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Power Management, Monitoring And Controlling In Intelligent Buildings Using WIireless Sensor Network (WSN)

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Abstract - *Energy consumtion in the residential sector represents a global average of around 30% of the total consumed in the country, so any advance that could reduce it, would have significant effects. Smart and zip-efficient buildings have recently become a trend for future building industry. The Major challenge in the control organization of rules pattern for such a building is to minimize the powerfulness consumption without compromising the customers comfort. For this purpose, the system principally monitors electrical parameters of household parameters such as voltage and current and subsequently calculates the power consumed. The novelty of this system is the effectuation of the controlling mechanism of appliances in different ways. The developed system is a low-cost and flexible in mathematical operation and thus can save electricity expense of the consumer.*

Key Words: *Energy management, home automation, intelligent control system, wireless sensor network, ZigBee.*

1.INTRODUCTION

IT is foreseen that service and personal care wireless mechatronic systems will become more and more ubiquitous at home in the near future and will be very useful in assistive healthcare particularly for the elderly and disabled people. Wireless mechatronic systems consist of numerous spatially distributed sensors with limited data collection and processing capability to monitor the environmental situation. Wireless sensor networks (WSNs) have become increasingly important because of their ability to monitor and manage situational information for various intelligent services. Due to those advantage, WSNs has been applied in many fields, such as the military, industry, environmental monitoring, and healthcare.

The WSNs are increasingly being used in the home for energy controlling services. Regular household appliances are monitored and controlled by WSNs installed in the home. New technologies include cutting-edge advancements in information technology, sensors, metering, transmission, distribution, and electricity storage technology, as well as providing new information and flexibility to both consumers and providers of electricity.

It is normal that 65 million family units will equip with smart meters by 2015 in the India, and it is a practical evaluation of the extent of the home energy administration market. There are a few proposition to interconnect different household machines by remote systems to screen and control. The models are verified utilizing testbed situations. Additionally, keen meter systems have been intended to specific uses especially identified with topographical uses and are restricted to specific places. Distinctive data and correspondence advances coordinating with savvy meter gadgets have been proposed and tried at various flats in a residential area for optimal power utilization however individual controlling of the gadgets are restricted to specific houses.

Moving towards the smart energy management will require changes not only in the way energy is supplied, but in the way energy market requires two types of zigbee networks for device control and energy management. These include neighborhood area networks for energy, using ZigBee for subenergy within a home or apartment, and using ZigBee to communicate to devices within the home.

The proposed approach is a low cost solution that overcomes these limitations with a new efficient data management system and identification algorithmics that allow a fully integration of any appliances and sensors in the home control network. It consists of a smart sensing unit, wireless sensors and actuators, a web-based storage system and a user interface for remote and mobile applications. The flexibility and configurability characteristics of our system are two important key points for users, beyond of the low power consumption and system portability.

2. RELATED WORK

Suryadevara et.al., proposed The pattern and maturation of a smart monitoring and controlling system for household electrical appliances in real time has been reported in this paper. The system principally admonisher electrical parameter of household appliances such as voltage and current and subsequently calculates the tycoon consumed[1].

M. Erol-Kantarci et.al, evaluated the performance of an in-home energy direction (iHEM) application. The performance of iHEM is compared with an optimization-based residential energy management (OREM) system,

whose objective is to minimize the energy disbursement of the consumer . Which shows that iHEM decreases energy expenses, reduces the contribution of the consumer to the peak shipment , reduces the carbon copy emission of the household, and its rescue are close to OREM[2].

L. Li, H. Xiaoguang et.al., recommended the system proposes new character of network architectures for the new generation AMR arrangement, and researches its protocol and analysis situs optimization of cluster formation. The recomended system of the body of work of the key technology of the WiFi-based WSN has important significance to the world technology evolution of Internet of Things and the Smartness Grid. Basing on the study of WiFi-based WSN [3].

D. Man Han et.al., introduces smart dwelling house interfaces and twist definition to allow interoperability among ZigBee devices produced by various manufacturers of electrical equipment , meters, and smart Energy enabling products. This system introduced the home energy ascendancy system of rules design that provides intelligent services for users and demonstrate its implementation using a real testbad [4].

