Wireless ARM-Based Automatic Meter Reading, Theft Control System and Fault Notification

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Abstract: Electrical energy is very imperative for ever day life and a spine for the industry. Electricity is indiscipline to our daily life with increasing need of electricity the power theft is also increasing power theft is a problem that continues to plague power sector across the whole country. Power data is used for various purposes such as bill management, for measurement of static power parameters etc. Control systems contains relay circuit, used for disconnection power supply when consumer fails to pay electricity bill in due time. The objective of this project is to design a system in order to avoid the displeasure for the users from theft bill irrespective of the use of the electricity due to theft using GSM module. In order to integrate the various parts together we must first properly understand the working of the different parts to be integrated together. A brief study is alone on the components and the technology which we are going to use in our project.

Keywords: Power theft, GSM, AT commands, wireless meter reading.

I. INTRODUCTION

Problem associates with traditional meter reading have been increased day by day, due to various reasons such as rapid growth in population, tedious location, environmental conditions etc. But with new developments of microcontroller, there are many improvements in automating various industrial aspects for reducing manual efforts. In traditional meter reading system in which utility usages are written on paper by workers, there is lot of chances of human errors. These will cost more to the utility company. Also there are chances that of unavailability of consumers during utility worker's visit for meter reading. In such cases, billing process will be pending & utility workers again require visiting to consumer. Going to each & every consumer's house & generating the bills is very laborious task & require lot of time. It becomes very much difficult in natural calamities especially in rainy season. Electricity theft is at the centre of focus all over the world, but electricity theft in India has a significant effect on the Indian economy. The loss on amount of theft is reflected in ARR of the electricity company. Thus these costs are routinely passed on to the customers in the form of the higher energy charges. Electricity power theft takes place in a variety of forms and thrives with the support of people from different walks of life: utility staff, consumers, labor union leader, political leaders, bureaucrats and high level utility officials. The problem challenging power utilities worldwide is the electricity, in other words using electricity from utility company without the company's consent. Significantly, it s enough to destroy the entire power sector of country. According to source 20% losses means the masses would have to pay extra 20% in terms of electricity tariff. This paper discusses the problem of electricity theft and notifies the electricity fault occurrence to the electricity office.

