Research Article

Auto Power Management System

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Abstract: Now a day's efficient energy utilization is the utmost priority in many industries so as to minimize the energy cost. This paper aims to deliver the techniques involved in the control of load in industry during heavy traffic with the help of Programmable logic controller (PLC). It also explains the usage of to monitor all the load parameters of the motor on personal computer. In the considered paper we have implemented the multifunction meter (MFM) to PLC communication with Modbus Remote Terminal Unit (RTU) communication; direct values from MFM are taken as feedback to the PLC. Initially constant current values to a single load is taken into the consideration, and any higher load is being applied on the current load, the variations in amps rating is taken as reference and extra load gets tripped at the same time power is managed. With the help of energy meter voltage and amperes rating is constantly observed, if variations of loads are observed rather than any pre defined load, alarms occurs in Supervisory Control And Data Acquisition (SCADA) and power and energy gets managed.

Keywords: Programmable logic controller, Multifunction meter, SCADA, Modbus RTU, Energy conservation measure.

1. Introduction

Power management & monitoring system is actually an energy efficient technique that usually helps the power managers by providing comments on different operating practices and the inferences of the power management systems. They also mentor on the level of usage of energy which is expected in a particular period of time. These management systems also provide the information in advance, regarding excess consumption of energy by malfunctioning of equipments and lack of effective maintenance. The aim of power management systems is to support business managers in identifying surplus usage of energy, predict the trend in consumption of energy by visualizing it and calculating the usage of power in future. Autonomous energy monitoring system is a part of energy management which is an endless process.

As a first step, the area for example, plant area, office building, process steps etc., for which energy conservation measure is required should be identified and a basic model must be built for that area . Process steps can also be considered as a field for energy conservation measure, to efficiently use the energy. As a next step, the energy in existing situation is monitored and measured, which will result in creation of basic model. The basic model can be constructed either with the help of historical data of energy that is consumed or from the standard data given by the manufacturers. After creating the basic model, then we can implement the program of energy conservation measure. By this way, we can improve the efficiency of the power utilization of the system and also replace devices that consume high energy. Once this energy conservation measure program is executed, then from the results of the program, we can actually compare between the basic model and actual energy usage.

This work is driven by the motivation that, it can be used by industries equipped with more number of power sources, for effective power management during heavy traffic. This is achieved by control of load with the help of PLC.

This paper is sectioned as follows: Section II reports the review of literature about various existing power management techniques. Section III presents the features of proposed system. In section IV the process involved in implementing this system is elaborated. The results obtained in this system are explained in section V. Section VI concludes the pros and cons of this system that is described in the paper.

2. Literature Survey

Numerous methods are available for management of electrical power. One of the major method by which energy theft occurs is through direct hooking. Throughout the globe 85% of the theft of energy is caused by tapping directly from the main line. This is done by the consumer, by tapping the direct distribution line well ahead of the energy meter. This energy that is consumed is obviously unmeasured.

If excess current is injected in the current coil of the meter, the coil will be damaged and the meter reading will not be exact.

This paper has investigated the different ways of efficient use of power management. Theft of power can be reduced with the help of smart meters. Usually consumption of energy is measured using electronic smart meters. These smart meters control power theft by employing an inspector box two meters from transmitting and receiving part. If any power theft is suspected, a difference in flow is created and an alarm is given by the inspector box.

3. Proposed System

In the proposed power management system, measurement is made first by considering the readings from energy and flow meters. Data is obtained from PLC by communicating with flow meters.

SCADA is implemented for live monitoring of all the data that is stored and compiled in database. For generating energy conservation measure program, these data in the database is essential for constructing basic model. Any deviation from the basic model with respect to historical data is adjusted from SCADA. At last energy conservation program is executed and results are obtained.

