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CONSUMER LOAD MONITORING AND CONTROLLING SYSTEM BASED ON PLC AND SCADA

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Abstract - *Transmission lines are the important factor of in modern age, automation has been placed on power reliability and economy. A power transformer is a very valuable and important link in a power transmission system. Transformers of substation are one of most important equipment in power system network. Because of, the large number of transformers and various components over a wide area in power system, the data acquisition, condition monitoring, automatic controlling are the important issues. By making use of a smart transformer we can monitor and control an entire substation. In this paper automation is done using PLC using wireless system technologies system. PLC (Programmable Logical Controller) plays crucial role in automation field where many process are automated. On the other hand SCADA (Supervisory Control and Data Acquisition) act as human interfacing medium with machine where voltage, current and temperature fluctuation are monitored and corrected if necessary.*

***Key Words*: Load, Relay, PLC- Programmable Logic Controller, Current Sensor, SMPS- Switch Mode Power Supply, Buzzer, Switches.**

1. INTRODUCTION

Today, the world is facing the most critical problem of inadequacy in power supply. The electricity demand is increasing with the growth of population and with the use of different appliances in the household. So, there is a need for the consumers to track their daily power usage and understand the consumption patterns to save and control these resources. In many countries including India, the primary need of electricity of the consumers is not filled due to the over consumption of power by some users than the power sanctioned by the power supply providers. The energy consumption is justice by the men need of having a comfortable survival, thus, the production, generation and power management is a clearly relevant and vital fact.

Now-a-days people expend electricity without care about the availability of power. As a result, the production ability does not match the demand. The global energy crises are increasing at an alarming rate and has the attention towards more and more energy production. Since one becomes wiser in using electricity one can instantly know how much to use and consume. Instead, we can use the power available in such a way that the user will only use the power which is allocated to the user according to the limit of sanctioned load provided by the service provider. A properly installed and monitoring system is a valuable advantage to almost any type of energy consumer by avoiding the power theft and un-organized power management due to lack of sufficient and efficient past energy consumption data, that has led to huge losses to power companies or unbearable high electricity cost for the customers. Thus losses in production in general, there are three basic categories of consumers: industrial, commercial and residential. Each consumer has a different objective for energy consumption. But now a day there is no arrangement for the detection of running load at the domestic level so that the service provider can calculate the load automatically. A lot of new technology has been introduced to satisfy the user demands.

1.1 Problem Definition

In now a days there are no arrangement for the detection of running load in domestic level so that the service provider can calculate the load automatically. So here we are trying to make the system in which a sensor will be added to the house of user and if consumer exceed the limit than he will be automatically warned 3 times and if he keeps exceeding the limit than the power will be automatically cut off and he will have to pay the penalty to the service provider and a control switch located in service provider control room will on the supply.

2. LITERATURE SURVEY

In order to start the thesis, the first step is to study the previous work performed by researchers. For this purpose, various papers have been studied. Heavy power consumer (Industrial applications) has to pay the fixed charges irrespective of the consumed power. Also, penalty is levied on such consumptions even if there is a slight overshoot in maximum consumption limit. There will not be any prior notification with this regard. In such situation, this implementation aims in providing details of overshoot time, peak power consumption, displaying the power consumption and the cost based on the tariff plans from any remote location. [1]

In the current financial climate, focus on energy saving within the home has intensified by the desire to reduce costs. Fossil fuel savings, carbon emission reductions, as well as a permanent fall in electricity prices, are significant incentives for the residential consumers to look at

different methods to reduce their energy consumption. Demand Response (DR) is an alternative method which provides an opportunity for consumers to reduce their energy consumption cost by deferring or shifting their electricity usage during peak periods. To this aim, this study evaluates the effectiveness of price-based DR techniques currently available in Western Australia based on the consumers cost of electricity and comfort level. The electricity tariffs are systematically examined. [2]

Next generation Smart Cities have the potential to enhance the citizen's quality of life and to reduce the overall energy expenditure. In particular, emerging smart metering technologies promise to greatly increase energy efficiency in the residential and industrial areas. In this context, new power metering methods such as Non-Intrusive Load Monitoring (NILM) can provide important real-time information about the contribution of any single appliance. In this paper, we present a complete hardware-software design that concentrates locally an efficient event-based supervised NILM algorithm for load disaggregation. This new kind of power analysis, which usually requires high computing capability, is executed real-time on a low-cost and easy-to-install smart meter ready for the Internet of Things (IoT). [3]

