Design of Real time E-metering using Residence Energy Control System (RECOS) and IOT Based Hostel Automation using LAMP Web Technology

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Abstract- *Hostel Automation is the technology stemming from web of things. To make a smart Hostel to provide comfort for human life is the main focus of the world. In the current automated industry Embedded systems and IOT (Internet of Things) is becoming highly efficient and mandatory to exhibit the potential market. While performing various operations, power consumption and efficiency is an important issue with the comfort level of user. The combination of embedded technology and IOT is represented by using E-controller which is the apt one for system's power consumption and efficiency experiments with size factor. The main objective of the system is real time information data monitoring of energy consumption. The paper introduces the implementation of IOT using embedded chips technology to simplistic the peripheral circuit and to lower the power consumption, thereby providing a high quality solution for a Smart Hostel Management and Information system (HMIS).*

Keywords- Internet of Things (IOT), E-controller, E-metering, Web application, MQTT protocol, Asp.Net, LAMP Web technology.

I. INTRODUCTION

IOT is one of the platforms of today's smart Hostel and management systems. IOT makes people and things to get connected at any time and place, with any device and person, ideally using any network and service. The vision of IOT has evolved due to a convergence of multiple technologies like wireless communication to internet, Machine-To-Machine (M2M) communications, embedded and web technology. IOT is based on three types of integrations: Things integration, Data (Internet) integration and Semantic integration,

- Things integration provides the perspective that real time information is obtained by attaching the sensors with real physical objects.
- Data integration provides the perspective that the entire device can be connected though internet and can be described as smart objects.
- Semantic integration provides the perspective that all the data collected from sensors need to be analyzed for interpretation.

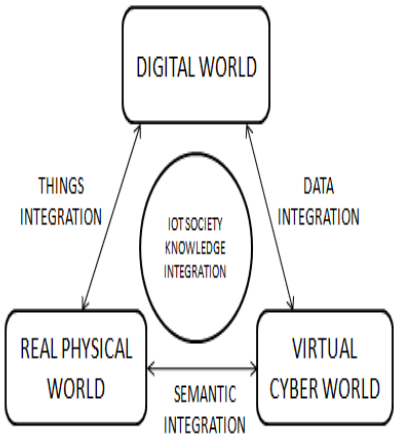

Figure 1. IOT Integration

II. LITERATURE REVIEW

In large data centres and server farms energy is a major problem. In such cases, Microcontroller which consumes low power can also be used as embedded web server [1]. Using many different communication technologies a smart Hostel system is built, providing a stable, reliable and a very practical system [2]. The greatest issue in smart Hostel automation is that all the sensors that are used belong to different manufacturers. It results in a proliferation of incompatible protocol standards used by various company vendors, which makes the smooth integration of different appliances a very critical process [3]. The best way to combat this problem is to connect all hardware appliances via Internet. A software system implements HTTP protocol and an embedded web server is a component of it. The size of the embedded web server greatly depends on the software system [4]. Generally the limited memory capacity of an embedded device is no more than several megabytes. The system is capable of predicting the real time needs of users. This automated control system optimizes the Hostel network environment and reduces the total number of working devices, thus improving the efficiency of the Hostel network of communication and the energy consumption of the Hostel-networking equipment and can also effectively maintain the Hostel-networking equipment performance and stability [5].

III. PROJECT OBJECTIVE

A. To reduce Power, Energy and Memory consumption in the web applications.
B. To create a web application for making easy energy metering.
C. To make Hostel automated and intelligent and provide comfort to every user.
D. To make the application real time so that the user can monitor real time data and takes a particular action.

IV.WORKING METHODOLOGY

Heart of the project is microcontroller which is controlling the entire device. It contains a server which is having a web application working as a cloud application where we can monitor and control the devices connected to it. The sensor will acquire the data from its surrounding that is the different types of sensors used in the module will sense and gather the data with current status from the respective module. Temperature is used to measure the temperature of the rooms in Hostel. LPG gas sensor is used for the detection of gas leakage. LDR (Light Dependant Resistor) is used to monitor the illumination of a light on it terms of resistor value. Data is sent to the controller. Controller sends the data towards web server using MQTT protocol. Data is then stored into Cloud database. Data is displayed on the web page with current status of devices. Updation of status makes the updated value to be sent to the database and the database gets updated. Updated values are then sent to the controller to control using MQTT protocol. Controller receives commands and performs the action of controlling devices.