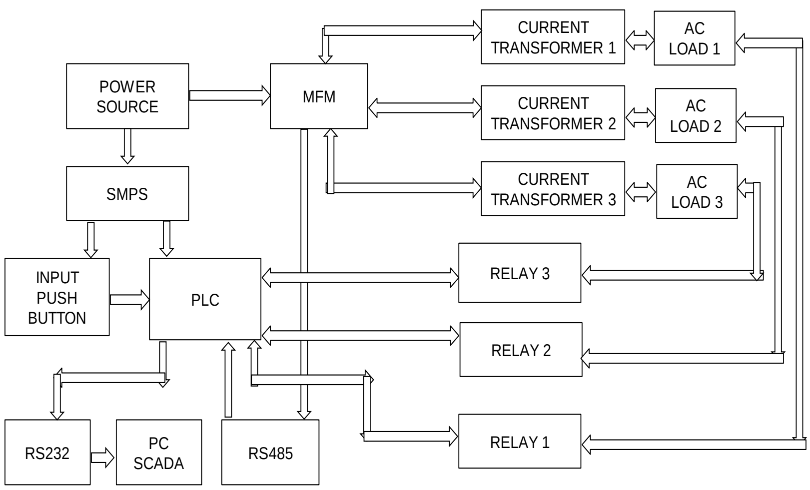

Figure 1. Blockdiagram of proposed system

3.1. Programmable Logic Controller

One of the most frequently used digital computer in industrial mechanical processes for automation is the Programmable Logic Controller, PLC. PLC finds its applications in processes like, control of machines on assembly lines, amusement rides etc,. The main purpose of design of PLC is to be used in many industries and machines for both digital and analog inputs and outputs. The features of PLC are it can be operated in extreme temperature ranges, not affected by electrical noises.

The following programming languages are supported by the controller

- Ladder Language
- Structured Text
- Sequential Flow Chart
- Function Block Diagram

The common program language of PLC is ladder diagram is used in this paper.

3.2. Wiring Diagram of Multi Function Meter

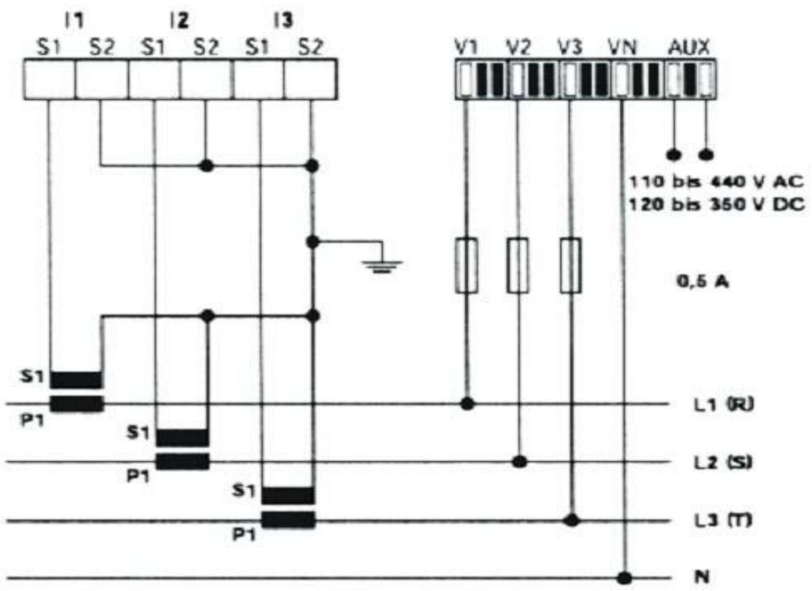

Figure 2. MFM wiring

The line neutral and line-line voltages are measured and displayed b ds-01. Instantaneous peak values of phase currents are measured sequentially for every 15 minutes, averaged and displayed. Automatic or manual ordering of parameter that is displayed is done on demand. As soon as the instrument is turned on, the same parameter that is shown at the time of switching off of the instrument is displayed again. While moving on to the neighbouring parameter display, we can see the character ‘n’ appearing at the left end of the display. Switching the display to the next ordered parameter is done by pressing the ‘F’ key for a time period of more than 2 seconds till the character ‘r’ is designated. To reset the peak and average values, the ‘F’ key has to be pressed even for a long duration till the character ‘c’ is displayed. Shunts are installed in order to connect the current transformers to the ds-01 directly. Thirty five numbers of current transformers are programmed initially. As in case of analog meters, the storage and display of peak values of measurements takes place. The operating power for ds-01 is obtained from the voltage measuring inputs. This is done in order to reduce the wiring constraints of the instrument.