Non-intrusive load monitoring is an important development direction of electric load monitoring. Traditional NILM mainly track and decompose the power voltage current, and other transient or steady-state parameters like power parameters at the monitoring system entrance, and then identify the specific type of load. The load identification method is complicated, and there are limitations on identifying multiple devices switching simultaneously. This paper studied on NILM oriented residential load identification methods and proposed one based on period gram, and then made the detailed theoretical analysis and simulation verification of the selection and determination of electric appliances characteristic model. [4]

3. PROPOSED SYSTEM

In this proposed method, a new protection method based on a programmable logic controller (PLC) has been introduced. This system has the ability to control the data of remote locations and also provides the proper monitoring results. So here we are trying to make a system in which a sensor will be installed in the house of the user and if the user exceeds the limit of power consumption than the sanctioned power, then that consumer will be automatically warned 3 times and if the consumer still keeps on exceeding the limit, then the power supplied will be automatically cut-off and will have to pay the penalty to the service provider that the consumer is abide to. And then only after paying the penalty, the power supply of that consumer will be resumed again by a control switch located in the service providers control room.

3.1 Block diagram of proposed system is as follows

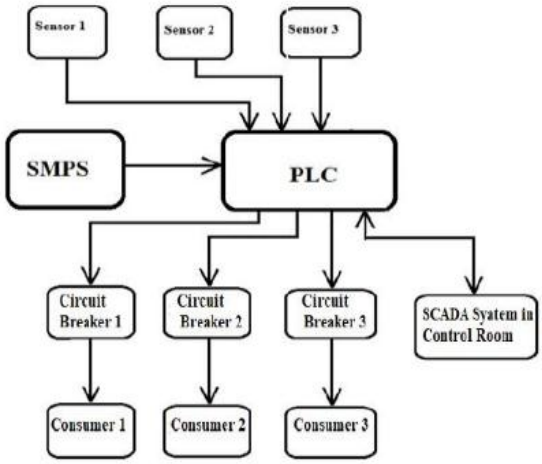


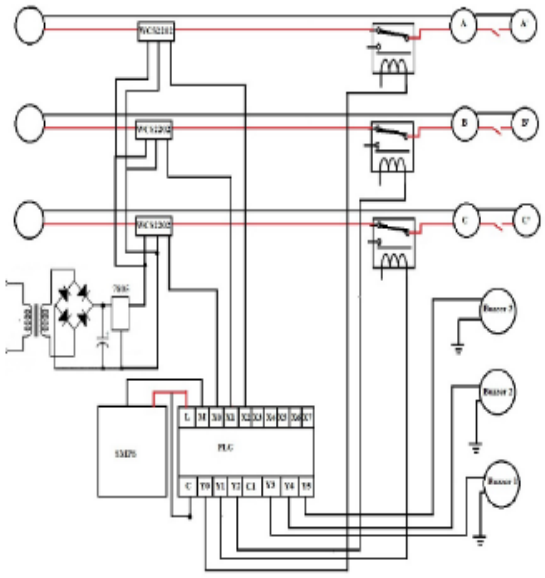
Fig No. 1 Block Diagram

3.2 Working

The system designed is used for monitoring the load exceeding parameter. For monitoring it, 3 loads as 3 consumers are assumed to be having their particular values of sanctioned load. Power is being supplied to these loads. In the hardware part there is the use of the current sensors that will sense the changes in the power consumed by the load. It will continuously monitor the power used by the consumers. If the limits of power usage will be exceeded, then the current sensor will sense it and give the signal to the PLC, and then accordingly, the PLC will take the actions. Here the PLC used is Delta DVP14SS2 which is connected with a SCADA by RS485 serial communication for the communication with software part, so that the system will be monitored and controlled easily and fast. The actions will be like rusty ringing the buzzer son exceeding the limits of sanctioned load. These buzzers will keep on ringing for 10 seconds.

The consumers should lower down their loads within 5 seconds. If the consumer does so, then it will be considered as the warning. Likewise, maximum of three warnings will be given every time the consumer exceeds the limit. After the third warning, again if the consumer exceeds the limit then, the power supplied to the consumer will be cut_ and to again resume the power, the consumer will have to pay the penalty that will be issued. And then with the help of SCADA, that will keep the data that is the records of the consumers, the power will again be supplied. Another action is related to the first action described. Action performed will be like if the consumer exceeds the limit of sanctioned load, and even after the 5 seconds of buzzer ringing that will be indicated as warning, if the consumer does not lower down the load within 5 seconds, then the power supplied will directly be cut-off.

