INTELLIGENT CLOUD HOME ENERGY MANAGEMENT SYSTEM

[1]Prof. R. V. Dagade, [2]Sanika Deshpande, [3]Sayali Gugale, [4]Pratiksha Choure, [5]Pooja Runwal
Marathwada Mitra Mandal's College of Engineering, Savitribai Phule Pune University
Email:[1]rahul.dagade@gmail.com, [2]sanikadesh198@gmail.com, [3]sayaligugale@gmail.com,
[4]pratiksha.choure@gmail.com, [5]runwalpooja26@gmail.com

Abstract— There are some non-renewable energy resources like electricity which should be conserved for our future betterment. Nothing runs without electricity at home or in industry. Population explosion and use of energy in an uncontrolled manner gradually exhausts the world store of fossil energy. So the possibility is that in near future power generation plant may face the electricity crisis. For precautionary measure, we are developing a system that employs the integration of multi-touch android mobile devices, cloud networking, wireless communication to provide user with remote control of various appliances present at their home. Intelligent Cloud Home Energy Management System is an integral part of Smart Grid. To supply demanded electrical power to the residential customers, our system includes an algorithm to manage high power consumption household appliances using cloud computing technique. The proposed system manages home electricity in two ways automatically as well as manually. In case if the system is working in an automatic mode, sensors will help to reduce power consumption according to threshold value. For security purpose, the proposed system is making the use of motion detection. This system will result in reduction of the average total power consumption by up to 7.3 percent.

Index Terms—Cloud networking, motion detection, smart grid, non-renewable energy resource.

I. INTRODUCTION

Home Automation is nothing but creating a ***smart home*** as it uses ***smart grid*** technology. Right now in many cities across the nation, new equipment and software are available that use emerging smart grid technologies to save energy and seek out the lowest rates [1]. To allow all of the emerging smart grid technologies to function together, the interactive relationship between the grid operators, utilities and customer is necessary. To minimize the stress from high demand on power grid, computerized controls and appliances can setup. Previously developed Energy Management Systems includes some sub-systems such as control of lighting, security surveillance, temperature sensing, level sensing etc. Our system simplifies the task by connecting these different sub-systems directly to the cloud and hence it reduces setup and maintenance cost.

Cloud Computing is a technique that stores individual's data and allows him/her to monitor, manage and control that data through internet from any remote area [6].

Now a day, many people throughout the world are consuming the electricity without taking care of the way they do. People usually tend to forget to switch off the electric devices while leaving the room. The time between the realizations, the consumption of energy is very high. And this wastage can lead to the major problem to be conquered. To avoid this wastage, efficient use of electricity is need of an hour. ***"Today's your wastage, can be tomorrow's shortage"***. If you do not think of saving power today, it can bring dark nights tomorrow.

Solution to this problem is what our system is. In manual behavior of our system, user can set the priorities to the devices as well as can manage, control those devices from any remote area. Our system not only provides a way to control power devices from remote location but its automatic behavior manages the devices if it does not found anyone in the particular room. This is possible as our system has a sensor like infrared sensor. The unique feature of our system is security which can be achieved by using motion detection technique.

II. PROPOSED SYSTEM

A. SYSTEM ARCHITECTURE

In our system architecture, mainly 5 components are used.

1. Home Server
2. Micro-controller
3. Cloud Server
4. Android Client
5. Camera

Flow of Our System:

It is necessary for the user to get registered for the authentication purpose. So registration is the first step for each new user. After this when user wants to login to the system he will get authenticated according to his credentials stored into database. Then the home server will fetch status of devices, sensor data from the micro-controller as well as the priorities of the devices and threshold values from database.

All this data will get uploaded to cloud server. Here cloud server is mainly used to store latest data which is useful for both home server and android client.

