WSN Based Tariff and Electrical Loads Theft Identification

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Abstract—Energy storing has turned into a notable statement for the society of nowadays. This paper displays a Wireless Sensor and Actuator Network (WSN) intended to offer help to a programmed framework, based on the GSM, which empowers a mindful utilization of vitality. The proposed system plays out a proficient administration of devices, machines and procedures, upgrading their activity to accomplish a decrease in their general vitality use at some random time. For this reason, significant information is gathered from smart sensors, which are placed at the required areas, just as from the vitality showcase through the wireless communication. This data analysis is to give learning about load use, and to enhance proficiency.

1. Introduction

Smart energy auditing of various loads has been reported in this paper. The system has been designed that can be used to monitor electrical parameters such as voltage, current and power of household appliances. This energy auditing system consists of a smart sensing unit that detects and controls the home electrical appliances used for daily activities by following different tariff rates. It can reduce costs for the consumers and thereby improve the grid stability of the system. A developed prototype has been extensively tested and experimental results have compared with conventional as well as with frequently measuring devices. Smart energy auditing system encapsulates the net metering system for facilitating consumers to optimally utilize the power consumption. The gaining importance and urgency of a smart energy auditing system use wireless sensor network for advancements and also provide more efficiency, reliability and options to customers.

2. Concept

There is a great necessity for optimization of energy consumption, especially for case of electrical energy in all economic sensor. From the stand point of electricity source the aim is usually to enforce the use of renewable energy. While from economic point of view, since energy costs represents a large percentage of the total cost of industrial processes, the aim is to set the reduction in associated outlay. Once the power supply is switched On, the power consumed by the loads will be measured by the current transformer. The current transformer connect to the controller through the current transformer-Analog to Digital converter circuit. The load current reading will be sent to the microcontroller, then the controller updates the reading in the Liquid Crystal Display(LCD). Similar current transformer circuits are driven to all loads in the home. The various current readings were monitored with proposed metering system. Based on the power consumption the system will updates their daily usage along with cost details by the predefined cost estimations. The system is secure and reliable because it can be accessed only by an authorized person and the user. This system not only solves the problem of manual meter reading but also provides additional features such as power management due to over usage, power demand period.
3. **Existing System**

These existing meter reading techniques in India are analyzed, determined and conducted an extensive study on different energy measuring instruments available now. In existing system either an electronic energy meter or an electro mechanical meter is fixed in the premise for measuring the usage. The meter which is currently in use are only capable of recording kWh units. The kWh units used before still have to be recorded by meter readers monthly, on foot. The recorded data needs to be processed by a meter reading company or the electricity board department. For processing the energy meter reading, the company has to first we have to link the each recorded power usage of data to an account holder and then determine the amount owed by means of the specific tariff which in use.

4. **Proposed System**

As has been established above, there is a great necessity for the optimization of energy consumption, especially for the case of electric energy, in all economic sectors. From the standpoint of the electricity source the aim is usually to enforce the use of renewable energy. While from an economic point of view, since energy costs represents a large percentage of the total costs of industrial processes, the aim is set at reducing the associated outlay. This work presents a Wireless Sensor Network (WSN) providing support to a new intelligent system for energy management within a given range of time to optimize costs. Its operation is based on analysis and decision-making from real-time energy generation and consumption data, according to some conditions.

5. **Block Diagram**

The complete block diagram of this paper of both transmitter side and receiver side are given in the figure1 and figure2.

![Block Diagram](image)

**Fig. 1:** The Block Diagram of the Transmitter side of the Tariff rates calculation.
Fig. 2: The Block Diagram for the receiver part of the Tariff rates calculation.

A. FLOW CHART OF THEFT DETECTION

![Flow chart of Theft Detection](image)

Fig. 3: Flow chart of Theft Detection.

6. System Description

The detailed description of the WSN based Tariff and Electrical loads theft identification are given below.
A. Power Supply

A power supply (sometimes known as a power supply unit or PSU) is a device or a system that supplies electrical and any other types of energy to an output load or group of loads in the output. The term is most commonly applied to electrical energy supplies, but not more often to mechanical ones, and hardly to others.

