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# ENERGY METERING AND MONITORING OF DISTRIBUTION TRANSFORMER USING PLC

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***Abstract***—The main objective of this paper is healthy monitoring of household appliances and distribution transformers. Discussing the later, the distribution transformers are one of the most expensive equipments in power system. Even a small fault may lead to a very big loss. In order to overcome these faults, monitoring of distribution transformers is very essential. The problems in the former are difficulties in billing and determining the energy usage. The proposed system uses power line carrier communication (PLCC) based system for the continuous monitoring and recording of energy consumption thus helping in energy auditing. The recorded data is sent continuously for every interval of time using the PLCC technique and the data are stored in the database in the EB substation. In addition to this, in the distribution side, various parameters like current, voltage, temperature, power etc., of the distribution transformer are monitored and the data is sent to the database in the sub-station. The collected data are sent to the microcontroller where there is a preset value. The changes in the parameters are sensed and recorded in the microcontroller. Based on the protocol, information is sent to the sub-station and other sequence of operation is performed for the protection of the distribution transformers.

Keywords—PLCC, Microcontroller, Distribution Transformer

## I. *Introduction*

To measure energy still electro mechanical meters and low cost digital meters with less accuracy is being used. Manually meter readings are done that leads to wastage of time, manpower and resource and sometimes error may also occur. It is also difficult to analyze the exact power consumed by the loads. This makes the traditional metering method an inconvenient one for energy measurement and billing purposes. To overcome these difficulties this project provides the energy consumption status of each appliances and the amount to be paid for the energy consumed. The above mentioned things are displayed in the meter itself that makes the consumer to know about energy consumed by each appliances and the bill to be paid. The energy consumed by the appliance is monitored by the microcontroller based system using PLCC. It is designed for automatic data collection of energy consumed by the appliance and to intimate them to the consumer by displaying it on a LCD in the consumer end and in the EB station through a database created in a computer by transferring the data through PLCC technique. The data send to the smart meter is stored in the backend database of the knowledge base module. The data sent by the control unit is recorded in the database. Distribution Transformers (DT) are distributed in large numbers in a power system, acquisition of data and monitoring them is an important issue. The system is so designed to calculate the energy delivered from the DTs to load, which helps in energy auditing. Parameters like Voltage, Current, Temperature, of DT are sensed and fed to the Microcontroller using interface devices. The changes in the parameters of the DT is sensed and recorded in the microcontroller and the data is stored in a database in the EB station. The current transformer and the potential transformer are used to measure the current and voltage output of the distribution transformer. Thermal sensors are used to measure the temperature of the transformer.

## *II. Literature Survey*

A. Vijay raj proposed that in their system has the central EB office to immediate access to all consumer homes in a locality with the help of an RF system. The energy meter present in each house is connected by wireless network with the EB office which periodically gets updates from the meter. The EB office by using a backend database calculates the amount to be paid according to the number of units consumed by the consumer and sends it back to the meter located at the consumer end and displays it and also sends the bill amount to the user's mobile phone by means of a sms.

## *III. Methodology*

### A. *Existing System*

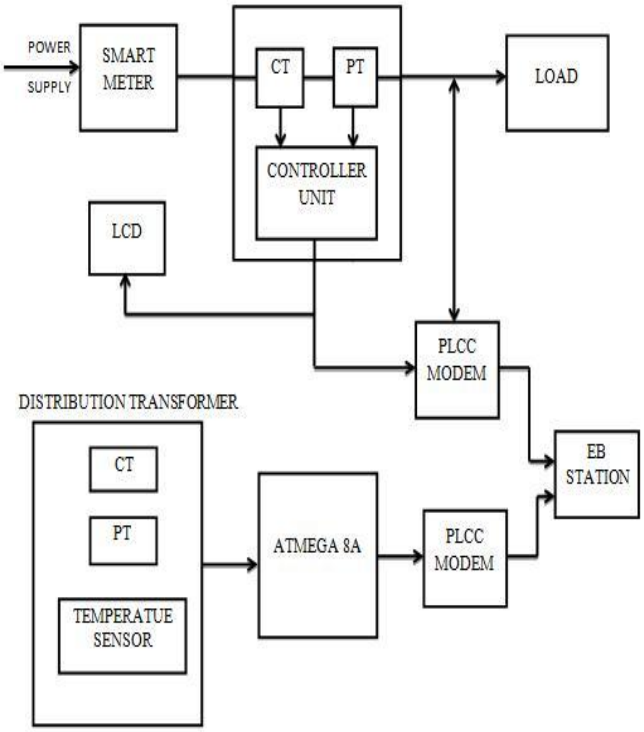
In the existing system, energy consumed in a particular place is taken as a reading by an employee of

electricity board from an electromechanical or a digital meter placed at that particular place and the amount to be paid by the consumer for the energy consumed is calculated manually which a time consuming and laborious task is. Here the disadvantage lies in meter reading and bill generation in which EB Employee must go to each and every place to take the reading and then bill is generated. Then in this the unit of energy consumed by an individual appliance is unknown so that power wastage cannot be identified and a separate controller is provided to monitor a distribution transformer in order to find the unit of energy distributed and also to monitor its temperature, voltage and current.

