The Fifteenth International Symposium on Artificial Life and Robotics 2010 (AROB 15th '10),
B-Con Plaza, Beppu,Oita, Japan, February 4-6, 2010

A study of Embedded Community Network System in Home automation

Chun-Liang Chen1, Pi-Yu Chen2 and Der-An Wang3

1. Dept. of Electronic Engineering, Nan Kai University of Technology , Taiwan
2.Graduate Institute of Electrical Engineering &Computer Science, Nan Kai University of Technology, Taiwan
3. Dept. of Mechanical Engineering, Nan Kai University of Technology , Taiwan
(Tel : 886-49-256-3489ext3367; Fax : 886-49-256-9834)
(junchen@nkut.edu.tw)

Abstract: This paper presents home automation in community network with embedded system. The system includes home security monitor and home energy monitor. Home security monitor uses sensors and micro switches to monitor home status; home energy monitor adopts Hall sensor to oversee household energy consumption and control the power consumption of home appliances, Furthermore, use embedded database to record, energy consumption. Besides, the system use Shortest Paths and Topological Sort of power dispatch module. Data is transmitted to computers, mobile phones, or other devices connected to Internet. The system integrates every node subsystem and is constructed on net framework by using Common Gateway Interface (CGI) and Cell Spitting.

Keywords: Embedded Data Base, Common Gateway Interface (CGI)

I. INTRODUCTION

Currently, most households install grille as a basic home security. However, grille may hinder rescuing in accident. By implementing the home monitoring automation system, one can ensure community safety with other residences in the neighborhood. With regard to increasing population and declining energy reserves, it is important to discuss how to efficiently use electricity. The power supply system of Taiwan Power Company does not provide for customer, so the user is unable to know how to use electricity efficiently. Presently many home appliances are advocated to be energy efficient and can reduce pollution; therefore, the researchers also use the energy monitoring function of this system to calculate electricity consumption per household so as to optimize this action research cycle [1] (Fig. 1). The system is able to tell which appliances consume more energy, so users can manage to save energy. This Home To Automate In Community is mainly established by the use of a basic community framework (Fig. 2).

II. SYSTEM DESCRIPTION

1. System Framework

The system used Intel XScale PXA270 ARM10 development platform as its central processing unit, and it then ports SQLite database to the platform. ARM is powerful and fast, so the researchers test inputs of peripheral equipments of two separate systems.[2] These two systems are home security monitor and home power monitor, and they are later integrated into two major functions of one single system. Each single node subsystem (Fig. 3) composes a comprehensive safety monitoring system (Fig. 4), and the system is then processed by a remote server and connected through network to form the Home To Aytomate In Community (Fig. 5).

2. Platform

This system mainly uses ARM development platform module to complete various tasks. The ARM development platform module adopts Intel XScale PXA270 (Fig. 6) as its central processing unit. The purpose of this research is to port database into the embedded platform for application; therefore, the researchers choose module with larger memory capacity as the development platform. [3]

3. DataBase

It is usually a must for a database to be able to process large amounts of data. However, if the data is fixed in content and does not have a lot of amounts, or the database will only be used on one single computer and not by multiple users, it is not necessary to establish a particular database system. Users can merely adopt embedded database such as SQLite[4].

4. Software framework(Fig.7)

- Web Service AP：To make a Web Service with CGI that user can use and control in Web Browser.
- GUI AP：The interface of ARM with Touch panel
- Data Picking up：Read message in Hall Sensor.
- Device Drivers：to link with peripheral device.
  (1). Anti-theft I/O：Monitoring switch whether on/off.
  (2). Power Monitor I/O：to control the relay of power loop relay.