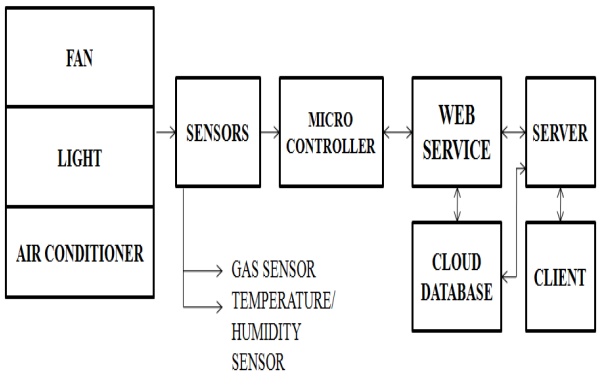

Figure 2. Block Diagram

In the proposed system the user can login and monitor the usage of electricity in Hostel rooms as well as can control the devices (Hostel appliances). BEST, TATA Power, MSEB, Reliance are various energy providers that can use the same application for service management and controlling. All the sensed data and the values to be updated are stored in SQL database, which is provided by web services to the application.

V. SYSTEM IMPLEMENTATION

Sensors, Microcontroller, Wi-Fi Modem and Current sensor as an energy meter forms the hardware part of the system. The software part includes the SQL database and working of cloud application with the help of Asp.Net framework in Embedded C programming language.

VI. HARDWARE DESIGN

A. Temperature sensor (LM 35)

The LM 35-series devices are high precision temperature sensors and their Vout is linearly proportional to the centigrade temperature. The main advantage of this device is that the user need not subtract a large constant voltage from the output to obtain the required centigrade scaling. Temperature and humidity sensor is used to control the fan speed and provides the best accuracy for temperature and humidity measurement when compared to other sensors.

B. Gas sensor (MQ6)

MQ6 sensor is used for the detection of gas leakage. Once a gas leakage has been sensed, it immediately sends an e-mail to the user through the web application. It is a 6 pin sensor module which operates on a supply voltage of 5v and consists of a heating element inside it which turns hot at 5v and remains stand by. When gas molecules in the range of 100-1000 ppm has been sensed then its output switches from high to low and the transistor triggering initiates the buzzer to activate.

C. LDR

Light Independent Resistor consists of two cadmium sulphide photoconductive cells (cds). The spectral response of LDR is similar to that of the human eye. The resistance of the cell falls with the increasing light intensity. Smoke detection, Automatic lighting control system, Batch counting and Burglar alarm systems are some of its applications. The main advantage of LDR is that they have the property to store the lighting conditions in which they have been stored. Light storage reduces the equilibrium time to reach steady state resistance values.

D. Current sensor module (ACS712)

ACS712 acts as an Energy meter to calculate the total current consumption. It operates on a supply voltage of 5v. The current sensing terminal provides analog outputs which is proportional to the current measured. Sensing terminal can measure current up to 5A/15A for high voltage loads with output sensitivity in the range of 185mv/A.

E. Microcontroller (C8051F340)

The microcontroller belongs to MCU family with 32-Pin LQFP type package having high speed when compared to 8051 microcontroller. The core provides up to 50 MIPS throughput, 768 Bytes of on-chip RAM, 8k Bytes of Flash memory, 2.7v operating voltage and supply current is 5.8mA at 25MHz and 11mA at 32 kHz respectively.

VII. SOFTWARE DESIGN

A. Cloud application

Cloud application is an internet-based computing web application which shares resources and data to computers and other devices on demand. It is a pervasive model, providing a global access to a bunch of configurable computing resources (E.g., computer networks, servers and storage). It can be furnished and released with minimal management effort. Using the cloud application the user can store and process their data in data centres that may be located far from the user. In the project, every user has an own E-meter with a randomly generated password code. It will be send to the registered email id from the web portal id "smartHostelportal@gmail.com". The user can login and control their smart Hostel by using the meter number and password.