### *B. Proposed System*

The proposed system overcomes the above mentioned difficulties by replacing the existing energy meters with smart meters. Each and every appliance can be monitored and controlled and the energy consumed by each appliance can be known. The energy consumed by the appliances is send to the microcontroller and then it is send to the meter in modulated form. The smart meter demodulates the data received and stores the data for analyzing and calculation. Then the smart meter transmits the data to the database created in the EB substation using PLCC technique. The consumer can view the status of energy consumed by the appliances in the LCD display. If suppose user fails to pay the bill within a period then power supply will be cut off automatically from the EB station using drivers. In this system voltage, current and temperature of oil in the distribution transformer is also monitored using the same controller and its data is sent to the database of EB substation using PLCC technique.

## IV. BLOCK DIAGRAM




### A. *PLCC Modem*

The communication of PLCC transmitter unit and receiver unit is done through the AC power line. PLCC modem is useful to send and receive serial data over existing AC mains power lines of the building. It provides high immunity to electrical noise persisting in the power line and it has built in error checking so that it does not provide corrupt data. The modem is capable of providing 9600 baud rate low rate bi-directional data communication. Electrical power is transmitted over high voltage transmission lines, distributed over medium voltage, and used inside buildings at lower voltages. Power line communications can be applied at each stage. Most PLCC technologies limit themselves to one set of wires but some can cross between two levels for example, both the distribution network and premises wiring. Typically the transformer prevents propagating the signal so multiple PLCC technologies are bridged to form very large networks. PLCC modems can be directly interfaced to microcontroller uart txd, rxd pins so that data in the microcontroller can be transferred easily.

### *B. Distribution Transformer*

A transformer is a static device that transfers electrical energy from one circuit to another through inductively coupled conductors the transformer's coils.

Distribution transformer or service transformer is a transformer that provides the final voltage transformation in the electric power distribution system by stepping down the voltage and providing it to the customer. Distribution Transformers are costly so that they should be maintained properly.

### *C. Relay*

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal. Relays were used extensively to perform logical operations.

### D. *Smart Meter*

Smart meters go a step further than simple AMR (automatic meter reading). They offer additional functionality like real time power outage notification and power quality monitoring.

Fig. 1

A type of smart meter uses nonintrusive load monitoring to automatically determine the number and type of appliances used and it shows how much energy each appliance uses. This meter is used by electric utilities to do surveys of energy use. It eliminates the need to put timers on all appliances in a house to determine how much energy each use. Smart meters use a secure national communication network called DCC to automatically and wirelessly send your actual energy usage to the suppliers.

### *E. Atmega8A Microcontroller*

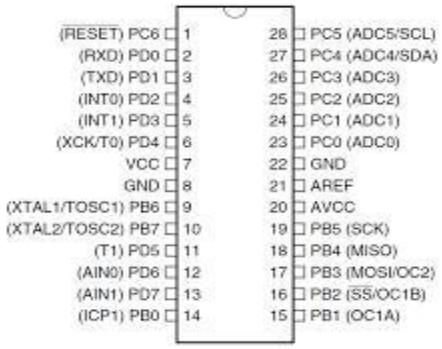



Fig. 2

Atmega8A microcontroller provides high performance, low-power microchip 8-bit AVR RISC based and combines 8KB ISP flash memory with read-while-write capabilities, 512B EEPROM, 1KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer with compare mode and external interrupts, serial programmable USART, a byte oriented two-wire serial interface, 6-channel 10-bit A/D converter (8-channel in TQFP and QFN/MLF packages), programmable watch dog timer with internal oscillator, SPI serial port and five software selecting low power saving mode. Operating voltage is 2.7-5.5 volts.

## *V. Advantages*

- Monitor electrical load in real time
- System has no running cost for data acquisition
- Reduction in manual meter reading costs.
- Reduction in late and estimated billing costs.
- Improved meter accuracy and reduced meter maintenance
- Reduction in Revenue protection losses
- Pre-Paid Metering can be done remotely, without requiring local smart card / Swipe Card.
- Remotely Connect / Disconnection of Power supply through PLCC Meter
- Faults can be detected in the distribution transformers before severe damage occurs.
- In case of nonpayment of bill by a consumer, then the power supply to the load is cut off automatically from the EB station.

## *VI. Conclusion*

This system is used for taking the reading of energy consumed by each appliance used in a particular place and monitoring of distribution transformer using PLCC technique without the interference of man. The system can be further modified by detecting power theft between pole and an app can also be created to view the energy consumption and billing details through smart phones. The present system is implemented to send non voice data only. The system can be further developed to transfer voice data through power line. But the system should be robust enough to handle interference in the power line.• Power line communication is a solution to transmit information by using the existing power lines and it provides an economical solution for automatic meter reading.

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