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Automatic Energy Meter Reading and Theft Detection

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Abstract

Electricity has become one of the basic requirements for human life, being widely used for domestic, industrial and agricultural purposes. In our work, we propose a digital energy meter which measures the energy consumption and the energy measured is transmitted periodically to the remote server or user or electricity board so that energy consumption can be monitored from remote end. Additionally an important concept used here is the IoT (Internet of Things).

It objective is to generate bill automatically by checking the electricity unit's consumption in a house and in a way to reduce the manual labor. The calculations are performed automatically and the bill is updated on the internet by using a network of Internet of Things Iot is an emerging system with unique identifiers and having the ability to transfer data over a network without human-to-human or human-to-computer interaction. Here using IoT the meter readings are uploaded into our specific web page for remote monitoring.

Keywords: *Electricity, energy meter, remote server, Internet of things (IoT), web page*

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I. INTRODUCTION

Digital signal processor or high performance microprocessors are used in digital electric meters. Similar to the analog meters, voltage and current transducers are connected to a high resolution ADC. Once it converts analog signals to digital samples, voltage and current samples are multiplied and integrated by digital circuits to measure the energy consumed. There are many methods of error correction in digital electricity meters which are usually based on the known methods of A/D converters error correction. Most of these methods use software correction based on calibration process. While in digital electricity meter, percentage error could be as low as 0.01%. IOT based energy meter reading consists of three parts: Controller, Theft detection and WIFI part. Controller part plays a major role in the system. Where all the information can send through this controller to the other part of the system and it also stores the information in it. WIFI part performs IOT operation in accordance with the Adriano controller. The energy meter connected with theft detection part if any temper happens it will send the information to the company as well as it will take automatic action by making power off .On the other hand consumers are also not satisfied with the services of power companies. Most of the time they have complaints regarding statistical errors in their monthly bills. Thus we are trying to present an idea towards minimization of technical errors and to reduce human dependency at the same time. With the help of this project we are aiming to send the total energy consumption in the form of SMS from the remote location directly to the consumer and electricity board via modem.

II. SYSTEM ARCHITECTURE

At present, the need and demand for electricity goes on increasing. In spite of very well developed sources for electricity, there are a lot of problems with distribution, metering, billing and monitoring of energy consumption. The problem worsens further in collecting the meter readings. In earlier days the energy was measured using electromechanical meter. Usage of this meter leads to inaccuracy while taking readings and allows energy theft. To overcome this disadvantage the above meter was slowly replaced by digital energy meter but this implementation also consumes more time and needs manpower for collecting the meter readings periodically. So we are designing a digital energy meter which is IoT compatible. Here we are using the GSM

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module for sending the meter readings to the consumer and uploading it on the webpage

III.PROPOSED METHOD

In our proposed digital energy meter we are using the voltage and current measuring circuits that measures the voltage and current and it is given to the Adriano microcontroller. This microcontroller is already programmed for calculating values such as amount of power utilized by the consumer and also the energy.

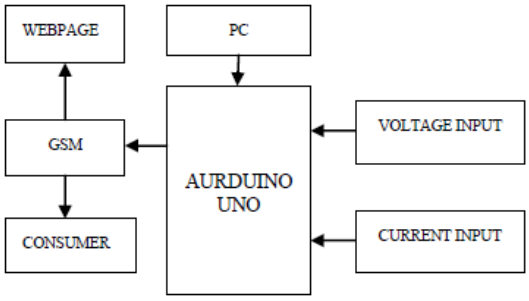


Fig.1 Block diagram of Propsed System

1. Voltage Measurement

For voltage measurement we are using a potential transformer. The transformer works on the principle of mutual induction of two coils. When current in the primary coil is changed the flux linked to the secondary coil also changes. Consequently an EMF is induced in the secondary coil. The voltage of the consumer is measured by means of a Potential transformer and is given to attenuator circuit.

2. Attenuator Circuit

A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. It converts both polarities of the input waveform to pulsating DC (direct current). Two diodes and a filter capacitor are needed for this purpose. The voltage obtained from this is given to the potential divider, which is used to provide arduino compatible voltage. Resistors **R1** and **R2** form a voltage divider that scales down the AC voltage.

3. Current Measurement

A current sensor is a device that detects electric current (AC or DC) in a wire, and generates a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. For current measurement we are using a CT sensor. The current sensor module is a device that is used for making current measurements. ACS 712 allows measurement of current direct or alternating flowing in a conductor.

The generated signal can be then used to display the measured current in an ammeter,

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or can be stored for further analysis in a data acquisition system, or can be used for the purpose of control. The desired measured current generates a magnetic field which the sensor converts to a proportional output voltage using the Hall Effect. This voltage in turn is read by a microcontroller system to an A/D converter to calculate its peak value and the corresponding RMS value of the load current.

