

An Efficient Zigbee-Based Enabled Smart Energy Meter

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ABSTRACT: *Now-a-days technology has developed to a large extend. At the same time the need for systems with automation and high security are favored. In view of this, the smart metering thought is attracted and adopted in global as a result of speedy development Demand Response (DR) process. The DR system managed the customer consumption of electrical power in keeping with altering provide conditions and balance between supply and demand. For such kind of administration the front and back end electronics is required. In this short form, we propose the hardware answer for DR system. The hardware solution that includes ZigBee transmitter and receiver which is communicated and managed with the aid of ARM. The ARM-11 can be used for controlling end devices utilising switching circuit. The front end VB and Microsoft SQL founded database are used to store end devices electricity consumption at regular interval.*

Index Terms—Demand response system, smart grid, smart meter, ZigBee protocol, ARM7

I. INTRODUCTION

Electrical power has become indispensable to human survival and progress which leads to the enhancement of the people's standard of life by the introduction of automation in to energy distribution and management. With the constant development in technology, the need of automated meter reading systems is also increasing. 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. The traditional meter reading process involves using the analog meters to collect the data of the energy consumed and display it either on a number dial or a digital display. The service provider person comes to the place of the meter and notes down the reading at the end of every billing cycle. But the traditional meter reading process not only wastes labor human power, but also is error prone. The procedures of sending the bills to customer are very laborious and cumbersome. The conventional process is time consuming as well. Another major problem in this system is that the readings cannot be taken if no one

is available at the home or where the meter is located. The current system does not provide any scope for the user to conserve energy or does it provide energy consumption predictions for near future that enables the user to act in a more planned way. There are many such problems that cause inconvenience to the power provider as well as the consumers. Even though the conventional meters were replaced with more efficient electronic energy meters these problems still persist.

Automatic meter reading system is a technology which is used to gather data from energy metering devices and transfer it to a central station in order to process it for billing purposes. Automatic meter reading system helps the customer and energy provider to access the accurate and updated data from the meters. AMR system can fetch energy consumption in an hourly, monthly, yearly basis on request or even in Real Time. This Real time energy usage can be seen by the users to control the use of power and be more economical. With the help of the collected data the service provider will be able to send energy saving ideas to the users. This kind of real time data collected from each of the individual houses is really a boon to data scientists, who use machine learning and data mining tools to build a predictive model over this valuable data to predict the future energy demands starting from every single house, area, city to the entire planet. Thus leading to sophisticated and predictive energy production, conservation and management.

A smart energy meter is typically an electronic equipment that stores consumption data of energy in intervals of an hour, minute or less and communicates that information at any time for monitoring and billing purposes. A smart energy meter is an electronics device that communicates between the base station and the energy meter. The safety of 802.15.4 can also be confirmed higher than many existing protocols in the literature. Commonly wireless sensor networks have the fundamental constraints of battery power and scalability but these constraints are good

addressed in new ZigBee based sensor networks with additional sleep mode choices and dynamic multihop algorithms. The proposed application is for smart grids, so with little auxiliary charging circuit sensor networks can also be made much less energy unbiased.

II. LITERATURE SURVEY

Automated Meter reading approach (AMR) regularly monitors the energy meter and sends data on request of service provider by means of SMS. That procedure used to be allowed to the customers to pay online bill both by credit card, debit card or by means of net banking is defined by the author **Abhinandan jain et al.** [1] who has developed fully automated energy meter having the capabilities of remote monitoring and energy meter controlling.

In paper [2] (2007) **H. G. Rodney Tan et al.** introduced working prototype of GAPMR method which is constructed to demonstrate the effectiveness and efficiency of computerized meter reading, billing and notification by means of GSM network.

Ashna okay, Sudhish N Gorgre proposed procedure [3] which routinely reads the power utilized and sends it to the service provider with using the present short messaging service (SMS).

Tian yew lim and tat Wai chan [4] described a prototype automated meter studying system with use of the power traces and frequency shift keying modulation operated within the EN 50065-1 A Band. The procedure's efficiency and reliability elements are presented by way of them.