II. OVERVIEW OF PROPOSED WORK

The power theft monitoring is an important research in electric power system and electricity stealing prevention became a big problem to the electricity. Electricity stealing is a long term problem; however each power supply department has me huge investments of manpower and material, the phenomenon of defending stealing electricity has increased and not abated and the method of electricity stealing is continuously improved. The behavior of electricity stealing not only makes the power industry suffering huge financial losses but also threatens the main power supply security and reliability. The system has two parts; they are the link method facility and remote terminal facility in control room. The link method is used between the main energy meter in the substation transformer and the user energy meter, the output of user single phase electric energy meter also has an proportional relationship with power. If electricity stealing is took place, the user single phase energy meter cannot measure accurately, then discrepancies will come up between the number of output impulse in standard electricity measure module and user single phase electric energy meter in unit time, it is considered electricity stealing happen or user electric energy abnormal when the discrepancies accumulative total arrives certain level. When the abnormity of the electricity measure impulse in two paths is monitored by system software in control room, current time is record, the beginning time of electricity stealing and alarm information are transmitted to the field man through GSM network.
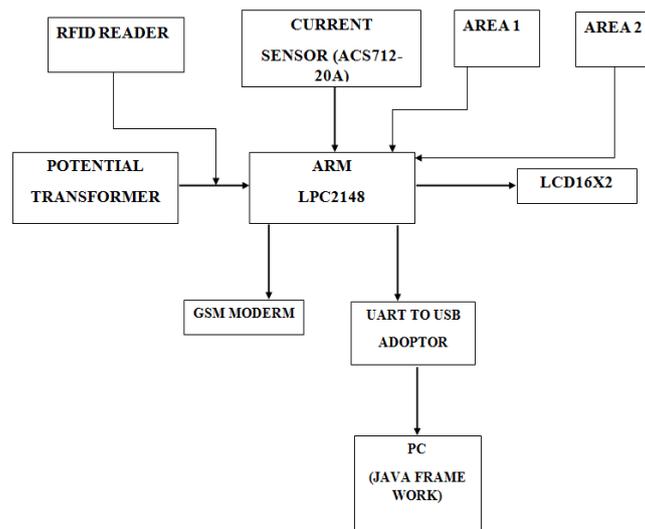
Our Proposed system is to make the energy meter as a smart meter to read the energy consumed, voltage level and power factor and also auto announcement features such as power failure, power factor lagging and low voltage level. In this system a relay circuit is used to disconnect the supply to the consumer for large outstanding dues. This system minimizes the power and time wastage.
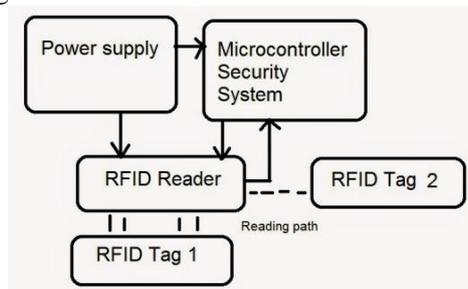
Electrically Erasable Programmable Read Only memory (EEPROM) is used to store the data regularly. By using Real Time Clock (RTC) the real time date and time is maintained in off line position. A keypad is used to view and erase the EEPROM. The monthly usage is also sent to the consumer through Short Messaging Service (SMS) and also displayed in LCD display.
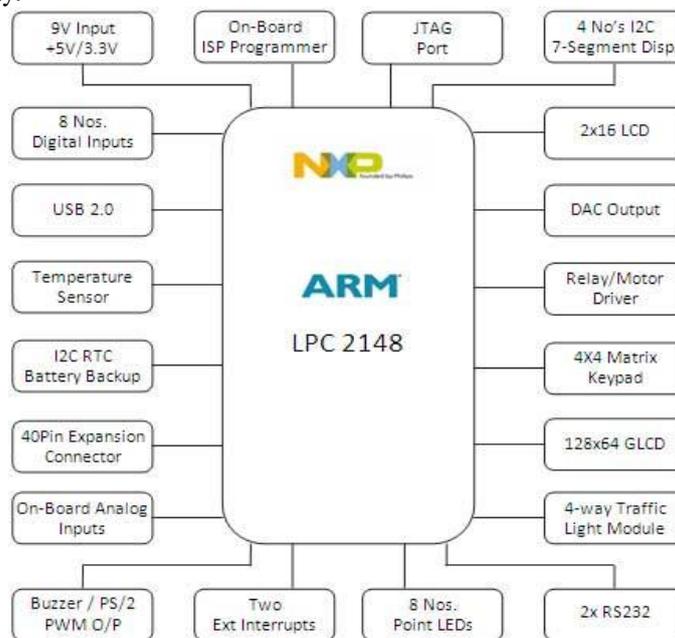
Pin diagram of ARM-LPC2148

The announcement feature and disconnect/reconnect features are controlled by the visual basic codes. The microcontroller receives the command from server and act. The advantage of this system is to reduce the effort of human beings. Another advantage is this system can be used in remote area or small villages.

ARM Processor

Automatic meter Reading: Automatic meter reading is to increase the accuracy reading and theft control system for customer and government. In the proposed method GSM technology used to transmit the meter reading to the customer and government with the required cost. The energy theft controlled by tactile sensor and ARM7 processor.
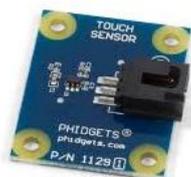

Tactile sensor

To control the theft, we use two types of theft controlling process namely
   i)   Tampering of seal in energy meter
   ii) Underground power theft control

The first process of theft control will be used by IR (Infrared) sensor. Tactile sensor is fixed in immediately inside of the energy meter. After identifying theft, tactile sensor send the data to the ARM7 processor and then message send to the government office by using GSM. Whenever there is a power cut 12V rechargeable battery give power to the tactile sensor automatically.
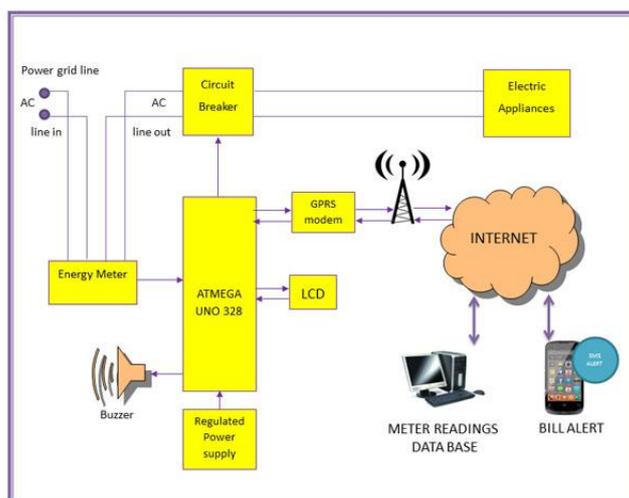
Automatic meter reading

III.   POWER MEASUREMENT AND THEFT DETECTION

   Aim of the Remote power monitoring is to measure the exact amount of power that is consumed by the user at a given instant of time so the power measurement unit is essential and is connected on the consumer side. The power is measured by using the instrument transformers. Instrument transformers are used for measurement and protective application, together with equipment such as meters and relays. Their role in electrical systems is of primary importance as they are a means of "stepping down" the current or voltage of a system to measurable values, such as 5A or 1A in the case of a current transformers or 110V or 100V in the case of a voltage transformer. This offers the advantage that measurement and protective equipment can be standardized on a few values of current and voltage. The types of instrument transformers available are
   •   Voltage transformers
   •   Current transformers.