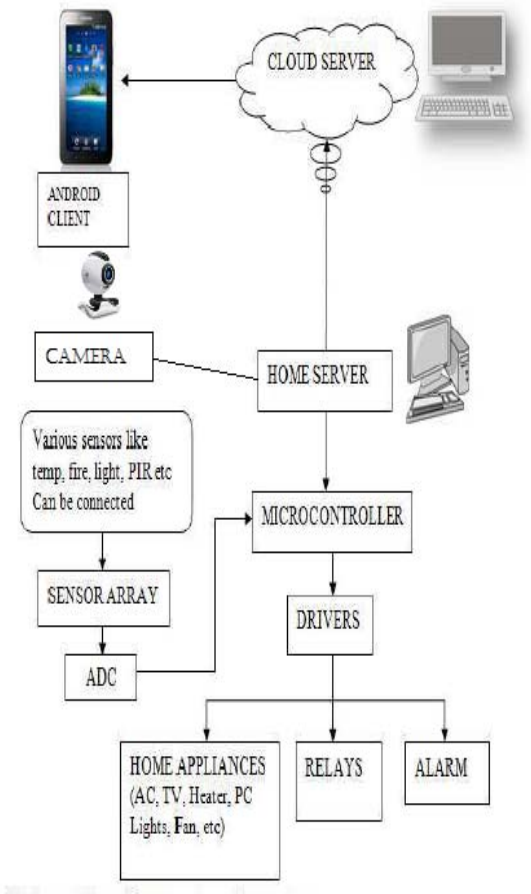

Fig.1 System Architecture

Now at the android client, the user will get access to the system through the android application. Here also user will get authenticated. After this, android client will have full control of system. If the android client make some changes in status of devices or changes the threshold values or changes the priorities etc., then all these commands will get send to the home server through the cloud server. The home server will download these requests and send appropriate signals to the micro-controller. Hence the android client's changes will get updated to the database.

B. FUNCTIONING OF HARDWARE

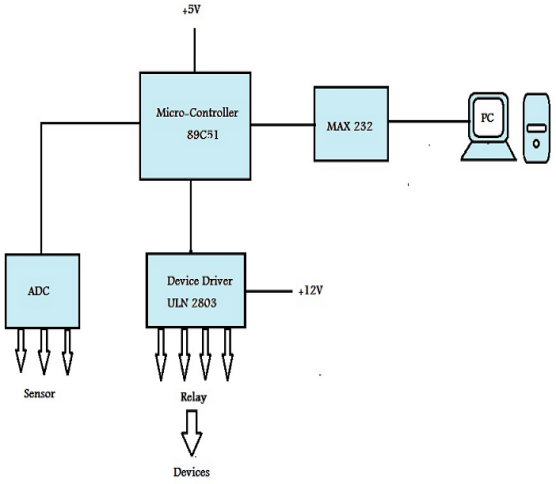

Fig.2 Hardware Structure

In the proposed system, all the devices and sensors are connected to ***8 bit micro-controller 89C51*** through RS232. The status of devices as well as values of sensors are fetched by home server and will get updated to the cloud server for android client. Max232 Convertor is used for serial communication between micro-controller and home server.

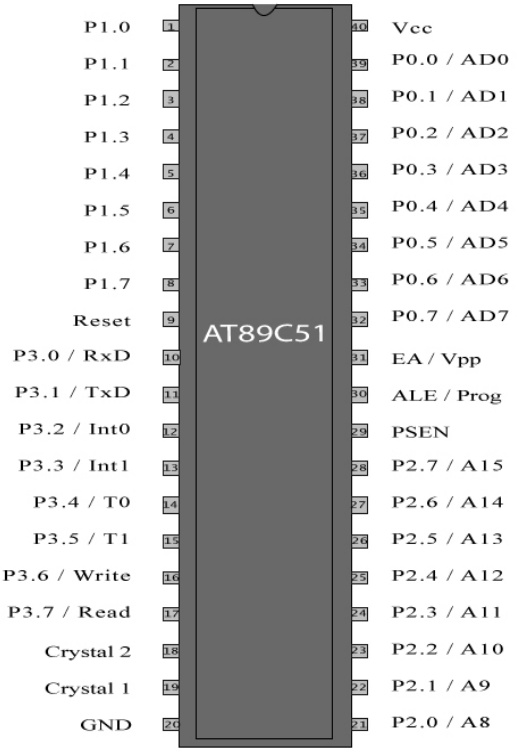

Fig.3 Micro-controller89C51 Pin Diagram

In this 89C51 micro-controller, there are total 32 input-output pins. In this project, pin 34(i.e. P0.5) is connected to ***ULN2803.***

At the time of fetching, ADC converts analog signals to digital values for home server operations.