B. Transformer

Transformer is a device used either for stepping-up or stepping-down the AC supply voltage with a corresponding decreases or increases in the current. A transformer is used for stepping-down or stepping up the voltage so as to get a voltage that can be regulated to get a constant 5V. A transformers are used to convert the high alternating input voltages into low alternating output voltages without any filters. A transformer consists of primary and secondary windings and turning coils which is built within it. In step down transformer the power coupled to the secondary coil is lesser than or exactly equal but not greater than the input voltage. We used transformer to step down the voltage and hence produce low voltage and high current from 220v to 12v in order for the microcontroller to work.

Fig. 4: The step down transformer.

C. Rectifier

A rectifier is a device used like a semiconductor, which is capable of converting sinusoidal input waveform units into a unidirectional output waveform, with a nonzero average component. Electronic components works with the DC power of about 5v. The output 12v ac from step down transformer is converted into 5v dc using rectifier because the kit and the microcontroller works only with less but not greater that of about 12v of power supply. Full wave bridge rectifier is often preferred for rectifier circuit since the rectifiers act as diodes.

Fig. 5: Diode Rectifier.
D. **Filter**

Capacitors are used as filters in the power supply unit. The action of the system depends upon the fact, that the capacitors stores energy during the conduction period and delivers this energy to the load during the inverse or non-conducting period. The operation of the rectifier circuit is to remove the pulsed DC without any noise signal found in it. The filter circuit consists of a capacitor and an inductor and few resistors. The function of a capacitor is to block DC and pass AC and also to prevent the noise. Inductor passes AC but blocks DC in a circuit. The output obtained will be no pulsed steady DC single way output. In this way, the time during which the current passes through the given loads is prolonged and rippled for the current is considerably reduced.

E. **Voltage Regulator**

All voltage sources will not be able to give fixed and desired output due to fluctuations in the circuit. For getting constant as well as steady output, the voltage regulators are used for this purpose. The integrated circuits are used for the regulation of voltages and are termed as the voltage regulator or voltage divider ICs. We can identify the usage of IC 7805. The voltage regulator IC 7805 is actually a additional member of 78xx series of voltage regulator ICs. It is a fixed linear voltage regulator. The xx present in 78xx represents the value of the fixed output voltage that is it provides only constant output value that the particular IC provides. For 7805 IC, it requires +5V DC regulated power supply for the electrical components to run. This regulator IC also adds certain provision for a heat sink. The input voltage of this voltage regulator can be used up to 35V, and this IC gives a constant 5V for any value of input voltage less than or equal to 35V which is the threshold limit for voltage regulators.

![Fig. 6: Voltage Regulator.](image)

F. **Current Transformer**

A current transformer (CT) is used for measuring the value of alternating electric currents. Current transformers, along with voltage (or potential) transformers (VT or PT), are called as instrument transformers. When current in a circuit becomes too high to apply directly to the measurement of instruments, a current transformer helps to produce a reduced current perfectly and accurately proportional to the current in the given circuit, which can be conveniently connected to measuring and recording the power value for the instruments. A current transformer isolates the measured and the measuring instruments from what may be very high voltage in the monitored circuit. Current transformers can be fixed on the very low voltages or high voltages leads of a power transformer; sometimes a section of bus bar is arranged to be easily removed for exchange of current transformers.
G. LCD
LCD (Liquid Crystal Display) is a type of display which is used in digital watches and many portable computers and also television. LCD display utilizes the sheets of polarizing material with a liquid crystal solutions between them. An electric current which is passed through the liquid causes the crystals to align so that the light cannot pass through that crystal. LCD technology has advanced very rapidly since its initial inception over a long time for the use in lap top computers. Technical achievements has been resulted in brighter displacing ability, higher resolutions, reduction in response times and cheap manufacturing processes. The liquid crystals can be manipulated and evaluated through an applied electric voltage so that the light is allowed to pass or is blocked by the crystal. By carefully controlling and observing where and what wavelength (color) of light is to be allowed to pass, the LCD monitor is able to display images and messages. A backlight reflection provides LCD monitor’s brightness.