Dr. V. N. Kamat,. demonstrated the use of smart LT apparent get-up-and-go m for effective step-down in ATC passing. The technical component is reduced through the implementation of a fair apparent energy based tariff . The use of smart meter to eliminate pilferage of energy from overhead LT lines is also covered in this system [5].

J. Han et.al., the proposed Hem system provides easy way to add, delete, and move family devices to other baron sales outlet. When a home device is moved to the different outlet, the energy data of the home device is kept consistently and seamlessly regardless of location modification. The proposed architecture gives more efficient energy-saving HEMS[6].

K. Gill et.al., the proposed system provied a ZigBee based home automation organization and Wi-Fi network which are integrated through a park home gateway.The home gateway provides network interoperability, a simple and flexible user interface, and remote access to the system.This theme identifies the rationality for this slow adoptionand evaluates the potential of ZigBee for addressing these problem through the design and implementation of a flexible home base automation architecture [8].

G. Song et.al., presents the design and implementation of a home monitoring arrangement based on hybrid sensing element networks. The system follows a three-layer architecture which trust hybrid-node networking with web access. An enhanced detector node has been designed and fabricated to minimal brain dysfunction controlled mobility to wireless sensor networks [9].

C. Suh et.al., proposed intelligent place dominance system divides and assigns various home network tasks to appropriate components. It can integrate diversified physical sensing selective information and control various consumer home appliances, with the support of active sensor networks having both sensor and actuator components [10].

W. Huiyong et.al., examines the possibility of integration WSN and the overhaul robot into a smarting home application. The service robots can be considered to be mobile nodes that provide additional sensing element ial entropy, improve/fixture the connectivity and collect information from wireless sensor nodes [11].

N. K. Suryadevara et.al., developed scheme for monitoring and evaluation of necessary daily activities was tested at the homes of four different elderly persons living alone and the results are encouraging in determining wellness of the elderly[12].

3. SYSTEM DESCRIPTION

The system has been intended for estimation of electrical parameters of family unit apparatuses. Critical capacities to the framework are the simplicity of demonstrating, setup, and use. From the purchaser perspective, electrical power utilization of different apparatuses in a house alongside supply voltage and current is the keyparameter. Fig.1 shows the utilitarian depiction of the created framework to screen electrical parameters and control machines taking into account the customer prerequisites.

The estimation of electrical parameters of home machines is finished by interfacing with created detecting modules. The subtle elements of the configuration and improvement of the detecting modules are given in the accompanying segments. The yield signals from the sensors are incorporated and associated with XBee module for transmitting electrical parameters data wirelessly. The XBee modules are interfaced with different detecting gadgets and interconnected as cross section topology to have dependable information gathering at a unified ZigBee facilitator. The greatest separation between the adjoining ZigBee hubs is under 10 m, and through bouncing procedure of the lattice topology, dependable sensor combination information has been performed

The ZigBee co-ordinator has been associated through the USB link of the host PC, which stores the information into a database of PC framework. The gathered sensor combination information have been sent to a web private entryway for remote observing and controlling the home environment. By breaking down the power from the

system, energy utilization can be controlled. The apparatuses are controlled either consequently or physically (neighborhood / remotely). The smart power metering circuit is associated with mains 240 V/50 Hz supply.

1. Block Diagram Of The Proposed System

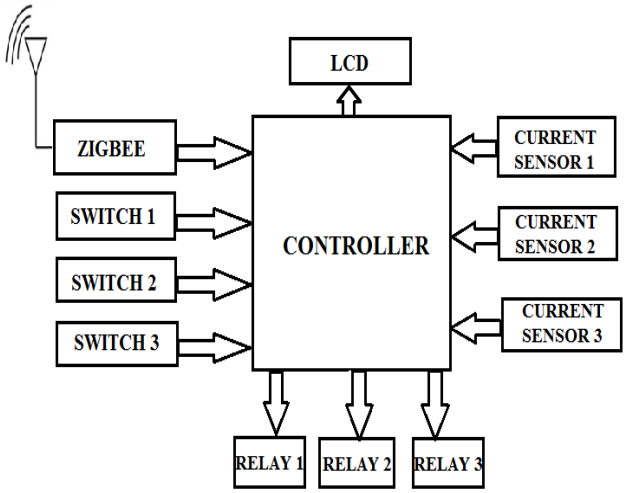


Fig. 1. Functional block diagram of the transmitting system.