4. Implementation

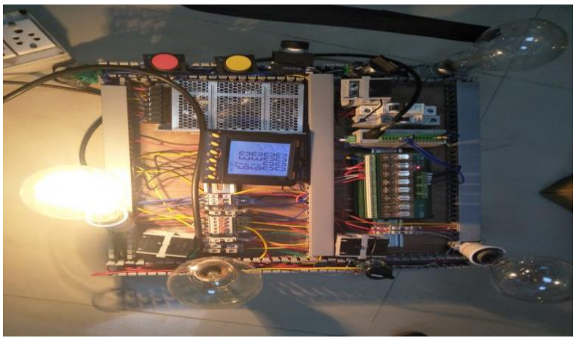

Figure 3. Proposed models with single load

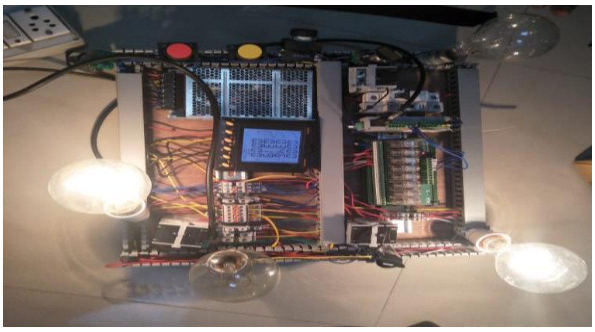

Figure 4. Proposed model with double load

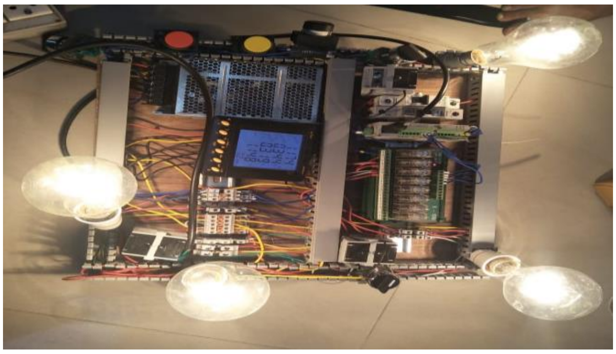

Figure 5. Proposed model with full load

The figure 3-5 shows that the experimental model for the validation of the proposed system using GOC 35 PLC. The current sensor output is sent to PLC through MFM. The MFM calculate the voltage, current and power of the AC load. The AC loads are controlled by PLC through mechanical relays. When the load current is above the threshold value, the PLC sent notification to SCADA and the excess load is controlled by the relay.

5. Result and Discussion

The scripts execute periodically, after the stipulated period. For instance, if a certain key script is programmed to execute for every 5 seconds when a specific key is pressed, then it gets executed sharply for every 5 seconds after the key press.

The SCADA In Touch software is used to show the effectiveness of the load management exploited in this paper. Figure 6 shows the status screen from SCADA software for high load condition. If this indication is shown, then automatically load is reduced.

Apart from this status of load condition, the values of different parameters like voltage, current and power can be monitored simultaneously with the help of parameter monitoring screen which is given in figure 7. This helps us to predict the load condition in advance and take necessary steps.

Figure 6. Status screen from SCADA

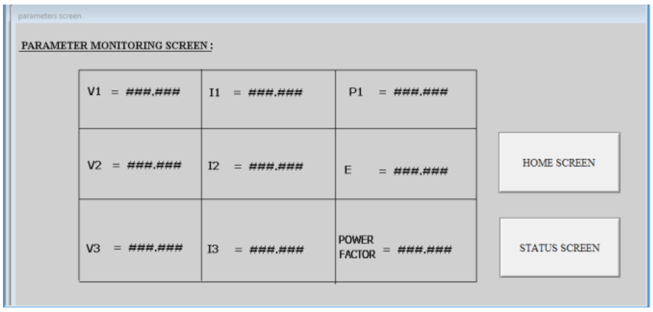

Figure 7. Parameter monitoring screen from SCADA

6. Conclusion

This proposed system observes the usage of energy in various divisions of the plants. Actual energy that is consumed is monitored by SCADA and comparison is made. By comparison with regular requirements of energy consumption, the wastage of energy is measured. An alert is made by the proposed system in case of emergency. In the experiment that is conducted, the proposed system is found to result in 37.27% of energy saving by executing the energy conservation measure program.

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