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Design and Development of a Remote Monitoring and Maintenance of Solar Plant Supervisory System

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Abstract: *In this Paper we are implementing Prototype solar PV monitoring and optimization includes a data acquisition system, Supervisory monitoring and control station at plant level and Decision Support System (DSS) at the Central Control Station. This Prototype System consist two plant level monitoring (PLM) systems and Central Control Station (CCS). One of Plant level system is for basic data acquisition from weather sensors related to sun energy and Sting Monitoring Units. Another plant level system will have features along with the solar tracker system. The CCS continuous on-line monitoring, control, storage, and reporting at plant level and collects data from PLM's via wireless module with time stamp for real time processing, storage, alarming, reporting and displaying. This system designed monitoring and analytics system.*

Keywords: *solar PV monitoring and optimization, data acquisition system, Supervisory monitoring, control station, Decision Support System (DSS).This system assists in reducing the cost of operation and maintenance.*

1. Introduction

As the world broadens its portfolio of power options to meet growing energy demands and increasingly stringent environmental concerns, solar power is emerging as an attractive option. Of all the routes for conversion of solar into useful energy, direct conversion of sunlight to electricity through solar photovoltaic technology is well accepted. Solar photovoltaic has been recognized as an important route for generation of substantial quantities of grid quality power by utilizing the light energy of solar radiation.

Benefits of grid connected solar PV power plant are Power from the sun is clean, silent, limitless and free and Generation of electricity from Solar PV is totally free of Green House Gas emission.

New technologies are breaking into the solar market, easing issues related to interference and making installation simpler. In the power industry, remote controls make life more than just a little simpler. Remote monitoring allows a solar plant operator not only to control, but, in many cases, to track and monitor the plant from a distance. Meanwhile, the growth of the solar market is leaving some technology companies in search of a form of wire-free monitoring for growing numbers of solar plants.

Solar arrays can also have a higher level of sophistication, in terms of optimizing their performance, extending their active life and increasing their residual value. Unfortunately, the technology to do this doesn't come with the basic package – but it's an option. Until recently, most new array owners have not been offered, or taken advantage of, these new monitoring and optimization options. However, the effectiveness, affordability and availability of these technologies are becoming much more attractive. We are approaching the point where large-scale solar assets will not be considered without it, just like you wouldn't be offered a car without engine management or anti-lock brakes, or dashboard warning lights.

Monitoring and performance analysis of solar PV plants have become extremely critical due to the increasing cost of operation and maintenance as well as reducing yield due to performance degradation during the life cycle of the plant equipments. This becomes essential to ensure high performance, low downtime and fault detection in a solar PV power plant. On-site weather data, production data from the panel strings, inverters and transformers are required to be continuously collected for monitoring and analysis of performance. Data acquisition from AC and DC control panels are further required for operational monitoring and control of the plant and substation. A well designed monitoring and analytics system assists in reducing the cost of operation and maintenance.

