



DYN-NEX: AUTOMATIC ENERGY METER

Ancy Mariya Varghese¹, Anjo Joseph², Aswin Manoharan³

^{1,2,3}Computer Science Engineering, Sahrdaya College of Engineering, Thrissur, India

Abstract

The technology of E-metering (Electronic Metering) has gone through rapid technological advancements and there is increased demand for a reliable and efficient Automatic Meter Reading (AMR) system. This paper presents the design of a simple low cost automatic energy meter and its associated web interface, for automating billing, connect/disconnect electricity and managing the collected data globally. The proposed system replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider. Also they can monitor the meter readings regularly without the person visiting each house. A GSM based wireless communication module is integrated with electronic energy meter of each entity to have remote access over the usage of electricity. Live meter reading from the GSM enabled energy meter is sent back to this billing point periodically and these details are updated in a central database. With proper authentication, users can access the developed web page details from anywhere in the world. The complete monthly usage and due bill is messaged back to the customer after processing these data.

I. INTRODUCTION

The struggle between energy consumption and human beings is well recognized by the international society. One way to avoid this is by giving an awareness to the consumer about the amount of energy that they are currently using. So that they can plan their energy consumption accordingly. Our invention will record the electricity usage of every consumer and predict the expected bill amount which they will have to pay by the end of the month. We also make use of live database so the reading can be recorded real-time manner. A Website and an Android app is used for

sending alerts or notifications about the energy consumption of the consumer and to give certain tips to effectively reduce the over consumption of energy.

The manual meter reading system is not that much efficient because it's accuracy depends on the E-meter reader. Automatic meter reading is the technology of automatically collecting data from metering devices and transferring that data to a central database for billing troubleshooting and analyzing. This technique has many advantages. It saves energy providers the expense of periodic trips to houses for meter reading. Billing will based on consumption rather than on estimates based on predicted consumption as in old meters. Alert will be given to the user if they exceed their limit. This can help both energy providers and customers to control the use and production of electricity.

This project has a very large scope in the economy as well the energy consumption of a country. It can reduce the manual labor in reading a meter as well as the reading would be more accurate than the previous. It can be used to analyze the peak usage of electricity along with section and region wise usage.

II. RELATED WORK

Some of the closely related works for parking slot detection have been discussed in this section.

In "Centralized automatic meter reading system based on GPRS Technology"[1] published in 2016 Sixth International Conference on Instrumentation & Measurement, proposes a centralized meter reading system with high speed , high degree of automation and high accuracy under GPRS technology. GPRS Technology, Concentrator, Data transmission module and Data management module are the system technologies used in it. They significantly reduce the electric power enterprise human resources

cost and create more benefits for the enterprise both economically and socially to promote the sustainable development of power industry.

In “GSM Based Automatic Energy meter Reading System with Instant Billing”[2] is a GSM based wireless communication module integrated with electronic energy meter. Each entity have remote access over the usage of electricity. Designed meter can send value of usage at a predefined time and the status is displayed in LCD for the next 5 minutes after sending. This enhances to generate timely bills, better understand energy demand patterns.

In “Smart Metering for Next Generation Energy Efficiency & Conservation” [3] published in IEEE journal proposed a better measurement method by showing all per phase information and three phase information on LCD. The proposed system can provide a good customer service by faster responds. In the future work, we intend to investigate the performance of the proposed system.

“New Design Approaches and Implementation of Smart Metering System” [4] published in IEEE ISCE in 2014, which describes a smart metering device that provides energy efficient functions and easy accessibility for user-convenience. This paper highlights the energy efficient and user convenient design for the smart meter. For the completeness of the proposed smart metering system, an interface between a web server and a smart metering server or a gateway added to keep connected with their smart mobile devices outside the premises.

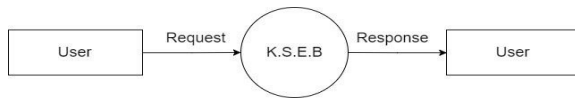
In “An Efficient Home Energy Management System based on Automatic Meter Reading”[5] published in IEEE Journal in 2011, which adopts plain energy management mechanism with an Automatic Energy Meter(AMR) network based on power line communication. They focus on the standby power reduction of consumer electronics.