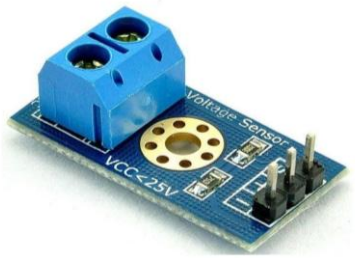


Fig.2 CT sensor

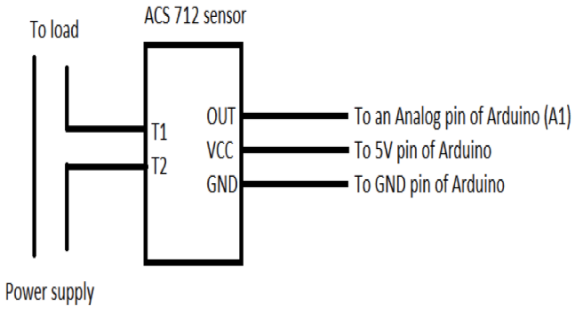


Fig.3 Circuit for current measurement

4. Gsm Module

The main goals of GSM is to improve spectrum efficiency, international roaming, low-cost mobile sets and base stations, high-quality speech GSM Module for its basic functions like calling, texting etc., specifically with the Microcontrollers. So here we are going to build a Simple Mobile Phone using Arduino, in which GSM Module is used to Make the Call, answer the Call, send SMS, and read SMS, and also this Arduino phone has Mic and Speaker to talk over this Phone. The power level of a transmitter within a single cell must be limited to reduce the interference with the neighboring cells.

GSM Architecture, Features & Working

GSM is a mobile communication modem; it is stands for global system for mobile communication (**GSM**). ... GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. The GSM module at the user end is connected to the computer with the help of the USB to serial cable converter.

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Fig.4 GSM Module

Arduino Uno

Arduino Uno board is based on ATmega328P Microcontroller. It has 14 digital pins, 6 analog inputs, 16MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. The size of the flash memory is 32KB which is used for storing code. The voltage and current input is given to the controller separately and this microcontroller is already programmed for calculating values such as amount of power utilized by the consumer and also the energy.

The calculated values can be viewed through the serial monitor and these values are then transmitted to the consumers as SMS via GSM. These meter readings are uploaded in our specific web page too

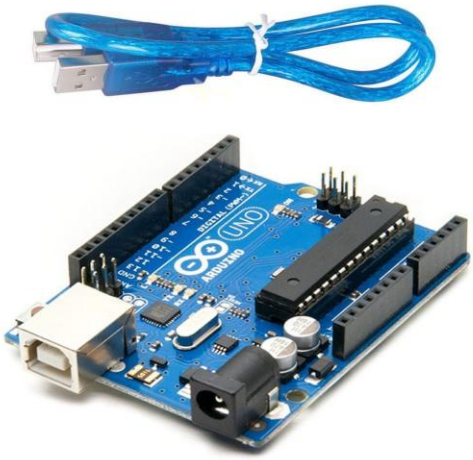


Fig. Arduino uno

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IV. SOFTWARE

Arduino IDE:

Arduino IDE is an Integrated Development Environment used for Arduino family. It supports both C and C++ programming languages. Arduino supplies the software library, which provides some common input and output procedure. This is an open source board which allows easy coding and upload.

Following are the steps involved in programming an Arduino UNO:

1) Open the Arduino IDE
2) Go to Tools>Board menu and choose Arduino UNO.
3) Make sure that the Arduino UNO is connected to the USB of the computer that you are working in.
4) Type the program which you want to dump in to the controller.
5) Save the file and verify by clicking the top left button.