Block Diagram

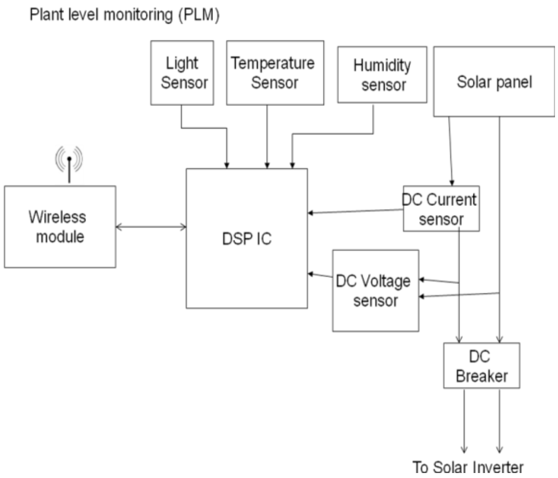

Fig 1. *Plant Level Monitoring.*

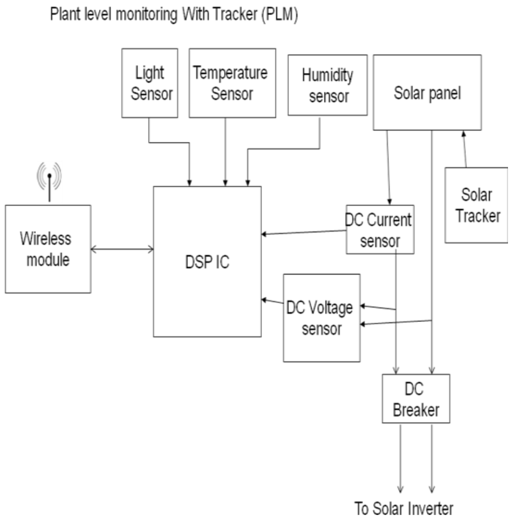

Fig 2. *Plant Level Monitoring with tracker.*

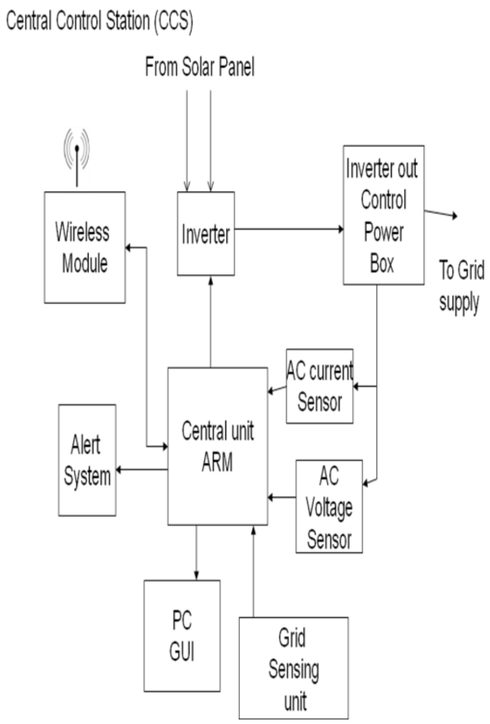

Fig 3. *Central control station*

In this system Fig 1 is the block diagram of Plant Level Monitoring (PLM-1) consists of temperature sensor (LM35), LDR sensor, Humidity sensor (SY-HS 220), DC Voltage sensor, DC current Sensor. The power generated by the solar panel depends upon the availability and intensity of sun so the performance of the solar panel depends on weather conditions. Temperature, LDR, Humidity sensors are used for weather monitoring. The power generated by the solar panel can be calculated by using DC voltage Sensor and DC current Sensor. The sensors data, voltage and currents readings are updated to central station by wireless modules. New values shall be updated to the CCS in sub-seconds interval based on the response time capability the PLM. This system also control and prevent the short circuit of solar panel to inverter input level via control circuit.

Fig 2 is the block diagram of Plant Level Monitoring with tracker (PLM-2) having the same components as of PLM-1 with additional solar tracker. The solar panel tracks sun according to the time by using RTC peripheral. In this system we are calculating the amount of power generated by PLM-1, PLM-2, and compare to know which plant is more efficient. If any of solar panel is not working we can know directly by the values, which are updated from the plant to central station for every minute. In PLM we can prevent the short circuit between solar panel and inverter by DC breaker Circuit. As the values of the plant are updated to central station we can continuously monitor the plant from central station.

Central control Station consists of wireless module, Alert system, PC GUI, Grid sensing unit, AC voltage sensor, AC current sensor & Inverter. Central Control Station will process the data from PLM's and the availability of the Line Grip power it will start the inverter functionality. Load Monitoring Units measure the values of AC current, AC voltage and AC power which map to the Grid. All these information will send to the Monitoring for analysis purpose. The sensors data from the plant are updated to the central control station through wireless module and displayed in the GUI. The amount of power generated by the plant is calculated & displayed in GUI. when ever grid wants the power supply, firstly it checks the status of the grid. If grid is available then central station on the inverter so that the solar panel generated power is fed to inverter which converts DC power to AC power. The amount of power supplied to the grid can be calculated by AC current sensor and AC voltage sensor. If the power supply required for the grid is not available then alert system i.e. buzzer is on and off the inverter functionality.

Result & Output

Fig 4. *PLM-2*

Fig 4. *PLM-2*

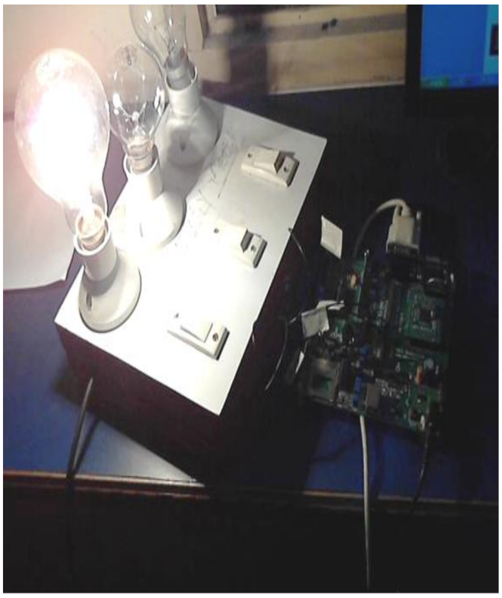

Fig 5. *Central control station*

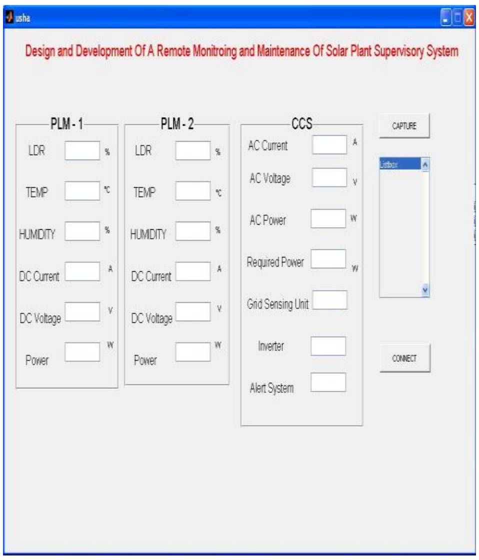

Fig 6. *GUI at CCS*

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