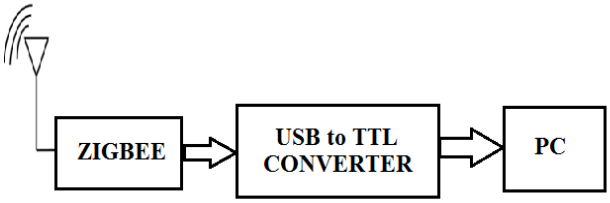


Fig. 2. Functional block diagram of the receiving system.

2. Measurement of Electrical Parameters

1) Voltage measurement: The scaling of the input is obtained from the input and output voltage graph. The actual voltage is thus obtained as follows:

$$Vact = m1 \times Vmeasured\ voltage \quad (1)$$

where m1 is the scaling factor obtained, Vact is the actual voltage, and Vmeasured voltage is the measured sensing voltage.

2) Current Measurement: For sensing current, we used ACS712 Hall Effect Base Linear Current Sensor. This design allow system designers to monitor any current path without breaking or changing original system layout at all. Any current flowing through this hole will generate a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage.

3) Power Measurement: In order to calculate power of a single-phase ac circuit, the product of root mean square (RMS) voltage and RMS current must be multiplied by the power factor

A. Residential IP Gateway: Transmission Over IP

In order to transmit real-time sensed data over the internet from the collected computer system, the ZigBee packet information is to be transformed to the Internet Protocol Version 6(IPv6). The key element in the data transformation from ZigBee packet is the address translation. This was implemented at the application gateway, a program for determining the source or destination address of a packet that encapsulates a ZigBee packets' payload.

The software used on the internet gateway to transmit data globally is the µVision development platform is easy-to-use and helping you quickly create embedded programs that work. The µVision editor and debugger are integrated in a single application that provides a seamless embedded project development environment. Keil Uvision4 is editor as well as compiler also. It provides us platform to write, edit, debug our code. Compiler is built in which will convert that embedded c code into hex code.

B. Storage of Data

The ZigBee packets delivered at the passage embody test information to be sent to windows based web server. An application on the server gets bundles on a self-assertive port and stores the pertinent data out of sight of MySQL database in the PC.

The database table store data, for example, source address, time, source channel, and sense information. Columns are added to this table for every bundle got. This permits tests to be sorted by time, sensor hub, and sensor channel. In the present framework, programs for location, bundle changes, and information transmission are composed utilizing "Java" programming , programs for parcel gathering and information stockpiling are composed utilizing "Eclipse," and Web interface is produced in eclipse Java Scripts.

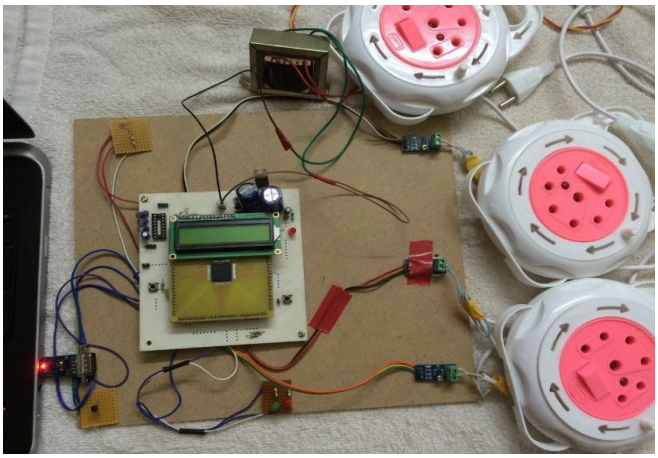


Fig.3: Developed system

4. EXPERIMENTAL RESULTS

The model is in operation in a trial home with different electrical machines frequently utilized by a tenant. The accompanying machines were tried: TV, drill machine, battery chargers, utilized as a part of the test setup; be that as it may, any electrical apparatus whose power utilization is under 1500W can be utilized in created framework.

