Implementation of Smart Electricity Meter using Internet of Things

Prof. Sonali A. Patil, Assistant Professor, Dept of Computer Engineering, JSPM'S BSIOTR,WAGHOLI, PUNE

Sneha Zanjurne

Sneha Kamble

Shaila Pawar

Pranita Somvanshi

ABSTRACT: The paper is focusing on automatic billing and metering the integration of the SMS gateway for Short Message Service (SMS) and Arduino provide the meter reading system with some automatic functions that are predefined. The energy consumption and electricity bill will be providing IOT module to the customer and to the concern electricity department. An alert message will be send to the customer and vigilance squad when the consumption unit reading reaches beyond the specific threshold. This paper contains energy consumption details in terms of power units and power units will be displayed on the real time on mobile application of user MSBET Web portal. This paper describes the digitization of energy meter readings over the internet. The proposed system design eliminates the human involvement in electricity maintenance. The buyer will be able to pay for the usage of electricity on schedule. The user can monitor energy consumption in watts from an application by providing a channel id for the meter. The program developed in C language with the Arduino syntax in the Arduino IDE. The proposed system will work for checking the current usage (bill), notify when reaching the limit, and reset the usage (bill) successfully, only using IOT.

KEYWORDS: Internet of Things (IOT), IOT Server, Android Application, LAN, Arduino, LCD, Current Sensor, Payment Gateway, Web Application.

INTRODUCTION

The billing process of electricity board should be faster and efficient to generate bills and give it to customer so that the customer can pay bills earlier. The process of board should be time efficient and straightforward to take actions. However the billing process of electricity board is time consuming, costly and error-prone. By wasting time and money current system makes board inefficient and slow. In general, networks are form by

connecting multiple computers through the LAN. We are developing the new android application through which we can easily monitor the network. The communication between particular client and the admin is achieved through a central monitoring server, our goal is to develop an integrated software application that will help network admin to remotely monitor network through android phone. The communication between the client and the android phones is done through the server.

LITERATURE REVIEW

Embedded Laboratory Environment Monitor System This framework exhibits a presentation of an installed processor-based lab environment screen framework and its outline for equipment and programming. This framework goes for finishing checking an assortment of constant information. This framework accomplishes the keen administration of research facility. By wired or remote means, the lab checking framework can speak with PC. [1]

Design and Implementation of Open Computer Lab Monitoring and Management system. This depends on sensor in which checking is done through implanted sensor in framework. Yet, we are actualizing the framework on LAN without utilizing sensor. We are including the idea of message sending; summon giving, and so forth. [2]

The issues confronted in PC research facilities is inadequate with regards to cognizance for administration and institutionalized administration, lacking means for executing and keeping up, no institutionalized procedure, no record for programming and equipment design and change too, furthermore changing setup arbitrarily. Our undertaking will help in lessening these issues. [3]

Checking electricity theft will drastically affect the power sector positively, as power companies will make adequate money from the sale of electricity and plan to improve the system. The only existing system that closely relates to the system developed in this paper, is the system developed. [4]

This paper shows the first set of tests conducted on a low cost smart meter. It highlights the good performance of this approach, using the algorithm described in this paper. The meter, with his wireless interface, could be integrated in a 169MHz network, spreading and sharing information about energy consumption for the smart grid. [5]