3.3 Circuit Diagram



3.3.1 Circuit Diagram Description

In the circuit there are two parts, one is power circuit and another is control circuit. Power circuit is 230 V ac supply to load which is operating 2 Loads and control circuit is the controlling and sensing circuit of whole system. An SMPS of 24V DC is connected which is used to power up the PLC and operate Relays and Buzzers. Another power supply of 5V is used for current sensors. Through this supply power is given to current sensor which is connected to comparator circuit. If the current is exceeded by a certain value, the comparator circuit gives a digital signal to relay driver IC and respective relay for the operation of the current sensor. Relay switches 8 supply to 24V and digital 24V which is required for PLC input is Switched for Input. Whenever 24V reaches to the PLC input the PLC executed further operation and according to program it turns on the Buzzer which is powered up with 24V DC supply. If same input is continuously ON for 5 sec or Input gets high for 3 times, the PLC turns on the relay which is connected across the power Circuit and respective load is turned off. The same signal is transmitted to the SCADA by serial communication RS485 and the Reset signal is also generated from SCADA.

4. HARDWARE AND SOFTWARE USED

4.1 Hardware Used

4.1.1 PLC

The PLC used here is Delta DVP14SS2 which has 8 digital inputs and 6 outputs which requires 20.4V to 28.8V dc supply for its operation.

4.1.2 Current Sensors

The current sensors used in the project are WCS2202, which can sense up to 0 3.0V current at 5V supply.

4.1.3 Relay

The relays used are 24V and 5V dc used for switching action for PLC and to cut-off the power supplied to the loads.

4.1.4 ULN2003A

This is a relay driver IC which provides the required voltage for the relays to turn ON/OFF. It is a IC chip with high voltage/ high current Darlington transistor array. They can have output up to 50V. Also they have output fly back diodes.

4.1.5 SMPS

The SMPS that used in the system is of P-zone that has maximum range of 140-300V input voltage and up to 2A maximum output current.

4.2 Software Used

4.2.1 WPL Software

The WPL soft is software used to Program Delta PLC. This software was developed to work on Windows XP, Windows Vista, Windows 7, Windows 8 or Windows 10 and can function on 32-bit systems. WPLSoft.exe, Wpl.exe

WPL209.exe, WPL208.exe or WPL207.exe are the common names to indicate this program's installer.

4.2.2 WONDERWARE INTOUCH

Wonder ware In Touch is award-winning HMI visualization software that empowers customers to achieve their quest for operational excellence.

4.2.3 KEP SERVER

KEPServerEX is the industry's leading connectivity platform that provides a single source of industrial automation data to all of your applications. The platform design allows users to connect, manage, monitor, and control diverse automation devices and software applications through one intuitive user interface.

5. IMPLEMENTATION AND RESULT

In proposed system, each consumer is being sanctioned load limit of 200 Watt. In order to obtain the results, following conditions can be considered.

5.1 Case 1: The loads that the consumers have connected are of 60 Watt while the sanctioned load limit is of 100 Watt. Since the loads are consuming the power below their sanctioned limits, as a result of it all the three sanctioned loads(bulbs) are glowing. This is the expected scenario.

Case: 1 Expected Scenario

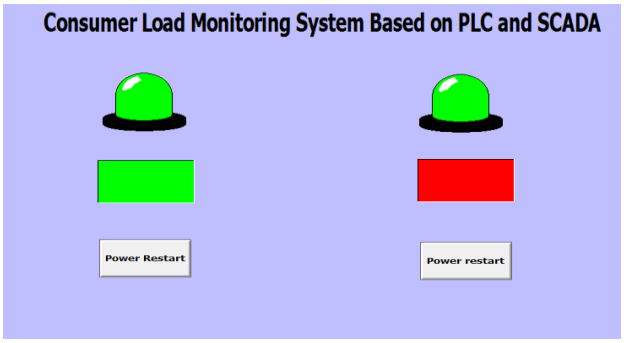
5.2 Case 2: In Second case extra load is of 200 Watt is used. Resultant total of 260 Watt is being connected to the system which is way too much than the sanctioned limit of 100 Watt. The consumer is expected to lower down its exceeding load within 5 seconds for which the PLC is being programmed. Otherwise the power supplied to the consumer will be directly cut on cut-off.

Case: 2 Cut off Condition

5.3 Case 3: If the consumer fails to maintain its sanctioned load limit, then to again resume its connection, the consumer needs to approach the power supply distributer who can resume the supply.

Case: 3 Welcome Window

5.4 Case 4: Only after the consumer pays the penalty, the distributor will do the login by providing its user-id and password for completing the authentication process with the SCADA system.



Case: 4 Consumers Record Window

CONCLUSION

The aim of this project is to develop a PLC and SCADA system for monitoring and controlling the sanctioned load. By using this, system we can easily control and monitor any load in our system and can improve the result, system reliability.

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