M Popa describes an AMR system based on power Line Communications [5]. Smart meters were related through a Lon Work kind industrial bus to the Gateway. In this The Gateway sends messages to meters and reads the accrued understanding. The communication was once, through GSM, with data Acquisition center (DAC) the place data is processed. The data obtained from an energy meter has been stored in database server which located at electricity board station via SMS gate method for additional processing by using energy supplier, provider additional sends electricity charges either via e-mail, SMS or via post.

Power lines [6] are without difficulty to be had and making the full use of them is most fascinating for the energy suppliers. These papers provided an investigation of the LV power line characteristics within the A Band of European Committee for Electromechanical Standardization European Norm (EN) 50065-1 commonplace for implementation of automatic meter reading in dense residential areas.

Ali et al. offered AMR utilizing radio frequency technology [7] supplies electrical utility provider company the possibility to develop operational efficiency, support client services, reduce data assortment costs and speedily collect important data that furnish perception to the organization resolution makers. The present digital electrical meter within the advertising and marketing is upgraded by using including RF module to provide remote communication capabilities.

Progress of an automatic meter reading method based on ZigBee [8], [9] is wireless electrical power administration and manage method. An automatic meter reading system specializing in the design for an energy meter implemented with ZigBee wi-fi conversation protocol conforming to IEEE 802.15.4 standard [9]. The place microcontroller is used to manipulate energy data and ZigBee to permit communication between the power meter and data facilities.

The comfortable mobile agent idea was provided in [10] which inform that energy meters can also be equipped in a group based upon the geographical region. In one region energy meters participate in their jobs beneath a security manager. The thought of local mobile agent is proposed to prevent the visit of external mobile agent to power meters immediately. Local mobile agent consists of the acceptable queries from security manager and visits energy meters. Embedded energy meter is developed in which [11] maximum demand of energy of a consumer will likely be indicated in the meter used by the client. After exceeding the maximum demand, for that reason the connection will automatically be disconnected via an embedded procedure inserted within the meter itself.

III. PROPOSED FRAMEWORK

The smart meter basically consists of transmitter module and receiver module. Here, the two way communication between transmitter module and receiver module is established using ZigBee protocol.

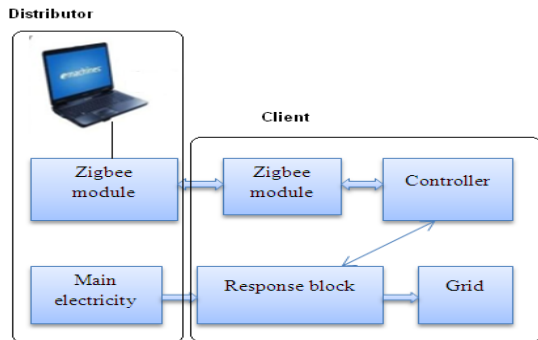


Fig.1 Basic block diagram of smart meter using ZigBee protocol.

ZigBee and IEEE 802.15.4 are standards-based protocols that provide the network infrastructure required for smart meter network applications. Fig.1 shows the basic block diagram of smart meter using ZigBee protocol. Generally, the smart meter consists of electronic meter unit, communication unit and end device switching unit. Here, ZigBee transmitter and ZigBee receiver are used for communication between consumer and electricity provider.

A. Raspberry Pi 3

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processor, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs. The main features of Raspberry pi 3 are [4]

Processor: Broadcom BCM2387 chipset. 1.2GHz Quad-Core ARM Cortex-A53 802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)

GPU: Dual Core VideoCore IV® Multimedia CoProcessor. Provides Open GL ES 2.0, hardware accelerated OpenVG, and 1080p30 H.264 high profile decode.

Operating System: Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT.

GPIO Connector: 40-pin 2.54 mm (100 mil) expansion header: 2x20 strip Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines. view

B. Zigbee:

It is the wireless device for transmitting and receiving purpose or simply it called as Transceiver. Zigbee is based on the IEEE802.15.4 protocol. The range of the Zigbee is covered as 100m. Its range is 10 times better than bluetooth device so it can be more preferable one in wireless device. The data rate is very low for transmission while using this device.

