Energy Management using Android Application

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Abstract

The paper introduces a system by which we are capable of controlling the usage of electricity to a greater extent. In this system the customer is able to know about the per day consumption of electricity. It also informs the user if any intruder breaks in or about gas leakage while the user is away from the household. In this, we use PIC 16F877A microcontroller, in order to calculate the per day consumption, also a relay network is used to control the appliances/devices connected to it. The presence of intruder and gas leakage is noted with the help of sensors attached with the module. The module as a whole performs automation of home.

Keywords: Energy Management, PIC 16F877A microcontroller

I. INTRODUCTION

Life without electricity is neither possible nor could be dreamt of. Nowadays, there is a lot of wastage of electricity due to lack of awareness and carelessness. The traditional energy meters are not user friendly, also it does not give the customer a way to control the usage of electricity. Also with the traditional system, the customer gets to know about the consumption at the end of month and if he wishes to know about per day consumption he might need to daily peek in and check with the reading every day. Also the reading displayed by the energy meter displays the reading from the beginning of the usage of electricity. The amount of money charged for the usage of electricity is also not shown in the conventional system.

In energy management using android application all the disadvantages of the conventional energy meter is overcome. As a result there will be less wastage of electricity, since the usage is in a controlled manner. The proposed system has four main functions, one is to send the per day consumption and corresponding amount to the user's mobile phone [1]. Second one is, the user can set a limit, and if the usage exceeds the limit a notification will be sent to the user's mobile phone. Third one is that the user can control the appliances even when he is away from home and fourth function is to detect any intruder or gas leakage in the house hold.

II. RELATED WORK

In [2] the picture of the reading is taken and converted to digital signal and send over the mobile phone. This system has many limitations and the accuracy rate of this system is very low, i.e, each digit has an accuracy rate of 96.49% and the reading as a whole will have an accuracy rate of 85.47%. Here the RGB image is first converted to grayscale. The grayscale is then transformed to image binarization, then the noise reduction is done and finally the reading area is cropped and the digit is recognized through feature extraction and template matching. In [3] the technology used for sending the reading from the energy meter is SMS service which is slow and has no mobility. No mobility implies that the user cannot receive the message or notification if the connection to the base station is lost. In [4] system the appliances are controlled using the Bluetooth as a result the user can only control the appliances when he is only inside the specified distance in which the Bluetooth can work. So when the user is away he/she cannot control the appliances. The Bluetooth module is connected to the relay network, whose other side is connected with the appliances. The user sends the on/off command through his mobile phone (Bluetooth) this command is transferred to the appliance via the relay network. In [5] the ZigBee technology is used for communication, i.e, the smart energy meter sends the reading from the energy meter to the receiver. Both the receiver and sender sends and data using ZigBee and GSM, but the ZigBee is a less efficient technology when compared to Bluetooth. The data transfer rate of ZigBee is 256 mbps.

III. SYSTEM AND OVERVIEW

The proposed system consists of a microcontroller, Bluetooth module, GSM module, CT sensor, PIR sensor, gas leakage sensor, power supplies.

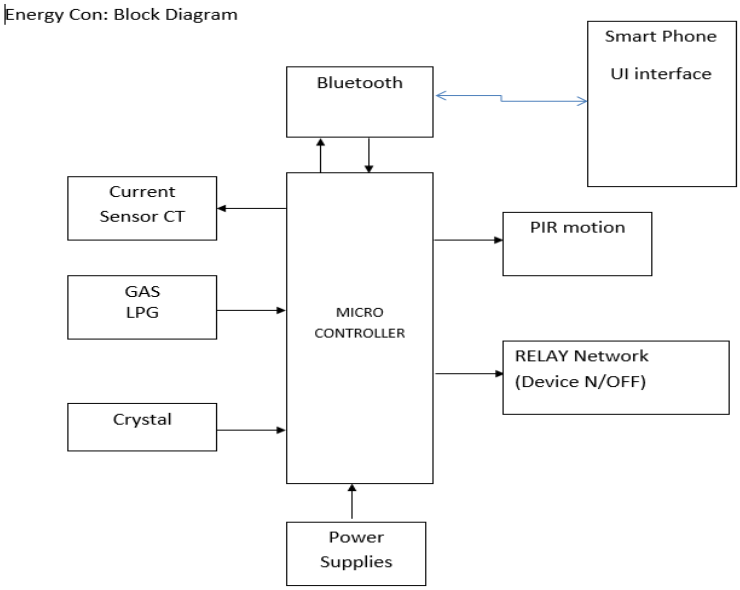

Fig. 1: Block Diagram

In our system PIC16F877A is used as the microcontroller. The microcontroller is connected with all other hardware units in the module.