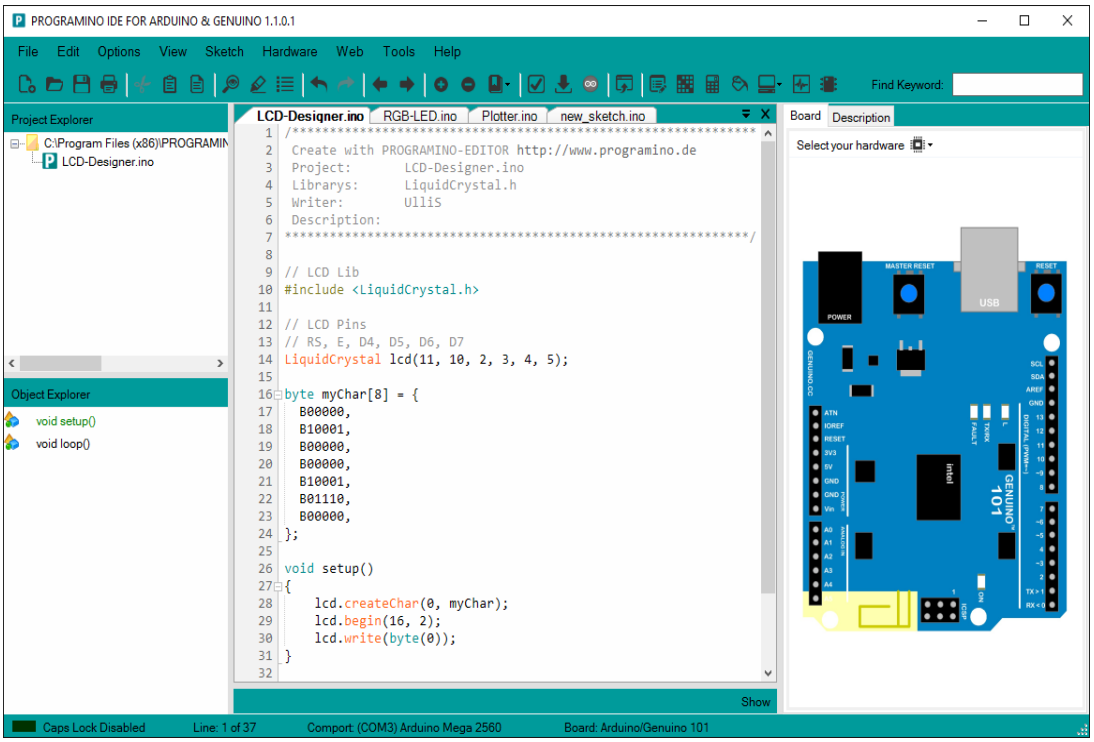


Fig.5 Screenshot for arduino IDE

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6) Upload the code into the board by clicking the REFERENCE upload button near the verify button.

7) In case of trouble, by pressing the RESET button on the board, the code will start to execute from the first line.

V. FUTURE SCOPE

The project mainly aims at providing overall infrastructure of the energy meter presently used for the smart city concept. The main improvement for the future is going to make energy meter readings, tampering identification techniques, and connection and disconnection and also the pre information providing to the users all is going to happen on wifi internet. Where we are going to develop some wifi hotspots in each area through which all the energy meters are get connected and set 4 to 5 parameters which is also going to be monitored. And the overall improvement information will be providing to the energy meter i.e. KPTCL will be easy for them to handle the things. Also in future we can go with some standard apps or standard tools, where in which it makes work easy for KPTCL people by reading the meter readings faster than the fastest method. And connect and disconnect of every meters on the on – payment and non – payment that will be fast as compared to the present method.

VI. CONCLUSION

In the era of smart city advancement, this project is concentrated on the connectivity & networking factor of the IoT .In this project, an energy consumption calculation based on the counting of calibration pulses is designed and implemented using PIC18F46K22 MCU in embedded system domain. In the proposed work, IoT and PLC based meter reading system is designed to continuously monitor the meter reading and service provider can disconnect the power source whenever the customer does not pay the monthly bill and also it eliminates the human involvement, delivers effective meter reading, prevent the billing mistake. The Project has achieved following objectives:-

- Ease of accessing information for consumer from energy meter through IoT
- Theft detection at consumer end in real time

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- LCD displays energy consumption units and temperature
- Disconnection of service from remote server

REFERENCES

Books:

[1] Masudur Rahman.M, Jannat.N.E, Islam.M.O and Serazus Salakin, M, " Arduino and GSM based smart energy meter for advanced metering and billing system," Electrical Engineering and Information Communication Technology (ICEEICT), 2015 International Conference

[2] Shraddha Male, Pallavi Vethekar, Kavita More and Prof. V. K. Bhusari, "A Smart Wireless Electronic Energy Meter Reading Using Embedded Technology". Shraddha Male et al Int. Journal of Engineering Research and Applications. Issue 1(Version 3), January 2014, pp.145-147.

[3] Vergara.A.L and Villaruz.H.M, "Development of an Arduino-based automated household utility power monitoring system," Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM), 2014.

[4] Sagar Patil, Gopal Pawaskar and Kirtikumar Patil, "Electrical Power Theft Detection and Wireless Meter Reading," International Journal of Innovative Research in Science, Engineering and Technology, 2013.

[5] S.Gopinath, R.Suresh, T.Devika, N.Divya and N.Suthanthira Vanitha, "Embedded Based Digital Energy Measurement for Improved Metering and Billing System," International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering.

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