H. GSM
Speech and voice calls are obviously the primary functions for the GSM cellular systems. To achieve this the speech, it is digitally encoded and later decoded when required using a vocoder. A large variety of vocoders are available for use, being pointed at different scenarios. GSM (Global System for Mobile Communication) is used for transferring information from the device to the external system. GPRS (General Packet Radio Switching Service) is an extension of GSM used for transmitting data at higher data rates. GSM module is operated when connected with the power supply unit and the communication interfaces. For functioning of the GSM module requires a SIM (Subscriber Identity Module) with IMEI number. In addition to the voice services, GSM cellular and mobile communication technology supports a variety of other data services and packages. Although their performances are nowhere near the level of those provided by 3G network, they are nevertheless still play an important part and are useful. A variety of data services and application packages are supported with user data rates which are up to 9.6 kbps. Services including Group 3 facsimile, videotext and teletex can be supported.
I. PIC Microcontroller

The PIC microcontroller instruction set is suited to the implementation of fast usage of tables in the program spaces. Such usage take one instruction and two instruction cycles. Many functions can be modeled in this way. Optimization are being facilitated by the relatively large program space of the PIC microcontroller (e.g. 4096 × 14-bit words on the 16F690) and by the designing of the instruction set, which allows for the embedded constants. For example, a branch instruction's target may be indexed by W, and may be executed as a "RETLW" which does as it is named - return with literal in W from the branch. The Interrupt latency is always constant at three instruction cycles. External interrupts should have to be synchronized with four clock instruction cycle, otherwise there can be atleast a one instruction cycle jitter. Internal interrupts are already perfectly synchronized. The constant interrupt latency allows PIC microcontrollers to achieve interrupt driven at a very low jitter timing sequences. An example of this type is a video sync pulse generator. This generator is no longer considered to be true in the newest PIC microcontroller models, because they have a synchronous interrupt latency of three or four cycles.

7. Embedded Software

The C Programming Language provided low level memory access using an uncomplicated compiler (a software that converts programs to machine code) and achieved efficient mapping to machine instructions. The C Programming Language became so popular that it is used in a wide range of applications ranging
from Embedded Systems to Super Computers. Embedded C Programming Language, which is widely used in the development of Embedded Systems, is an extension of C Program Language. The Embedded C Programming Language uses the same syntax and semantics of the C Programming Language like main function, declaration of data types, defining variables, loops, functions, statements, etc. The extension in Embedded C from standard C Programming Language include I/O Hardware Addressing, fixed point arithmetic operations, accessing address spaces, etc. Embedded Software or Program allow Hardware to monitor external events (Inputs) and control external devices (Outputs) accordingly. During this process, the program for an Embedded System may have to directly manipulate the internal architecture of the Embedded Hardware (usually the processor) such as Timers, Serial Communications Interface, Interrupt Handling, and I/O Ports etc.

8. Explanation

Once the power supply is switched on the power consumed by the loads will be measured by the CT. The CT is connected to the controller through CT-ADC circuit. The load current reading will be sent to the microcontroller, then the controller updates the reading in the LCD. Similar CT circuit is driven to all loads in the home the various current readings were monitored with proposed metering system. Based on the power consumption the system will updates their daily usage along with cost details by the predefined cost estimations. The data sets like individual load usage or overall usage were transferred to the GSM protocol for the user acknowledgement. Every time when the power consumed is greater than the estimated power, the microcontroller allows the GSM to send the warning message to the user so that the user can be aware of how much power is being consumed as well as how much power is in excess from the estimated limited power. This will help the user to save power from exceeding the predefined limit. On the other hand, it detects the load or device theft by using GSM. So we have to be given an individual ID to each devices. We can detect the location from where the load or device are currently being stolen by the usage of their IDs. The data sets like individual load usage overall usage were transferred through the GSM protocol for the user acknowledgement.

9. Conclusion

The system is secure and reliable because it can be accessed only by an authorized person and the user. AMR(Automatic Meter Reading) not only solves the problem of manual meter reading but also provides additional features such as power management due to over usage, power demand period etc. AMR also gives the information of the total load used in a house at time and individual load usage so the classification of loads can be done along with the GSM based data transfer system.

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