A. PIC16F877A

The 16F877A is one of the most popular PIC microcontrollers, it comes in 44 pin DIP pin out and it has many internal peripherals. The PIC has five ports Port A, Port B, Port C, Port D and Port E. The port A and E are for ADC connections, i.e, by connecting to port A/E we can convert the analog signals to digital signals. The CT module is connected to the microcontroller's A/E port so that it converts the analog signal to digital for transmission. PIC has many registers in it, they are TRIS, ADCON. The TRIS registers are used to depict whether the pins are to be set as either input or output and the ADCON0 and ADCON1 registers are used to set the ADC channels. The PIC used is connected with all other units in the module. The PIC collects the reading from the CT sensor and converts it to digital signal and gives it to the Bluetooth module. The PIC also collects information from PIR sensor and gas sensor and sends it to the Bluetooth module.

B. Bluetooth Module

The Bluetooth module is used to connect with the GSM module. It gets information from the PIC and gives it to the GSM module (smart phone) connected with it. The Bluetooth can also be used to send information from the user to the main module.

C. CT SENSOR

The CT sensor used here is CT 1270. It will be connected with a phase line from which it reads the electricity used and sends it to the Microcontroller. The CT sensor is used instead of the energy meter.

D. PIR Sensor

The PIR sensor is used to detect the presence of intruder in the house hold. The PIR sensor comes in two forms, PIR infrared sensor and PIR temperature sensor. In the PIR infrared sensor the sensor emits infrared light and when the intruder cuts the beam the PIR begins send information and in case of PIR temperature the sensor detects the presence of intruder by detecting human temperature.

E. Gas Sensor

With the help of gas sensor one can detect if there is any gas leakage in the surrounding. When there is more amount of gas in the atmosphere than in the usual case, then the sensor will begin to detect this and send information to the microcontroller.

F. GSM Module

The information send from the Bluetooth module is given to the GSM module and later it uploads the information to the server from where the user can retrieve the data. The GSM module used in here is a smart phone. From the Bluetooth module the information is collected by the android application in the smartphone and it uploads this information to the server. From the server the user can view the details via an android application installed in his mobile phone.

IV. IMPLEMENTATION AND RESULTS

The communication part is coded using android with the help of android studio. The system consists of two android applications installed in two different smartphones. The code that is burned into the PIC microcontroller is done in Embedded C and this is burnt into it using the software MPLAB. The server part is done using the PHP code. The figure 2 shows the hardware part of the system.

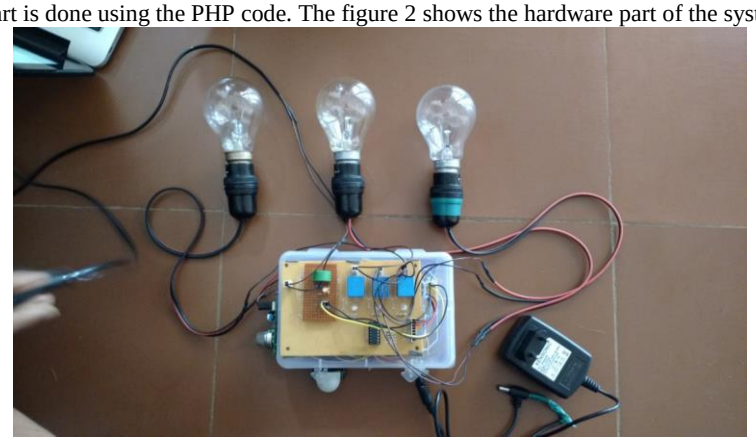

Fig. 2:

Figure 3 show the login page through which the user can login inorder to view the informations.