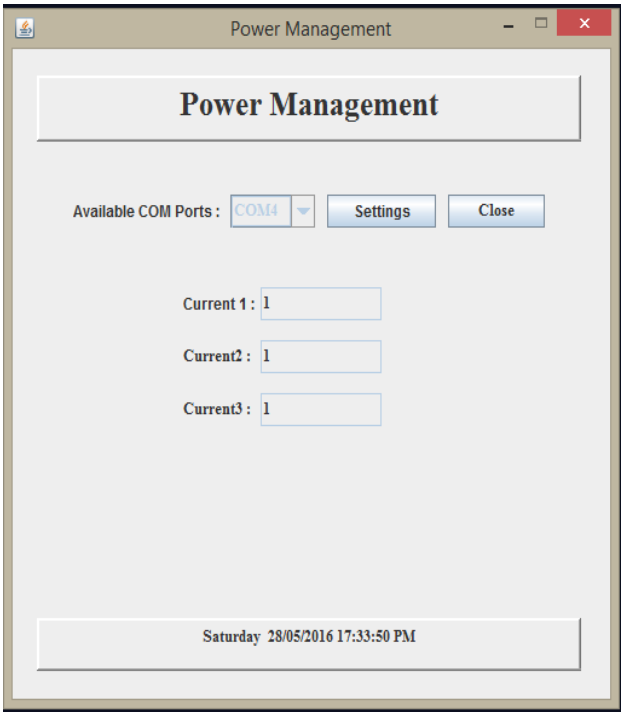
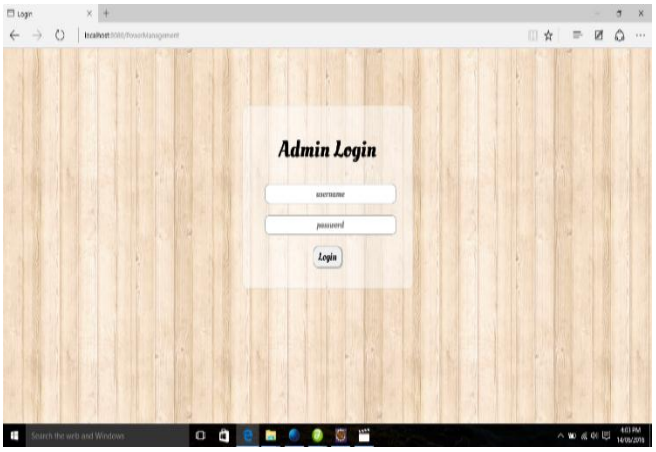


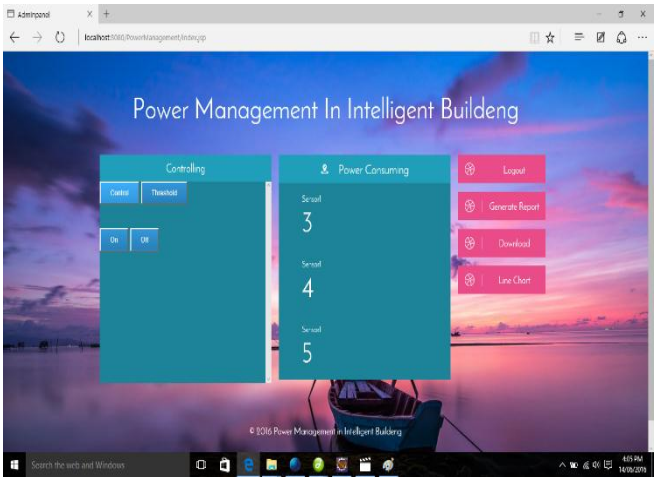
Fig.4: Graphical user interface of power monitoring and control system at the intelligent buildings.

By observing utilization of power of the machines, information are gathered by a smart organizer, which spares all information in the developed system for preparing and in addition for future use. The parameters will be entered in the information organizer in programming from apparatuses incorporate voltage, current, and power. These parameters will be put away in a database and dissected. Gathered information will be shown on the PC through graphic user interface (GUI) window so that suitable move can be made from the GUI.