Whenever we want to turn on or off devices, the signals are given to ULN2803. Pin 10 of ULN2803 is connected to the positive side of relay. So when ULN receives high voltage signals it passes it to relay. Even in case of low voltage signals, ULN converts low voltage signals to high voltage signals and perform the same task [2].

C. MOTION DETECTION

Motion detection is fundamental processing step in majority of visual surveillance algorithms. In ***image processing*** technique, pixel based metrics or object based metrics are used for the detection and recognition purpose. There are many techniques which are using pixel based metrics with some issues. To overcome this, motion detection technique is invented which follows an object based metrics [5].

In proposed system for surveillance purpose, we are using motion detection. In this, we are using a camera which captures a stable image of specific area and stores it into the database. Camera captures image continuously and compare that image with the image stored in the database. If it found any difference then it will activate security alarm [3].

In this technique, both recognition and detection is performed on distributed motion activity on the basis of ***temporal texture*** and complexly moving compact object on the basis of their activity [4]. This approach is different than old approach of recognizing the motion. Here, detection is performed on objects because it is easy to detect and identify moving objects than the stationary one. Some techniques are required for gray scale texture analysis to classify regional activities. To apply these techniques on the stored image that is on approximation, it is necessary to extract the statistical spatial and temporal features from it. This technique is used for action identification to locate and track moving objects and then use spatial and temporal texture arrangement in

conjunction with Fourier image analysis to identify any objects that moved periodically.

D. MOTION DETECTION ALGORITHM

Step 1: First camera will capture stable reference image and the home server store that image into the database.

Step 2: Algorithm runs until the detection of the motion.

Step 3: Once it is detected, algorithm has two images to understand whether there is change which can be considered as motion in projected vision or not.

Step 4: This calculation is done in ***RGB format*** data of the images in byte arrays.

Step 5: Two images firstly process to see the general change. This general change should not affect image difference calculation since it is not important for security purpose. This difference is stored to use in a pixel difference calculation part and it is called as ***correction*** after here.

Step 6: To see whether there is considerable change in a pixels, two byte arrays are compared. This change is determined by a pixel threshold value.

Step 7: Pixel threshold value and difference between two pixels is compared first and if difference is greater than ***pixel threshold***, then it is compared with correction value. As a result if pixel value has changed, it is labeled as black otherwise labeled as white.

Step 8: Now the new image is the reference image which keeps an image of difference. To catch a motion of an entire body this image is referred than an individual minor pixels. This method is known as ***Blob calculation***.

Step 9: Then Blob calculation calculates the body of black blob size. This is done by finding radius of blob. Then it is compared with another blob threshold value.

Step 10: Depending on what sensitivity to be achieved on the motion detection system, the value of ***blob threshold*** is determined.

Step 11: The algorithm detect the motion at upper layer whenever a radius value of blob is greater than blob threshold.

