.

SCADA System:

The components of the SCADA system combine to provide auto-remote control and switching capabilities into GRID Co network and ECG's Primary network. The system provides the operators monitoring the HMI with sufficient information to operate the network. Furthermore, it gives warning and alarms for unexpected or critical events; allow remote control and post fault analysis. The section of the power system in Ghana that has benefited from SCADA is from the generation section through to the high voltage transmission network and sub-transmission network of the distribution utilities. There is however no remote means of monitoring the condition of power transformers in the distribution utility companies which is a vital component of the power system. As such personnel have to travel long distances to remote site to take readings manually [2].

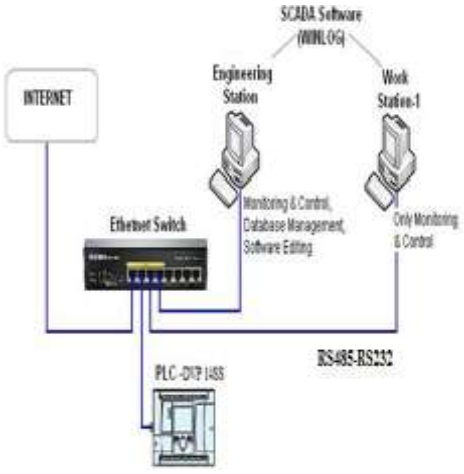

Fig.2 basic block diagram industrial networking system

PROGRAMMABLE LOGIC CONTROLLER COMPONENTS

Definition

A Programmable controller is a solid state user programmable control system with functions to control logic, sequencing, timing, arithmetic data manipulation and counting capabilities. It can be viewed as an industrial computer that has a central processor unit, memory, input output interface and a programming device. The central processing unit provides the intelligence of the controller. It accepts data, status information from various sensing devices like limit switches, proximity switches, executes the user control program stored in the memory and gives appropriate output commands to devices such as solenoid valves, switches etc.

Input output interface is the communication link between field devices and the controllers. Through these interfaces the processor can sense and measure physical quantities regarding a machine or process, such as, proximity, position, motion, level, temperature, pressure, etc. Based on status sensed, the CPU issues command to output devices such as valves, motors, alarms, etc. The programmer unit provides the man machine interface. It is used to enter the application program, which often uses a simple user-friendly logic.

Components

The PLC mainly consists of a CPU, memory areas, and appropriate circuits to receive input/output data. We can actually consider the PLC to be a box full of hundreds or thousands of separate relays, counters, timers and data storage locations. They don't physically exist but rather they are simulated and can be considered software counters, timers, etc. Each component of a PLC has a specific function:

Input Relays (contacts) - These are connected to the outside world. They physically exist and receive signals from switches, sensors, etc. Typically they are not relays but rather they are transistors.

Internal Utility Relays - These do not receive signals from the outside world nor do they physically exist. They are simulated relays and are what enables a PLC to eliminate external relays. There are also some special relays that are dedicated to performing only one task. Some are always on while some are always off. Some are on only once during power-on and are typically used for initializing data that was stored.

Counters - These are simulated counters and they can be programmed to count pulses. Typically these counters can count up, down or both up and down. Since they are simulated they are limited in their counting speed. Some manufacturers also include high-speed counters that are hardware based. We can think of these as physically existing.

Timers - These come in many varieties and increments. The most common type is an on-delay type. Others include off-delay and both retentive and non-retentive types. Increments vary from 1 millisecond through 1 second.

Output Relays (coils) - These are connected to the outside world. They physically exist and send on/off signals to solenoids, lights, etc. They can be transistors, relays, or triacs depending upon the model chosen.

Data Storage - Typically there are registers assigned to simply store data. They are usually used as temporary storage for math or data manipulation. They can also typically be used to store data when power is removed from the PLC. Upon power-up they will still have the same contents as before power was removed.

SOLAR ENERGY

Solar Energy One of the 21st Century's Grand Challenges for Engineering identified by the U.S. National Academy of Engineering is to make solar energy economical: “Overcoming the barriers to widespread solar power generation will require engineering innovations in several arenas—for capturing the sun’s energy, converting it to useful forms and storing it for use when the sun itself is obscured” [7].

The 392 mw Ivanpah installation is the largest concentrating solar power plant in the world, located in the Mojave Desert of California. other large CSP plants include the SEGS (354 mw) in the Mojave Desert of California, the Solnova solar power station (150 mw) and the Andasol solar

power station (150 mw), both in Spain. the two 550 mw solar farms, topaz solar farm and desert sunlight solar farm in the united states, are the world's largest photovoltaic power stations [3].