HARDWARE DESCRIPTION

1] Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Figure 1: Arduino

2] Pin Diagram

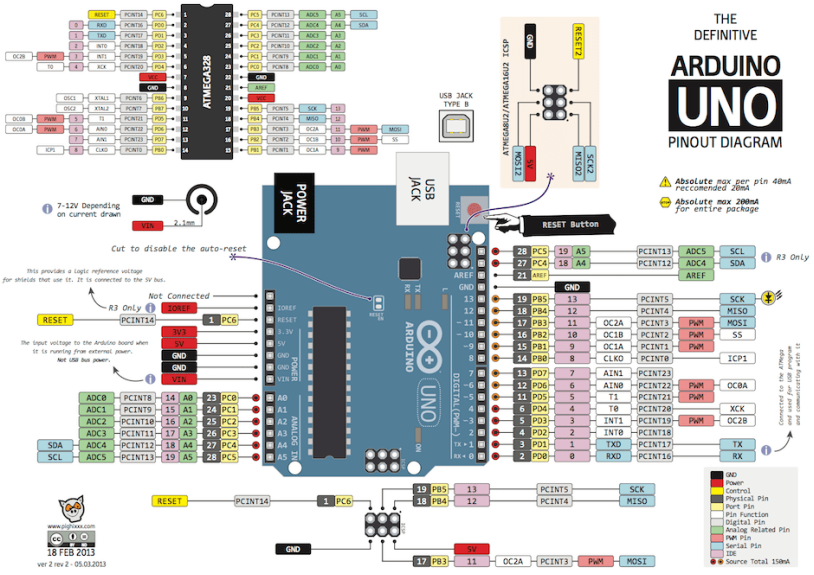

Figure 2: Pin Diagram & GPIO

Sr. No.	Name & Description
1	**Power USB** Arduino board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection.
2	**Power (Barrel Jack)** Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack.
3	**Voltage Regulator** The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.
4	**Crystal Oscillator** The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz.
5	**Arduino Reset** You can reset your Arduino board, i.e., start your programs from the beginning. You can reset the UNO board in two ways. First, by using the reset button on the board. Second, you can connect an external reset button to the Arduino pin labeled RESET.
6	**Pins (3.3, 5, GND, Vin)** 3.3V − Supply 3.3 output volt 5V − Supply 5 output volt Most of the components used with Arduino board works fine with 3.3 volt and 5 volt. GND (Ground) − There are several GND pins on the Arduino, any of which

	can be used to ground your circuit. Vin − This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.
7	**Analog pins** The Arduino UNO board has six analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.
8	**Main microcontroller** Each Arduino board has its own microcontroller. You can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.
9	**ICSP pin** Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an “expansion” of the output. Actually, you are slaving the output device to the master of the SPI bus.
10	**Power LED indicator** This LED should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.
11	**TX and RX LEDs** On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino UNO board. First, at the digital

	pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led. The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process.
12	**Digital I/O** The Arduino UNO board has 14 digital I/O pins (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled "~" can be used to generate PWM.
13	**AREF** AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

3] Internet of Things (IOT):

Internet of Things (IOT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions amongst each other or with respect to the external environment. In the upcoming years, IOT-based technology will offer advanced levels of services and practically change the way people lead their daily lives. Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a very few of the categorical examples where IOT is strongly established.

There are four main components used in IOT:

- Low-power embedded systems
- Cloud computing
- Availability of big data
- Networking connection

There are two ways of building IOT:

1. Form a separate internetwork including only physical objects.
2. Make the Internet ever more expansive, but this requires hard-core technologies such as rigorous cloud computing and rapid big data storage (expensive).

EXISTING SYSTEM

From previous decade, electronic meters were widely used. Electronic meter display the energy used, on an LCD or LED display, and some can also transmit readings to remote places. In addition to measuring energy used, electronic meters can also record other parameters of the load and supply such as instantaneous and maximum rate of usage demands. In the existing system, meter tampering can be done easily and it's one of the major drawbacks for an energy crisis. Billing system fails if no GSM Network Coverage. Charges may be applicable for network use.

DISADVANTAGES OF EXISTING SYSTEM

- Major drawbacks for an energy crisis.
- Management of power consumption is difficult.
- Two way communication.
- Real time monitoring.
- Energy tampered.

PROPOSED SYSTEM

Today system is exceptionally basic necessity from little business to corporate area. In Windows organizing utilizing the system Places application we can without much of a stretch search each PC which is associated with LAN. Yet, now and again the prerequisite is distinctive, assume we need to duplicate, erase, rename or introduce application on each PC which is associated. There is one disadvantage with windows organizing. We need to play out this operation on every PC physically. Implies we need to search every PC one by one and after that play out these same undertaking on each PC over and over. This procedure is extremely long, exhausting, and furthermore tedious. So the answer for this issue is our venture i.e. System Command Execute. When we begin this venture it shows every one of the

PCs which are associated. At that point we have put some regular errand in our undertaking like, duplicate a document, make an envelope, erase a record, erase an organizer, rename a document, introduce application, shutdown , begin a specific application, printing , message passing and some more. After that simply select any charge from the rundown and after that that chose summon is executed on every PC which is in system. So there is no compelling reason to play out this operation physically on every PC.