B. MQTT Protocol

MQTT protocol has many advantages when compared to HTTP protocol. It is a protocol with faster response output, lower battery and low bandwidth consumption. Enterprise level applications are worked efficiently by assuring accurate data transmission and distribution. It is also called as publish and subscribe protocol. It is a light weight and open standard protocol which is the most suitable for constrained environment.

C. System flow

A System Context Diagram (SCD) defines the barrier between the system and the system's environment, showing the entities interacting with it. The application works on the precept of "Ternary Structure Context Model", consisting of Simple Monitoring, Automatic Controlling and User centric services.

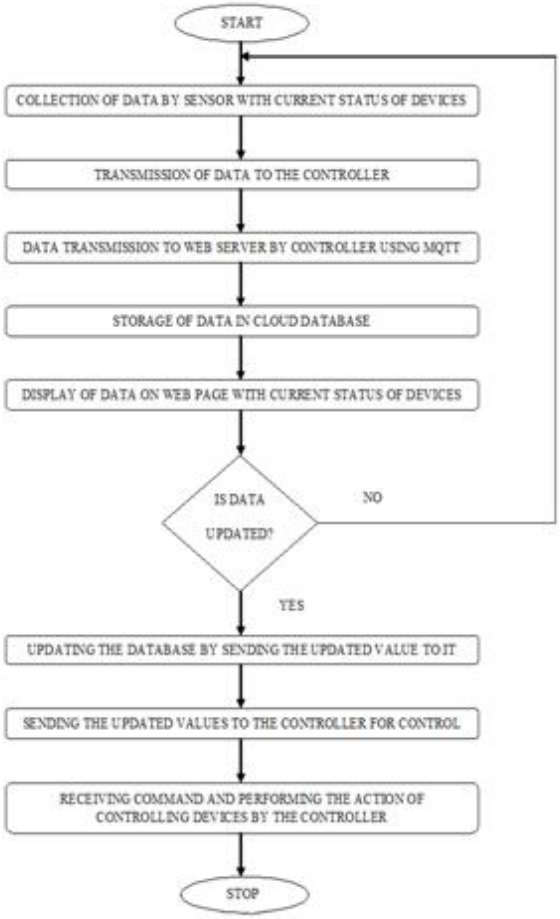

Figure 3. System flow

VIII. PERFORMANCE ANALYSIS

A. Hostel Page

Hostel page displays urgent notice and alerts. Consumed energy charges and online bill payment can be viewed here.

Figure 4. Hostel Page

B. Admin Login Page

Admin Login page displays c_id, Meter no., Name, Email and Phone no. of the user. It also provides "Add new customer" and "Complaint Box" options.

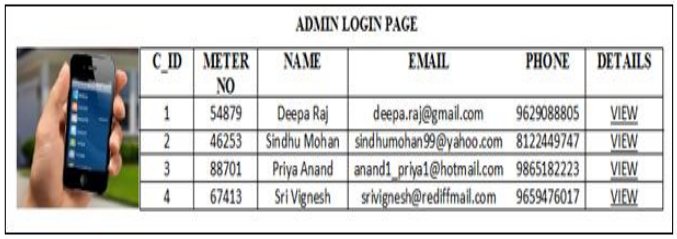

Figure 5. Admin Login Page

C. Smart Hostel Facility

Smart Hostel facility shows five control buttons to control the parameters such as fan, fan speed, light intensity, bulb status and gas sensor status.