India is bestowed with solar irradiation ranging from 4 to 7 kWh/square meter/day across the country, with western and southern regions having higher solar incidence.

India is endowed with rich solar energy resource. India receives the highest global solar radiation on a horizontal surface.

Government of India launched its Jawaharlal Nehru National Solar Mission.

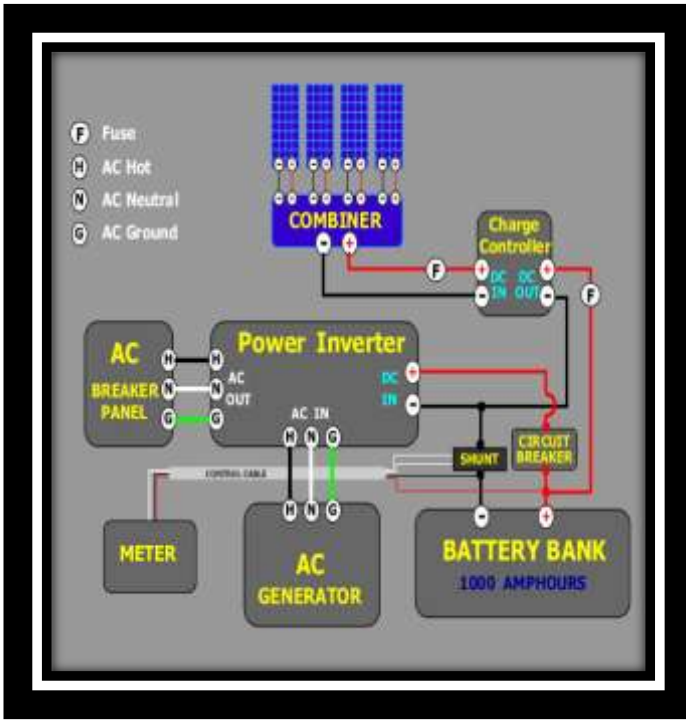

Fig. 4 Basic solar PV system

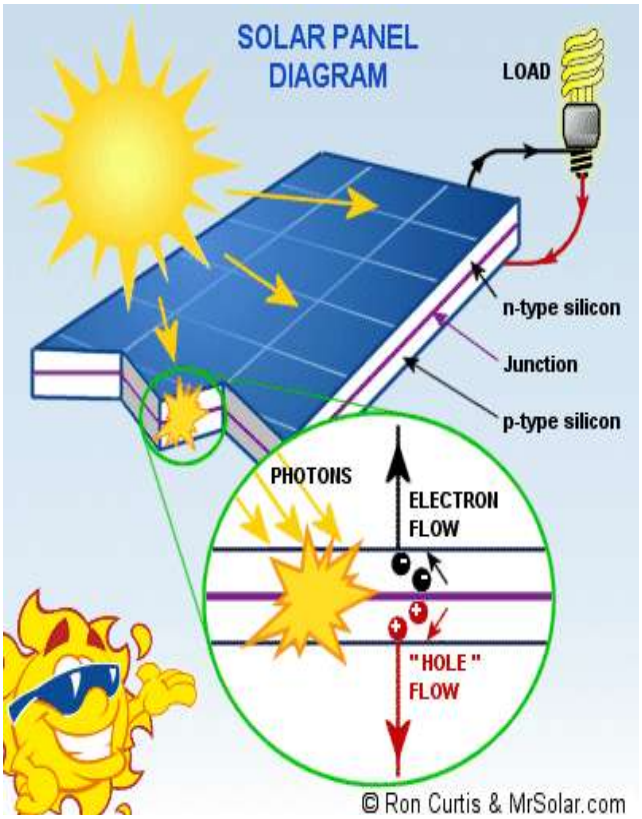

Fig. 3 PV panel

The first Indian solar thermal power project (2X50MW) is in Phalodi Rajasthan.

India is planning to install the World's largest Solar Power Plant with 4,000 MW Capacity near Sambhar Lake in Rajasthan.[8]

Land acquisition is a challenge to solar farm projects in India.

Exploring means to deploy solar capacity above their extensive irrigation canal projects, thereby harvesting solar energy while reducing the loss of irrigation water by solar evaporation [3].

CONCLUSION

PLC is hardware and SCADA is a software System is used to develop industrial networking for monitoring the various electrical parameters (voltage, current, power factor etc). By using these parameters, we can easily control any load in our

system to improve system operation, system reliability, etc. alternatively, SCADA and PLC communication system make it possible to integrate protection control and monitoring electrical parameter together for maximum benefit.

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