III. RESULTS

1. Registration

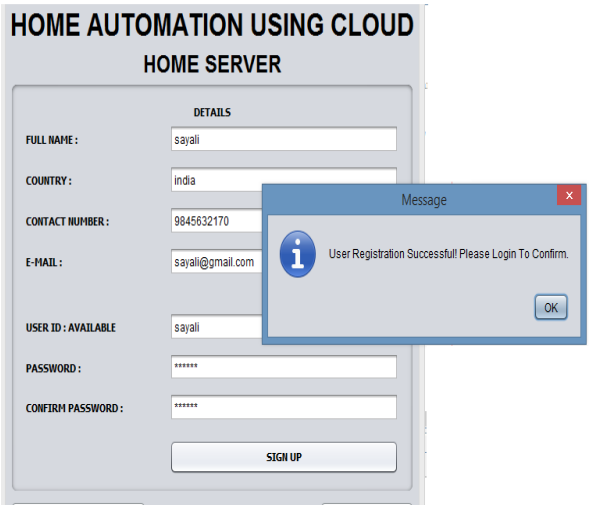

Fig.4 Sign Up Screen

First user has to register to get access to the system.

2. Communication Port

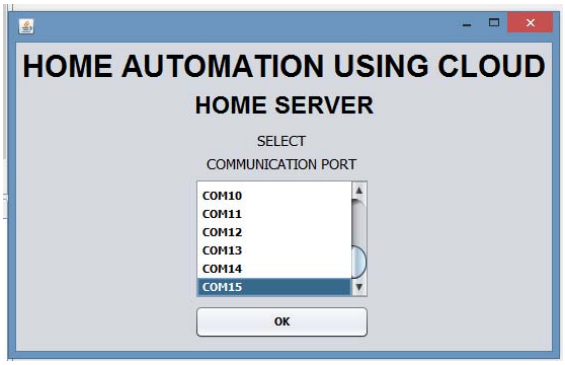

Fig.5 Communication port selection Screen

Then user has to select the communication port at which the hardware is connected.

3. Device Test

User can turn on or off the particular device by performing Device Test. By selecting Toggle button as shown in Fig.6, we can swap previously selected on and off operations.

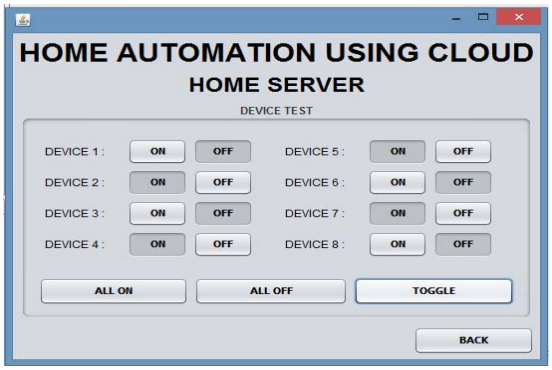

Fig.6 Device Test Screen

4. Monitoring from Home Server

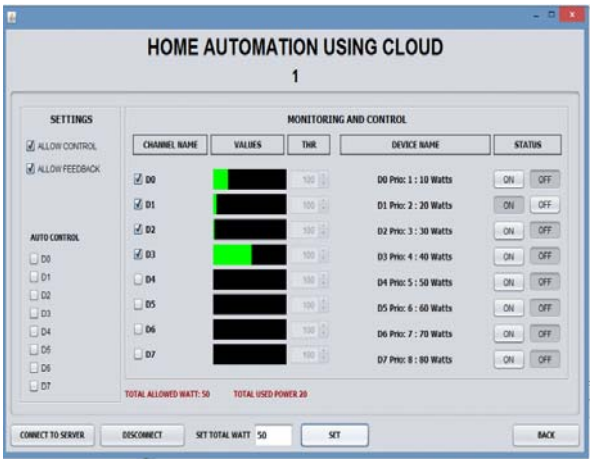

Fig.7 Home Server Monitoring Screen

In Fig.7 Green bar is reflecting the value of Sensors. Now here at left upper corner, two options are present. First is ***"Allow Control"***. By selecting this option, Home server will give the authority of monitoring and controlling devices and sensors to android client as well. Then second is ***"Allow feedback".*** By selecting this option, the status of sensors and devices will get stored into database. But for all these operations first we have to select ***"connect to server"*** button which will connect to the cloud server.

It is necessary to set the priorities and watts of each device in another sensor test part. Then here we can also control connected devices manually and can control its usage by setting total watts.