5 Boa Web Server

uClinux has three major web servers: htpd, thttpd, and Boa. Httpd is the simplest web server. It has fewer functions and does not support any certifications or CGI. Both thttpd and Boa support certifications and CGI and areequipped with more functions. To realize dynamic Web technology, the researchers choose Boa Web Server, which supports CGI and is suitable to be embedded into the system. Boa is a single-task, open-source, and highly capable http server. uClinux has already included source codes of Boa. One needs only some setups and modifications to use Boa under uClinux. There are by far four techniques for choice regarding the implementation of dynamic web page: CGI(Common Gateway Interface), ASP(Active XServer Page), PHP(Personal Home Page), and JSP(Java Server Page). However, to make dynamic web page under uClinux, only CGI is applicable since uClinux does not support ASP or PHP. The picture (Fig.8) shows the procedure of establishing Boa.[5]

6. Common Gateway Interface (CGI)

Common Gateway Interface (CGI)(Fig.9) can connect network host and browser to allow data storage. CGI can complete the said action, and it is a general interface instead of a particular program. CGI program can be compiled using several programming languages. Based on various operating platform, the most common programming languages for CGI are C, C++, Perl, PHP, TCL, JAVA, VB, etc. Functions such as message boards, discussion forums, visitor counters, online voting, electronic cards, online visitors, ect. all belong to CGI. An intercommunication channel is an environment variable. HTTP can convey data in <FORM> to CGI via STDIN; and CGI can use STDOUT to return outputs to HTTP and show them on browser. The second communication channel offered by CGI is method=get. It uses environment variable to transmit data. The capacity of environment variable is limited, so when conveyance of large amount of data is needed, the space for storing environment variable may be insufficient, causing data incompletion or CGI implementation failure. Method=post utilizes I/O redirection to allow CGI to communicate directly with browser via STDIN and STDOUT, solving the shortcoming of method=get.

7.Cell Spitting

There are many kinds of coding algorithms to carry out in genetics, the methods we used of cell Spitting as follows .Fig. 10 and Fig. 11 show the Cell spitting.[6]:

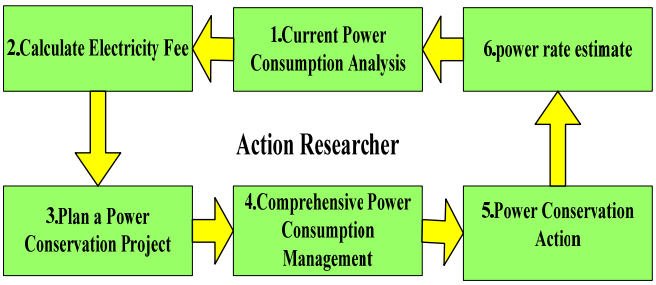
(1).Select one initial vectorial Xi from training the vector quantity =[Xi1 Xi2 Xi3 Xip], uses this to be initial produce vector quantity m piece from for the initial for yards of vector quantity [V1 V2 Vm], among them Vj =[Vj1 Vj2 Vj3 Vjp], i =j = m, v jk =xjk =Xij+(2* i-m-1) *δ.

(2).By m an initial yard vectorial V1 V2 Vm central point, hive off other training vector quantity, calculate group of central points again, get other m a new central point.

(3).This m is a new central point, will all split into m vectors, and hive off again, calculates the new central point. The movement that split can sustain, split once, number of group with m. It is awfully quick and long. Repeat the step described above, until reach the size of coding set u.

III. System Implementation

The system consists of two parts: home security monitor(Fig.12) and home energy monitor.(Fig.13) Both parts can operate independently, but all records are stored in a common database. The records are sorted with database page format to avoid data disorder. Home security monitor allows users to control anti-theft switch through network, and it records when the switch is turned on. Once the anti-theft switch is activated, the system alarms to owners, neighbors, or security contactors. The home power monitor is also based on net framework, and users can also switch on or off home appliances through network while there is no one at home; on the other hand, they can also turn on before returning home. The timer function allows appliances to be activated at the same time, and it helps reduces electricity fees.



