A Smart Home Automation and Metering System using Internet of Things (IoT)

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***Abstract*—Internet of Things (IoT) is an augmentation of existing internet facility to deliver communication, connection and internetworking between various devices and physical objects also known as "Things". Accessibility of great speed internet makes it possible to switch and control numerous kinds of devices very easily. This paper discussed a smart low-cost home automation system which is designed using IoT. With the help of this system, all the home appliances and electronic machines can be controlled and observed through a website very easily. The metering method of a home can also be supervised using this system. Not only the consumers but also the dealers will get the opportunity to observe the anomalies of the power distribution system by watching the metering system. Online billing system also included in the designed system.**

Keywords— Arduino, home automation, internet of things (IoT), metering system

I. INTRODUCTION

Enhancement of technology makes the human daily life easier with the help of newly developed smart systems. Due to the rapid development of internet technology and smart embedded systems, people are more interested to involve in using the internet to control and observe different types of devices. Internet of things (IoT) creates a innovative evolution of the technology world with a new era of mature intelligence computing [1][2]. IoT can be defined as the connection between many kinds of devices like smartphones, personal computer, and tablets to the internet, which brings in the very new kind of communication between things and people and also between things [3]. The key goal of IoT is to control any kind of electric objects or devices around us in a more easy, evocative and smooth manner [4]. IoT helps to improve the prominence of electric devices by confirming cost-effective living with protection, safety, and entertainment. IoT technology is used to come in with a pioneering idea and great growth for smart homes to improve the living standards of life [5].

In recent years, the concept of a smart home is a growing interest among consumers. There are lots of research going on home automation involving IoT. S.H. Hussain *et al.* developed a smart home system with high security and low implementation cost using IoT [6]. K. Mandula *et al.* proposed an IoT-based home automation using low-cost Android phones in the Indian context [5]. J.J Padmini developed a system using IoT for power utilization and conservation in smart homes. In this system, they used an image processing system to recognize human activities [7]. N. David *et al.* designed a home automation system that can control different household devices with the help of WiFi and GSM technology [8]. Though there are other researches are going on, still, there is the scope to improve this home automation system using IoT.

In this paper, authors proposed a system for home automation and metering system. A website is designed, by using that home appliance and other electronic devices can be controlled through a website. Moreover, the metering system can be monitored with the help of that website. The online billing system is also included in the system. The proposed system architecture is discussed in Section II and the action of the system is covered in Section III. Finally, the paper is resolved in Section IV.

II. SYSTEM ARCHITECTURE

The block diagram of the system is shown in Fig. 1. In this system, a website has been designed. Initially, the user accesses that website (*http://ha.dcoders.net*) from where he or she will send a command over Internet. Then, the command will be received by the microcontroller via a Wi-Fi unit. After that, according to the command sent by the user the electronic devices can be operate. The structure consists of both way communication which is shown in the Fig. 1. The first is to control the devices using the website, as previously depicted, The latter one is, from the website the user can get a knowledge of the power consumption by the devices as the meter reading can be obtained directly from the website. That funds that the devices will send the power consumption data to the website using a microcontroller over WiFi. From the website, the user can perceive the meter reading and the billing information.

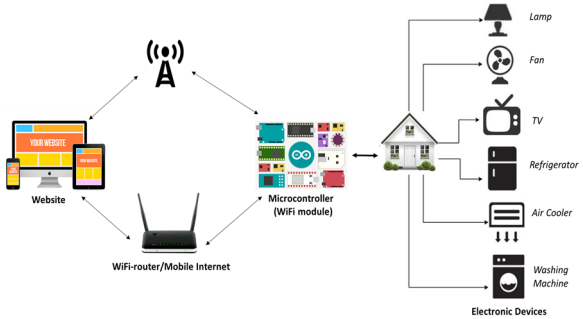

Fig. 1. System Architecture.

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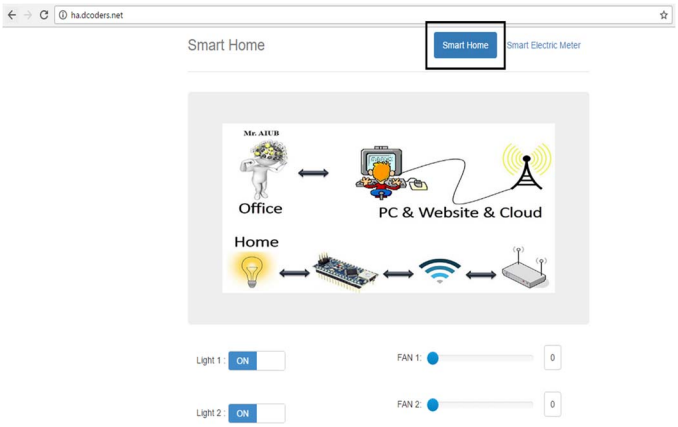


Fig. 2. Website Image for Smart Home.

The image of the website is given in Fig. 2. The user should select the option *smart home* at first. Then the user will be redirected to the page from where the home appliances like fan, light, TV, air cooler, washing machine etc. can be controlled.

In the Fig. 3, the hardware picture for smart home is shown. The hardware consists of a microcontroller (Arduino Pro Mini), Wi-Fi module (ESP8266 Wi-Fi chip), relays and an LCD. From the LCD, date, time, temperature and the device condition (ON/OFF) can be observed. The date, time and temperature are real-time data that means all these data are collected directly as well as observed from the internet.

In Fig. 4, another part of this system is shown, which is a meter reading option of the system that means the power consumption of the devices and the billing information. After accessing the website, the user needs to select the *smart electric meter* option to enable the metering option. For a specific user, a meter number will be given.