III. SYSTEM DESIGN

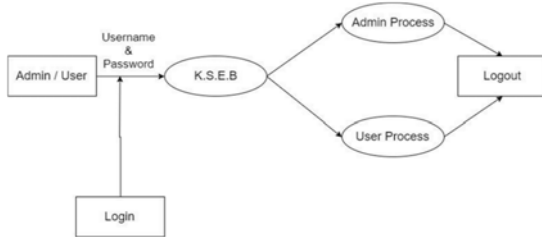
Electricity has become vital in everyday life. It is tough to imagine a world and human life without electricity. But the vitality of electricity has meant that people consume vast amounts of energy unmindfully and carelessly. The world’s energy consumption/capita stands at a staggering

2782 KWh. At this rate the world’s energy resources would get depleted very soon. Already a big chunk of fossil fuel resources got exhausted because of lavish and mindless usage. The present system of energy metering uses electromechanical and somewhere digital energy meter have poor accuracy and lack of configurability and also consumes more time and labor. The conventional electromechanical meters are being replaced by new electronic meters to improve accuracy in meter reading. Still, the Indian power sector faces a serious problem of revenue collection for the actual electric energy supplied owing to energy thefts and network losses

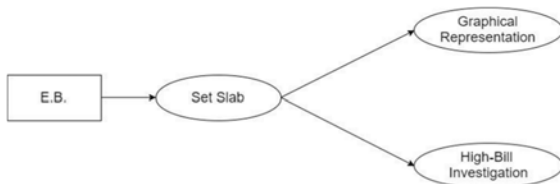
Module Description : The Raspberry pi is a microcontroller board based on the ATmega328Pu microcontroller. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. A 16 x 2 LCD is used to display the units consumed and the remaining credit balance and also indicate peak hour. Figure. 5 illustrates snapshot view of a separate module installed at load center end for two way communication consists of RF Transmitter, PC and data base. The RF transmitter at the load center end sends commands to the RF receiver at consumer end. It receives usage data from the consumer end sent through GSM. This data is recorded in a database. GSM Modem-RS232 is built with Dual Band GSM/GPRS engine-SIM900A, works on frequencies 900/ 1800 MHz The Modem is coming with RS232 interface, which allows connecting PC and microcontroller with RS232 interface chip (MAX232). The baud rate is configurable from 9600-115200 through Attention commands (AT). Unlike mobile phones, a GSM modem doesn’t have a keypad and display to interact with. It just accepts certain commands through a serial interface and acknowledges for those. These commands are called to instruct the modem to perform its functions. Load is connected to the supply through energy meter and relay. The relay trips the load if the bill is not paid for a long time after allowing some emergency credit as leeway. The Relay used in this project is a 12 V DPDT relay i.e.it needs a 12 V supply to operate. But the output of the Raspberry pi is only 5 V.



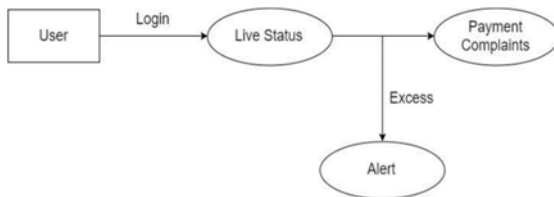
DFD Level 0 Diagram



DFD Level 1 Diagram



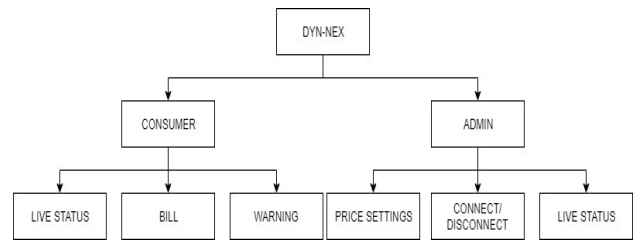
DFD Level 2 Diagram (Electricity Board)



DFD Level 2 Diagram (User)

IV. DESIGN AND DEVELOPMENT

The design of a system is essentially a blueprint or a plan for a solution for the system. The design process for a system often has two levels. At the first level the focus is on deciding which modules are needed for the system, the specification of these modules and how the modules should be interconnected. This is called system design or top level design. In the second level the internal design of the modules or how the specification of the modules can be satisfied, is decided. This design level is called detailed design or logic design.



A. Getting reading from Energy meter

The CAL LED on the energy meter blinks 3200 times for one kWh of power consumed. An op-to coupler is connected to the leads of the CAL LED to measure the power usage. Since the op-to coupler is used there is no physical contact between the 230 volt supply and the 12v controller circuit.

B. User Interface

The UI consist of two main windows. One is for user login, other one is for administrator login.

The user can login to the website to check the current energy usage from anywhere at any time. The user will be updated with real time data from the meter. The user is also able to set the limit at which the alert has to be sent to the given phone number.