Voltage Transformers

The voltage transformer is one in which "the secondary voltage is substantially proportional to the primary voltage and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections." In an "ideal" transformer, the secondary voltage vector is exactly opposite and equal to the primary voltage vector, when multiplied by the turn's ratio.

Current Transformers

A current transformer is defined as "as an instrument transformer in which the secondary current is substantially proportional to the primary current (under normal conditions of operation) and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections." This highlights the accuracy requirement of the current transformer but also important is the isolating function, which means no matter what the system voltage the secondary circuit need be insulated only for a low voltage.

Theft Detection Method

The simple formula behind theft detection is whenever input power is passing from supplier to the receiver, at that time if the total amount of power is not received by the receiver then there is possibility of theft of energy.

..Σ P sent = ΣP consumed + Loss ....No Theft Σ P sent $\neq$ Σ P consumed + Loss ....Theft Occur .Here, P sent = Power measured by pole side energy meter P consumed = Power measured by load side energy meter
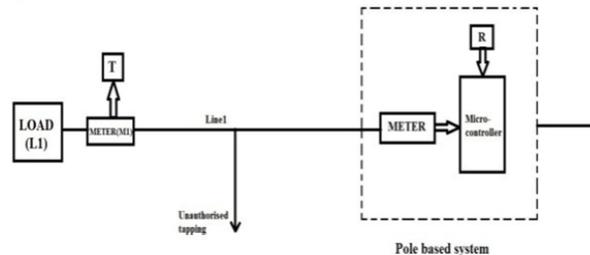
Power Theft detection

Consider a distribution system shown in conceptual diagram. Two single phase loads L1 and L2 are supplied from two different phases. M1 and M2 are the energy meters that measure power consumed by these loads over a period.

Pole based system (P) have been installed to detect power theft. Conceptual diagram L1,L2 Single phase loads M1, M2 Digital energy meters P Pole based system (installed on a distribution pole) There are three different types of systems to monitor power sent.
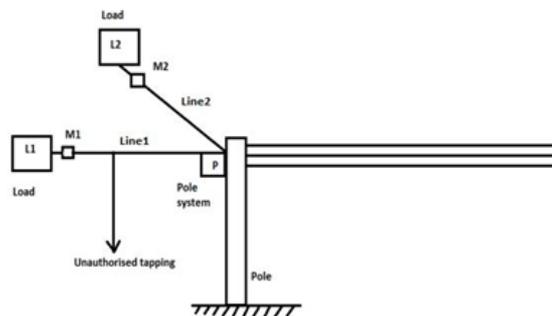
Conceptual diagram

Pole based system: It consists of Wireless data receiver, Micro-controller, Digital energy meter. Digital energy meter will measure power sent over each line for a certain time period. B.

Pole Side Energy Meter: One energy meter is installed in a pole based system. This meter is capable to measure a power sent over each line connected to that pole. C. Load Side Energy Meter (M1, M2): Meter is installed on load side to measure a power consumed by load over a time. Also it has an additional feature of transmitting that data to receiver using wireless technique ZigBee network. Fig: load side meter D.

Suppose there is tapping done by any unauthorized person on the line to connect his appliance. Over a certain period there will be difference between meter reading and pole based reading. Microcontroller will compare these two values and if the measured value on pole is more than value send by meter by some tolerance then power theft is happening on line. This theft signal generated on pole system can be transmitted to substation by power line communication technique, Tolerance should be provided for losses of line. Because over a long period there will be difference in reading of meter on load side and pole side due to loss of line between pole and load. Therefore tolerance should be provided through programming of micro-controller.

IV. CONCLUSION

In developing countries electricity theft is a common practice especially in remote areas, as they do not pay utility bills to a government company in case of electricity and gas as well. To solve these problem governments must think of an idea to provide help in terms of subsidy to manage this issue. With this system the service provider can collect the bill any time with a single message. The data collection and manipulation task becomes fast and easier. Any modification can be made to the code in less time. Changes in rate or unit calculation can be done very effectively.

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