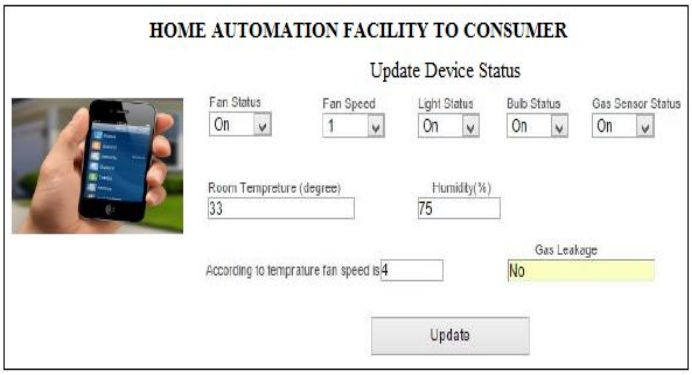

Figure 6. Hostel Automation Facility to Consumer

D. Current Energy Consumption

Current energy consumption and bill section shows the total amount of energy consumed and the bill of the user.

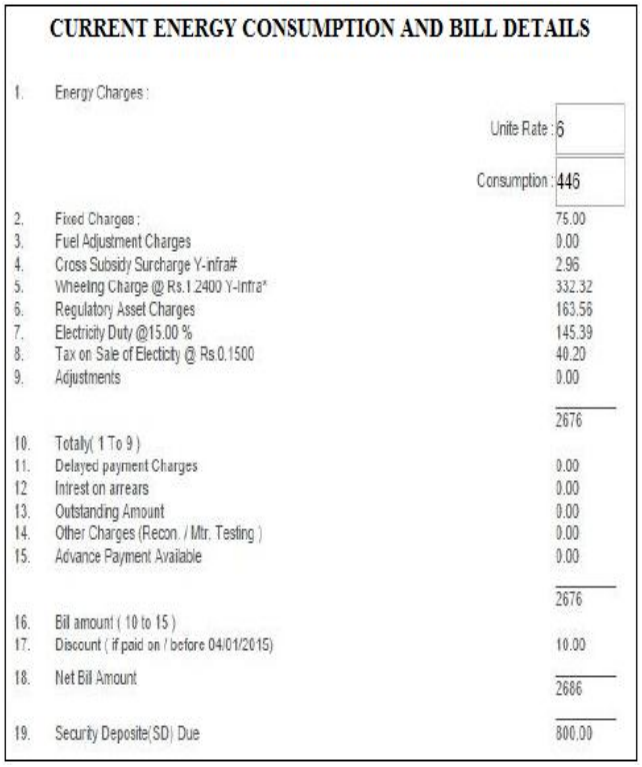

Figure 7. Current Energy Consumption and Bill details

E. Updated Energy Consumption

Updated energy consumption section displays the values that are updated. Usually the values get updated in 5-10 seconds.

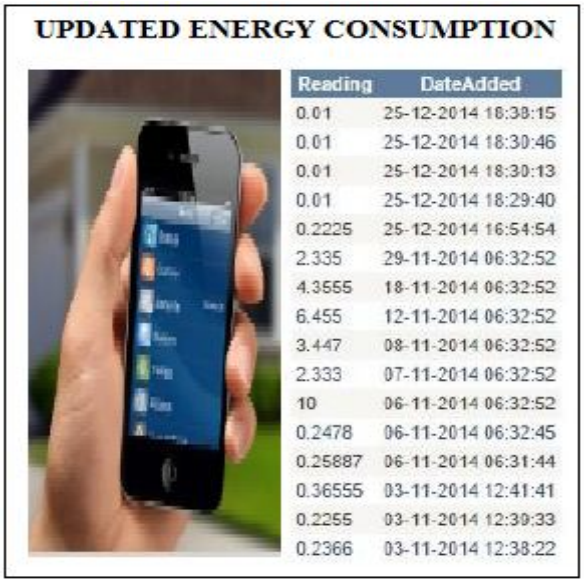

Figure 8. Updated Energy Consumption

F. Energy Consumption Graph

Energy consumption graph facility is made available for the user to get aware of their energy consumption monthly/yearly.