The administrator can login to the website to set the tariff for the energy usage. Also admin can monitor the energy usage anytime, in case if the user fails to pay the electricity bill the admin is able to disconnect the supply of the user.

V. TECHNICAL DESCRIPTION

A. Description of block diagram

1. E-Meter
2. Optocoupler
3. GSMmodule
4. AT Mega 328
5. User Interface

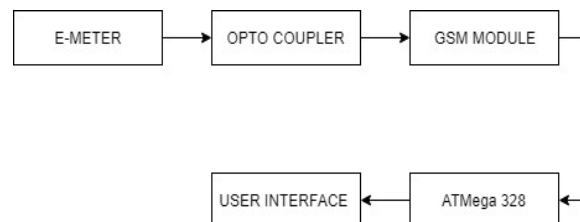


Figure 1. Hardware unit

B. Hardware Description

a) Energy meter

The meter which is used for measuring the energy utilises by the electric load is known as

the energy meter. The energy is the total power consumed and utilised by the load at a particular interval of time. It is used in domestic and industrial AC circuit for measuring the power consumption. The meter is less expensive and accurate.

b) *Microcontroller*

The Arduino Nano is a small, complete, and breadboardfriendly board based on the ATmega328P (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

c) *CT*

CT(Current Transformer) is used to measure the following current inside the conductor. The amount of current flowing is used to calculate the power consumed. This can be directly connected to the Arduino and values can be analyzed

c) *GSM Module*

GSM Modules are similar to modems, but there's one difference: A GSM Modem is an external equipment, whereas the GSM Module is a module that can be integrated within an equipment. It is an embedded piece of hardware.

A GSM modem is a wireless modem that works with GSM networks. A wireless modem behaves like a Hayes compatible dial-up modem. GSM modem sends and receives data through radio waves.

d) *Arduino*

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

C. *Software Description*

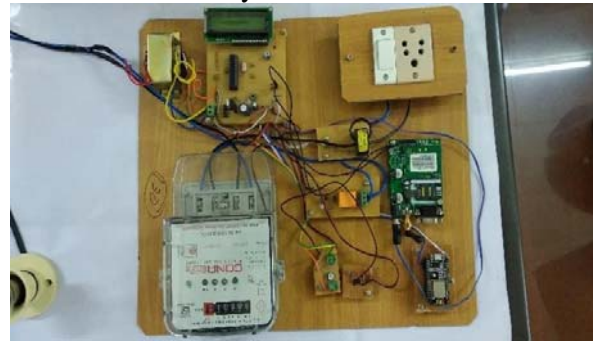
a) *HTML*

Hypertext Mark-up Language (HTML) is the standard markup language for creating web pages and web applications. With Cascading Style Sheets (CSS) and JavaScript it forms a triad of cornerstone technologies for the *Web*. *Web* receive HTML documents from a web server or from local storage and render them into multimedia web pages. HTML describes the structure of a web page semantically and

originally included cues for the appearance of the document.

VI. RESULT AND CONCLUSION

Various electronic meters have been developed and are still being developed and are still being developed. However the use of GSM provides numerous advantages over methods that have been previously used. The cost of efficient transmission of readings ensures that power consumption values can be transmitted more frequently. Can also be able to transmit readings more often will help to generate timely bills, better understanding of energy demand patterns, live status and user's complaint facility. Also helpful in energy consumption by giving an alert to the users for over usage of energy. This system gains high degree of automation and energy conservation facility.



REFERENCES

- [1] LiuNan, WangYang, LiuShanShan "Centralized automatic meter reading system based on GPRS technology" 2016 Sixth International Conference on Instrumentation & Measurement, Computer, Communication and Control, china
- [2] Ashna.k, Sudhish N George, "GSM Based Automatic Energy Meter Reading System with Instant Billing", IEEE 2013
- [3] K.S.K.Weranga, D.P.Chandima, S.P.Kumarawadu, "Smart Metering For Next Generation Energy Efficiency & Conservation" IEEE PES ISGT ASIA 2012
- [4] Kwang-Soon Choi and Sukil Hong, "New Design Approaches and Implementation of Smart Metering System" IEEE ISCE 2014
- [5] Seong Ho Ju, Yong Hoon Lim, Moon Suk Choi, JongMock Baek, Sang-Yeom Lee "An Efficient Home Energy Management System based on Automated Meter Reading" 2011 IEEE International Symposium on Power Line Communication and its Applications