5. Android Client

The Application Screen of the Android Client will exactly look the same as in Fig.8. After Android Client gets authorized he can control devices by clicking on the D0 to D7 buttons. The status of the sensors and their threshold values will get reflected here for each sensor from S0 to S7.

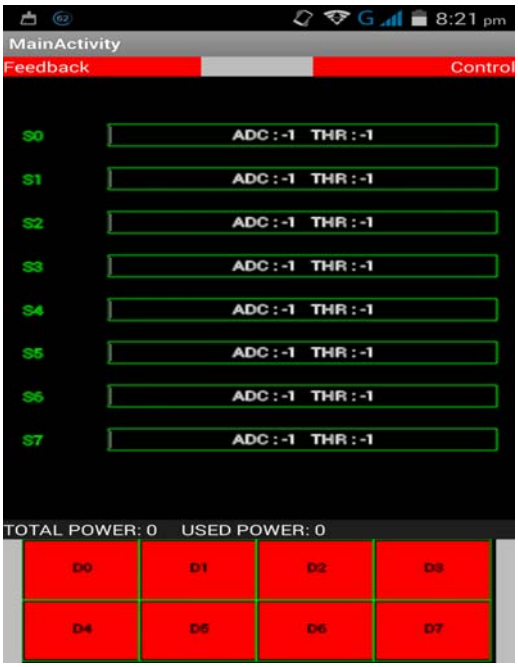

Fig.8 Android Client Screen shot

6. Motion Detection

It comes under the automatic mode of this system. It can be allowed by selecting auto control options present in previous screen shot. And currently we are working on this part.

IV. FUTURE SCOPE

The proposed system can have night camera to detect the motion in dark room and can immediately switch on the lights and also activates the alarm as of now.

We can even connect more than 8 devices by using different micro-controllers.

The mobile application can also be developed for another platform like iOS, windows etc.

We can also connect different sensors like fire alarm, pressure sensor, door control, environmental monitoring, HVAC control, water heater control etc.

V. CONCLUSION

This paper proposes secure, remotely controlled, low cost solution. The approach discussed in this paper achieved the target to control the home appliances remotely to fulfill the energy saving

purpose by satisfying user needs and requirements.

As compare to previously existing systems, this solution has proved to be controlled remotely, provide home security and is cost effective.

Hence we can conclude that the mentioned goals and objectives of home automation system have been achieved.

The system design and architecture were discussed and results generated presents that the home appliance control and remote monitoring has been implemented.

Finally the proposed system has a better scalability and flexibility than the commercial home energy management system.

VI. REFERENCES

[1] Jinsung Byun, Insung Hong, and Sehyun Park,
"Intelligent Cloud Home Energy Management System Using Household Appliance Priority Based Scheduling Based on Prediction of Renewable Energy Capability", IEEE Transactions on Consumer Electronics, Vol. 58, No. 4, November 2012.

[2] Zeeshan Ahmed, Mujtaba Ali, Saman Majeed, "Implementing Computerized and Digitally Mobile
Home Automation System towards Electric Appliance
Control and Security System", Int. J. Emerg. Sci., 1(3), 487-503, September 2011 ISSN: 2222-4254 © IJES.

[3] Mihir Shah, Amit Sheth, Sagar Shah , "Home Automation Using Embedded Web server".

[4] Ramprasad Polana and Randal C. Nelson, ``Recognition of Motion from Temporal Texture'', Proc. IEEE Conference on Computer Vision and Pattern Recognition, Champaign, Illinois, June 1992, 129-134.

[5] J. Renno, N. Lazarevic-McManus, D. Makris and G.A. Jones, "Evaluating Motion Detection Algorithms: Issues and Results"

[6] KALAGIAKOS, P. ; DEPT. OF INF. TECHNOL., HELLENIC AMERICAN UNIV., MANCHESTER, NH, USA ; KARAMPELAS, P, "CLOUD COMPUTING LEARNING" IEEE 14 OCT. 2011.