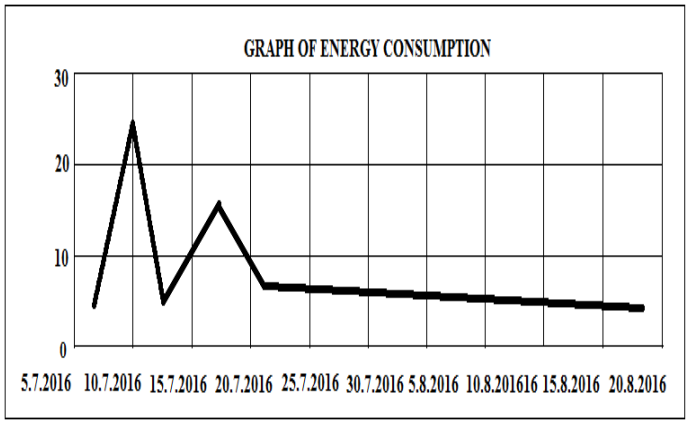

Figure 9. Energy Consumption Graph

IX. CONCLUSION

The paper reviews an automated system playing a dual role of Hostel automation and real time energy controlling. The system uses an industrial purpose microcontroller, consuming less power when compared to servers there by providing comfort to the users. Based on the up-and-coming technological advances, it seems that a fully functional smart Hostel is to be expected in the very near future. Definitely it will take a long time for the people to completely leave their entire responsibility up their Hostel's system, but in the long run it will surely be incredibly beneficial for not only comfort but also for energy efficiency, utility cost reduction, Hostel safety and security.

REFERENCES

[1] Navid Mohaghegh and Mokhtar Aboelaze, "Using Low-Power Embedded Microcontrollers as Web Servers", 10th IEEE International Ssymposium on Parallel and Distributed Processing with Applications, 978-0-7695-4701-5/12 2012 IEEE.

[2] Yongen Liang and Shiming Wan, "The Design of Smart Hostel Control System", 5th ICCCNT – 2014 July 11 – 13, 2014, Hefei, China.

[3] Lei Yu, Yang Lu and Xiao Juan Zhu, "Smart Hostel based on Internet of Things", Journal Of Networks, vol.7, No.10, October 2012, Page No.1-8.

[4] Zhang Xi-jun, "Design of the Embedded Web Server based on Linux", Wireless Communication Technology, China, vol.3, pp. 44-47, 2010.

[5] T.Yashiro, S.Kobayashi, N.Koshizuka and K.Sakamura, "An internet of things (IOT) architecture for embedded appliances", Humanitarian Technology Conference (R10-HTC), 2013, pp. 314-319.

[6] Jean J.Labrosse, "MicroC/OS-II The Real-Time Kernel (Second Edition), Beihang University Publishers, Peking, pp. 283-317, 2003.

[7] Kenneth D. Reed, Introduction to TCP/IP, WB47.0, Publishing House of Electronics Industry, Peking, pp. 197-317, 2005.

[8] BAO Yujun, Software basis of computer, Dongnan University Publishers, Nanjing, 211-219 (2008).

[9] N.Mohagheh, "A green cluster of low-power embedded hardware server accelerator", Dept. Of Computer Science and Engineering, York University, Sep 2011.

[10] Apache Software Foundation, "Apache HTTP server benchmarking tool" located at http://httpd.apache.org/docs/2.0/programs/ab.html, March 2012.

[11] M. Ghazy, N. Mohaghegh and M. Aboelaze, "Controlling the response time of a web server", Proceedings of the International Conference on Internet Computing ICOPM2011, Las Vegas, NV. July 2011.

[12] Wu Guanglin, Bai Ruilin: Based on the platform embedded Web server of the design and realization of the [J], Computer engineering, 2011, 31 (18): 216-219.

[13] Zhou Zhiguang, Based on the information Hostel appliances of the design and realization of the embedded TCP/IP protocol [J], Micro computer information, 2010 (6-2):-56.

[14] Liu Zhijie, Zhang Huazhong, Chan Xiaolan: Based on embedded Web of remote real-time monitoring technology research [J], Computer engineering and design, 2007, 28 (15): 3734-3736.

[15] Yuan Yao, Yaping Dai and Lunlun Ma, "Design of an E-experiment platform in E-Laboratory," 2012 International Conference on Computer and Information Science, Safety Engineering (CAISSE 2012).