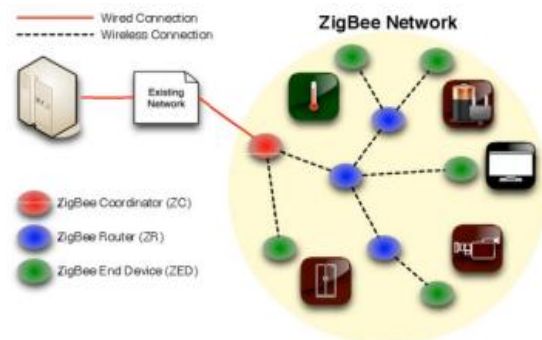


Fig.2. Zigbee network overview

IV. RESULTS AND DISCUSSION

In this study, we document that the supply is single phase to control the end devices. The power supply is linked to the switching circuit block. The switching circuit determines the load operation at peak of supply, so end devices possess the smartness of their operation. The front end GUI for data collection is created utilising VB platform and Microsoft SQL. That is used to store end devices electrical energy consumption at commonplace interval. The front end GUI and the system flow are shown in Fig. 3 and Fig.4.



Fig. 3 GUI for data collection

The current sensors are used to experience the online fame of home equipment i.e. Voltage and present, it presents knowledge to microcontroller for further manipulation. Microcontroller will stage-manage this information and calculate the current utilization fame of home equipment. After this brief manipulation, the microcontroller will ship this information to laptop node, the place additional operation on this knowledge is carried out via right algorithms. The front end GUI will manipulate this information on their database. After large calculation, the microcontroller will switch this data making use of ZigBee transmitter to distributor database, where data is stored in unit interval of time.

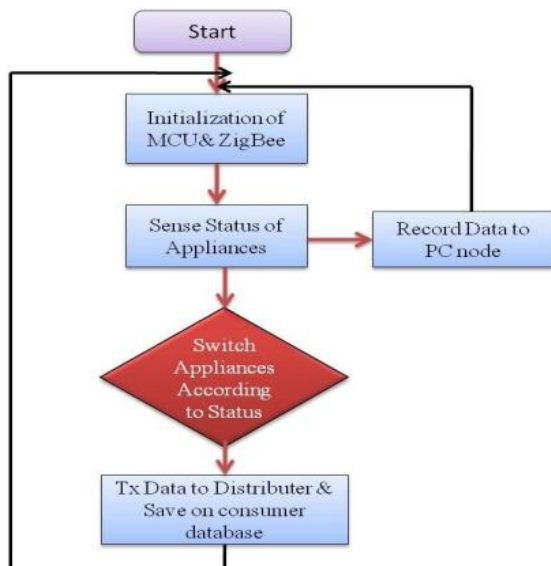


Fig.4. System flow diagram of ZigBee enabled smart meter

The procedure flow is depicted in Fig.5. The switching circuit will care for peak demand of home

equipment. When peak demand of electrical power is stated, then switching circuit routinely reduce off the mains from home equipment. This workflow will control the demand response of electrical energy using ZigBee enabled smart meter. There is no drought that with suitable algorithm and supportive assets, the smart meter shall be the best solution for next century smarter grid and smarter planet.

V. CONCLUSION

Based on all the systems surveyed, their advantages and drawbacks, this paper presents the features that make up an ideal AMR system and provides an overall insight of the various methodologies applied for AMR so far thus providing a base for further research in this area. Although the smart meter proposal is adopted globally, however as per cost point of view, this form of low cost ARM-11 and ZigBee enabled smart meter platform can be a better resolution for traditional grid system. DR process benefits all electrical energy consumers and it changes end-use consumer electricity consumption. This kind of process can grow to be the conventional grid process to a smarter grid approach. Its advantages measure when, scale back the peak load and demand electricity. Aside from this precise transformation, the future of sensible metering will closely rely on the energy policy and the governmental bodies.

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BIODATA



Shekar Boddupally completed M.Tech VLSI System Design.



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