IV. FIGURES

Fig. 1 Power Consumption Analytical Cycle

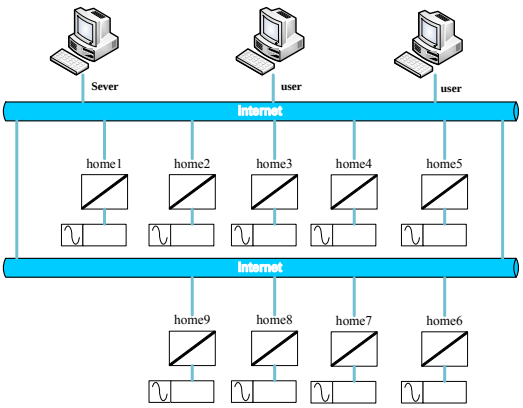


Fig. 2 Basic Community Framework

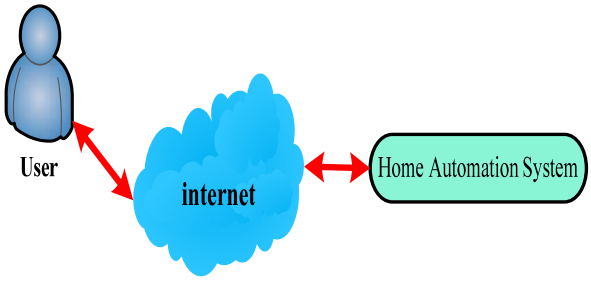


Fig. 3 Single Node Subsystem

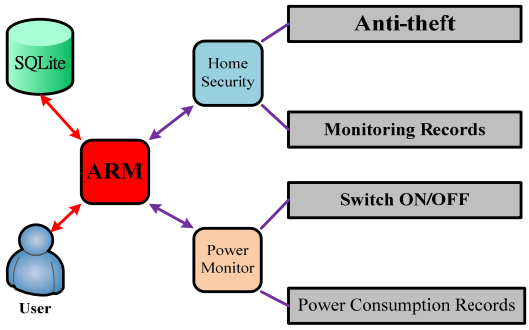


Fig. 4 Embedded Safety Monitoring System

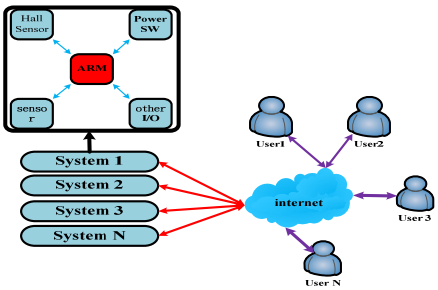


Fig.5 Home Automation In Community

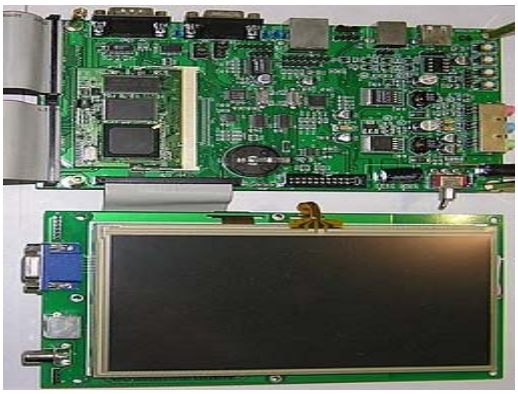


Fig. 6 Intel XScale PXA270 Module

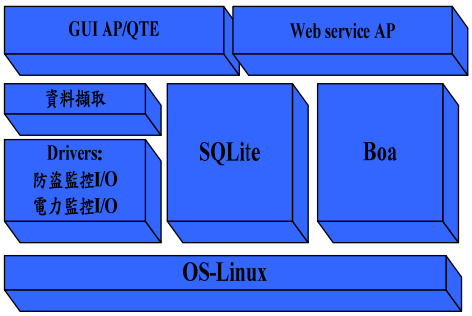


Fig. 7 Software framework

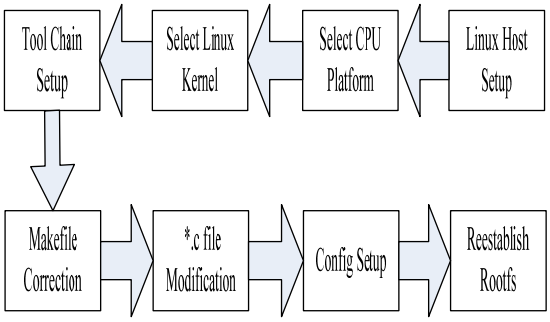


Fig. 8 Procedure of Establishing Boa

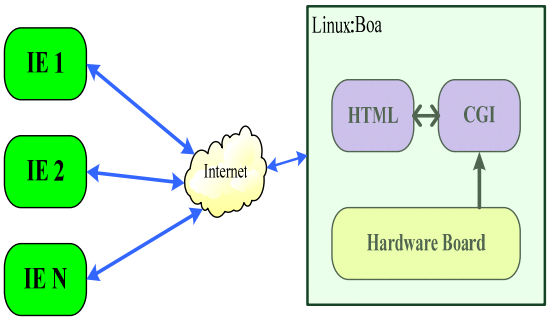


Fig.9 CGI Framwork

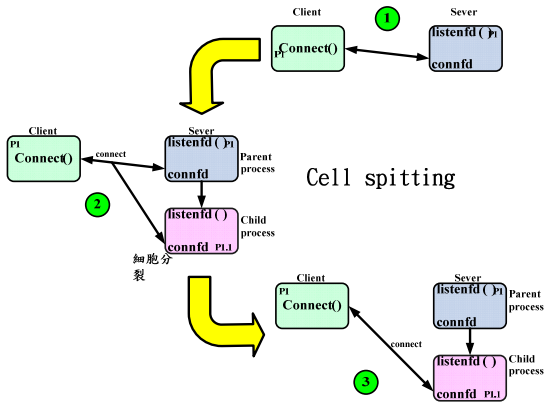


Fig.10 Socket using Cell spitting

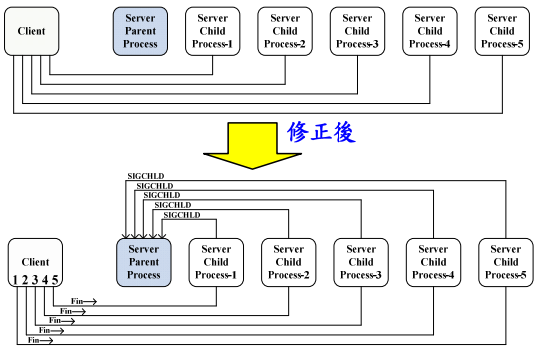


Fig.11 Socket using Modified Cell spitting

System Information for Server