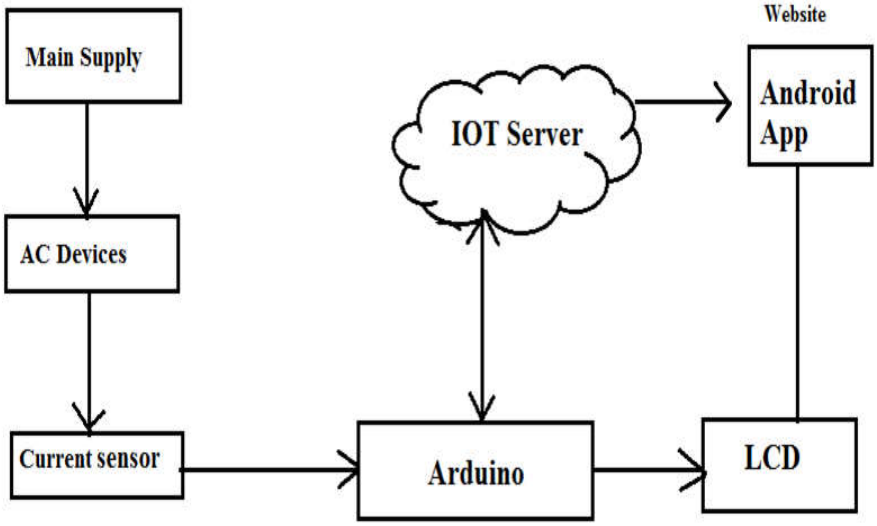

Figure 3: System Architecture

APPLICATION

- This is used in applications such as Also if consumer gets faulty bill he has to go to Electricity Board office to correct it.
- Also as customer is getting message of bill printing can be avoided to reduce paper wastage.

ADVANTAGES

- Collect meter reading data accurately and without manual interference and errors.
- Proven solutions with guaranteed results.
- Ready to integrate solution reducing the time-to-market.

CONCLUSION

Thus, IoT basic concepts are studied. Microcontroller Arduino is reviewed in detail. Paper covers the complete component study required for developing the Smart electricity

meter which is the best IoT application going to benefit the society. Paper focuses on following outstanding properties: Voltage and Current will be displayed on LCD. Exact power calculations of power will be calculated. IOT based power consumption will be recorded.

FUTURE WORK

In future we can make a system which can send SMS to the concerned meter reading man of that area when theft detected at consumer end. We can make an IOT system where a user can receive SMS, when he/she crosses threshold of electricity usage slab.

REFERENCES

[1] H. G. Rodney Tan, C. H. Lee and V. H. Mork, Automatic power meter reading systems using GSM network, IEEE, 8th International Power Engineering Conference, pp. 465-469, 2007.

[2] Ashna K, Sudhish N Gorgre, GSM based automatic energy meter reading system with instant billing, IEEE International conference held at Kottayam, pp.65-72, 2013.

[3] Tian Yew Lim And Tat Wai Chan, “Experimenting Remote Kilowatt Hour Meter Reading Through Low Voltage Power Lines At Dense Housing Estates”, IEEE Transactions on Power Delivery vol. 17, Issue 3, pp. 708-711, Jul 2002.

[4] [1] R. E. Ogu and G. A. Chukwudebe , "Development of a Cost-Effective Electricity Theft Detection and Prevention System based on IOT Technology", *Research Journal of Engineering Sciences*, vol. 2, no. 10, October 2017.

[5] F. Abate and M. Carratu, “Smart meter for the IOT”, 2018.

[6] A. Ali, N.A. Razali, N. H. Saad, N.Vitee, Implementation of Automatic meter reading using radio frequency module, IEEE International Conference on Power and Energy (PEcon), pp. 876-879, Dec 2012.

[7] Subhashis Maitra, “Embedded Energy Meter- A New Concept To Measure The Energy Consumed By A Consumer And To Pay The Bill”, Power System Technology and IEEE Power India Conference, 2008.

[8] Najmus Saqib Malik, Friedrich Kupzog, Michael Sonntag, An approach to secure mobile agents in automatic meter reading, IEEE, International Conference on Cyber worlds, computer society, pp. 187-193, 2010.

[9] Guilin Zheng, Zhifu Zhang, Intelligent wireless electric power management and control system based on ZigBee technology, International Conference on Transportation,

Mechanical, and Electrical Engineering (TMEE) Changchun, China, pp.11201124, December 16- 18, 2011.

[10] "Smart Meter: An IOT Based Smart Meter for Live Electricity Monitoring and Bill Payment", Pritee Mahajan, Sneha Tatia, and Prachi Jadhav, Electronics and Telecommunication Engineering department, SPPU, NBN Sinhgad School of Engineering Ambegaon (bk) 411041.

[11] A. Vijayarajet Automated EB Billing System Using GSM and AD-HOC Wireless Routing, International Journal of Engineering and Technology Vol.2 (5), 2010,343-347.

[12] Power Africa, 2017 IEEE PES "Field Survey Of Smart Metering Implementation Using A Simple Random Method: A Case Study Of New Juaben Municipality In Ghana".