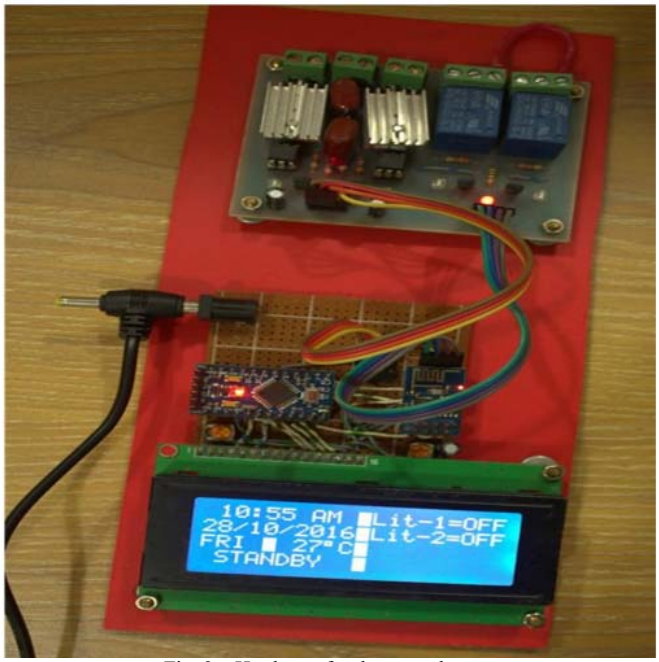


Fig. 3. Hardware for the smart home.

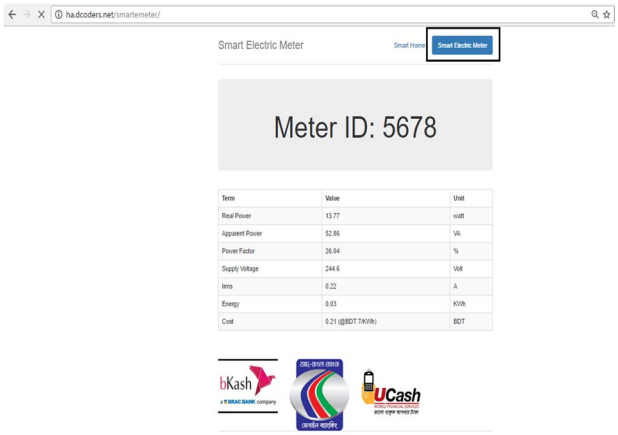


Fig. 4. Website Image for smart meter reading.

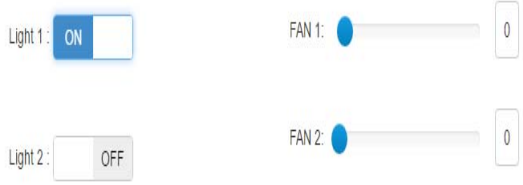
From where the user can get the information about the real power, power factor, apparent power, supply voltage and energy consumption by the devices. Moreover, the user can get the billing info from the website also. The website is refreshed every three seconds so that user can get the latest update of his meter reading. Only 3 Kb/s data has been used during this refresh. Therefore, the user doesn't have to use a large amount of internet data.

III. Operation of the System

The operation of the system is very simple. From Table 1, the operation of a smart home can determine. In the website, there will be several options to control or to turn on and off the devices used in home appliances. As shown in the table, if any user wants to turn on the device he or she just has to click the OFF option. Then the device will be turned on and from the LCD we can get the confirmation that the device is turned on. Applying the same procedure a user can also turn off the device. From Table 1, it also determined that there are options, FAN1 and FAN2. And this option consists of a scroller bar. By this option user can control the speed of the fan, it's like the regulator of the fan. If the user wants to turn off the fan he/she has to move the scroller to 0 so that the speed is null. If the scroller moves to the middle the value will show in the website 50. Means, the fan is moving at half speed. The fan will move at full speed when the value is 100. Following these steps, all the home appliances can be controlled via the website.

The second operation of this system is to get the meter reading and the billing data. As shown in Fig. 4, the user can get the meter reading means the energy rating from the website. Sometimes due to the carelessness of the meter reader, the electricity bill becomes very high for a user. Again, sometimes due to some unfair meanings by the meter reader the supplier of electricity gets less money, as the meter reader does not provide correct meter reading. This system prevents both of these situations. As the consumers are getting the information of energy used by them and also the billing information, it's not possible for a meter reader to give a wrong meter reading, hence, the former problem can be solved. Moreover, the supplier can get the information about energy consumption by the user through the website.

TABLE I. OPERATION OF THE SYSTEM

Serial	Web Page	Device
1		
2		
3		
4		
5		

Therefore, no need to depend on the meter reader. Hence, the latter problem can also be solved. Sometimes people use other people's electricity line without their permission. People can easily find out whether there is any discrepancy on their line as they are always up to date about their power consumption.

It's also applicable to the suppliers. They can identify whether any user taking any illegal electricity line by observing the real power, apparent power, and energy consumption. Another main advantage of the designed system is consumers can pay their electricity bill directly using the website by observing their meter reading.

Controlling the power factor is one of the major issues for industrial users. There are some rules that industrial users have to follow based on power factor. According to the rules, the power factor of an industrial user must higher than a specific value. This value is set up by the authorities. As the power factor value also can be determined from the websites the concerned authority can keep an eye on the industrial users also and take action if necessary.

IV. CONCLUSION

In this paper, a smart home automation system along with metering system using internet of things is presented. The main goal of the paper is to control the home appliances as well as electronic devices through the website. The user interface of the website is designed in a very simple way and everybody can access it. With the help of this website not only the user can control and monitor the electronic devices but also can observe the metering system. The supplier of electricity also can monitor the metering system and are able to find out whether there is any discrepancy in the distribution system. The website also can be used to pay the electricity bills through online.

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