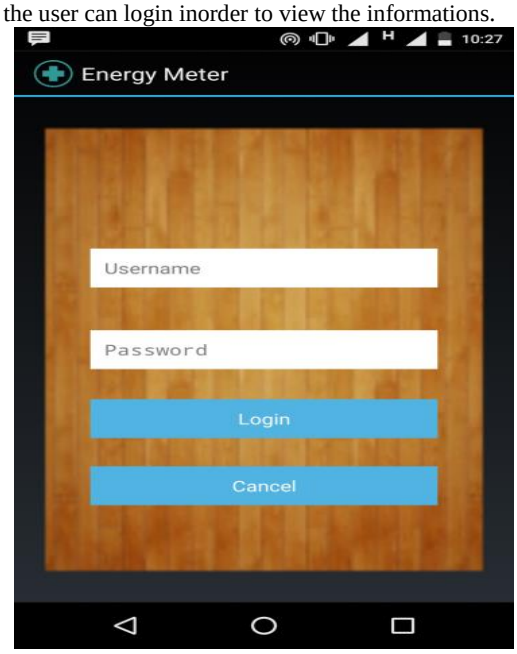

Fig. 3:

The user's android application consists of the facility to display the per day consumption and its cost, this is shown in figure 4.

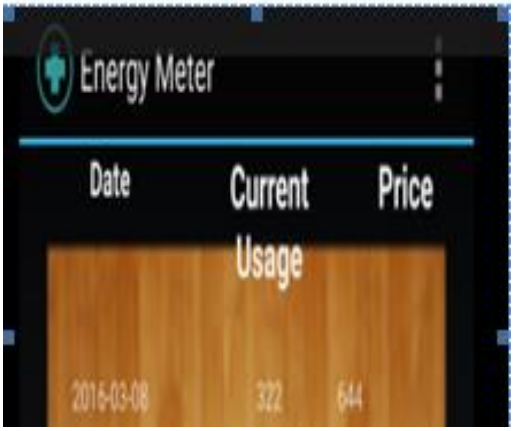

Fig. 4:

Figure 5 shows the values detected by the sensors, i.e, the gas sensor and PIR sensor. When an intruder is detected the message" Human Detected "is sent to the user's mobile phone. When there occurs any gas leakage the message "Gas Detected" is sent to the user's mobile phone.

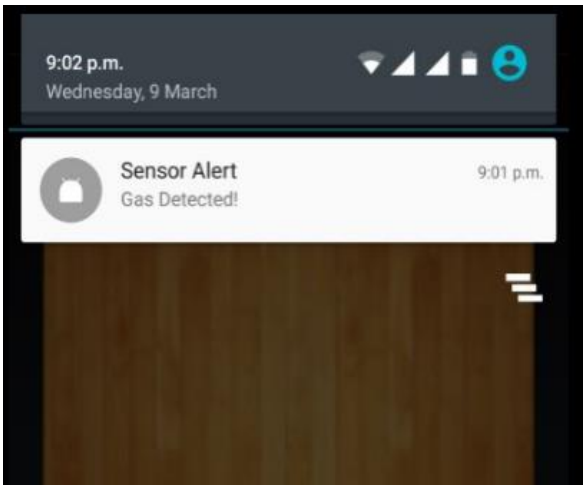

Fig. 5

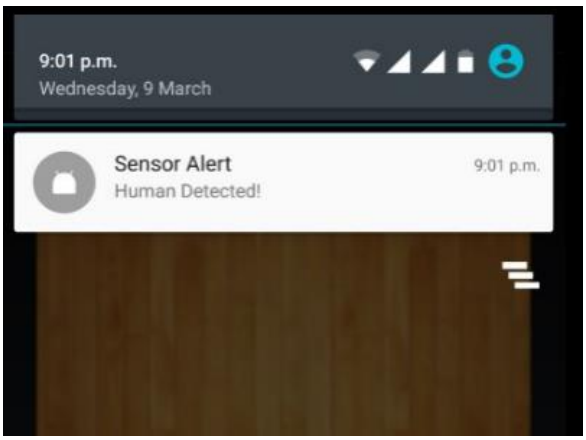

Fig. 6:

Figure 6 shows the interface design of the server that is used to store the values and information.

Fig. 7:

V. CONCLUSION

In this paper we designed a system where one can keep a good control over the electricity management of a household. The customer gets to know about the per day consumption and its corresponding cost is sent to the user's mobile via a Bluetooth and Gsm module. A set of relay network is used for controlling the appliances and set of sensors are used to detect intruder and gas leakage. The energy management system also includes a facility with which the user can set a limit. As a future scope the user can build the system with wireless connection included in it so as to avoid the complexity in building with wired connection.

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