The obtained voltage, current, and power qualities are shown on the graphical user interface running on a PC. The prepared information are exact and easy to use. The detecting framework in the sensor hub measures the parameters (voltage and current). The raw information are transmitted to the organizer. The PC then gathers the information from the organizer and procedures them. The PC then applies the fundamental recipes to get the real voltage, current, what's more, power utilization of the electrical apparatuses. The voltage what's more, current readings are prepared utilizing Java programming.



(a)



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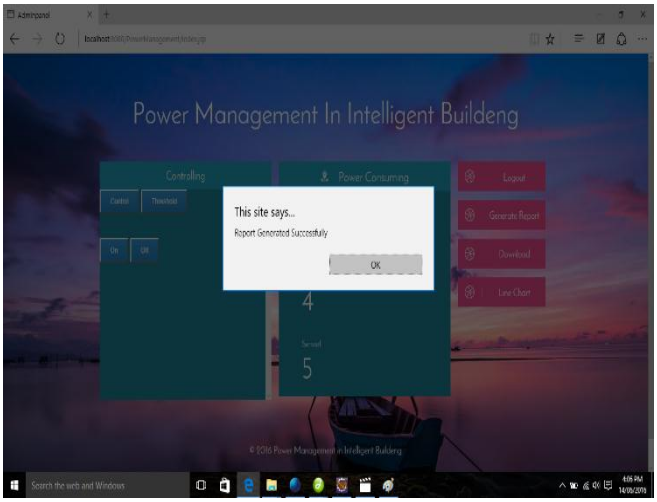
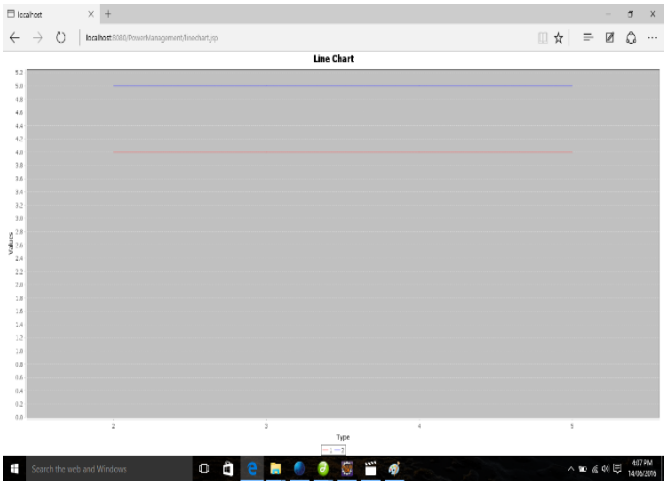


(c)



(d)

Fig. 5. (a) Admin login page on website. (b) Website (localhost:8080/powermanagemnent/index.jsp) displaying the real-time information (power consumption of appliances). (c) Website (localhost:8080/powermanagemnent/index.jsp) downloading the real-time information of power consumed in Excel sheet. (d) Downloaded Excel sheet information in line chart.

Here the hardware sends all the sensor values to the database i.e to MySQL. The fig 5(a) is the admin GUI login page on website which is prepared with the help of java script. In that login page we can assign the user name and password. The fig 5(b) is the website page which is displayed after the login id and password and shows the real time power consumption information of the devices connected to that sensors. The hardware sensor output values displayed on this website is in the form of power consumed.

The daily power consumption data is stored at the backend of the website in excel format, and that data can be generated by using generate data command on the website, the generate report sends the request to the database after which it selects the appropriate directory of excel and generates the excel sheet, and that same data can be downloaded by command download which is shown in the fig 5(c). This whole information of data usage of power consumption can be graphically represented by using line chart. Line chart sends the request to the database and it provide the detailed power usage, which gives graphical chart. This chart can be downloaded by using line chart command which is shown in fig 5(d).

CONCLUSION

A smart power monitoring and control system has been planned and created toward the usage of a intelligent building. The developed framework adequately screens and controls the electrical machine utilizations at an elderly home.

Thus, the constant checking of the electrical appliances can be seen through a site. The system can be stretched out for observing the entire intelligent building. The system intend to decide the zones of day by day peak hours of power use levels and accompany an answer by which the system can bring down the utilization and improve better use of effectively restricted assets during peak hours.

The sensor systems are modified with different client interfaces suitable for clients of fluctuating capacity and for master clients such that the system can be kept up effortlessly and connected with essentially.

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