User Name	Enable	SW1_Name	SW1_State	SW2_Name	SW2_State	SW3_Name	SW3_State	SW4_Name	SW4_State
tony1	1	door-1	1	windows-1	0	door-2	1	windows-2	0
tony2	0	door-1	0	door-2	0	image	0	windows-2	0
tony3	0	safe	0	image	0	windows-1	0	windows-2	0
tony4	1	door-2	1	safe	1	image	0	door-1	0
tony5	1	windows-1	1	windows-2	1	safe	1	door-1	1
tony6	0	windows-2	0	door-2	0	safe	0	door-1	0

Fig. 12 Home Security Monitor

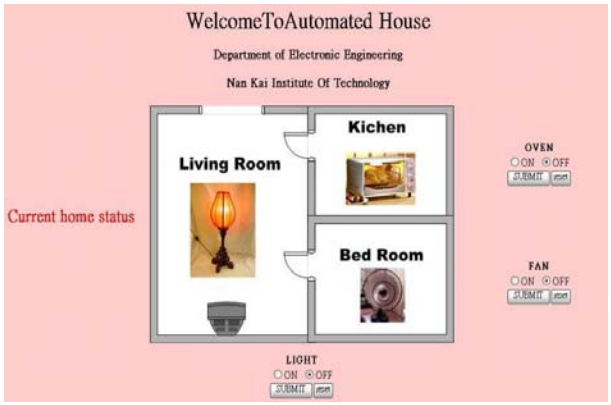


Fig. 13 Home Power Monitor

V. CONCLUSION

The system in this research has been established and tested. Its home power monitor oversees and manages each circuit. Power consumption and on/off time is recorded separately in database, allowing users to adjust power saving project based on the data. Another high power consumption source is from appliances (lights, fans, etc.) not switched off in rooms with no one. Such issue is also improved by using this system since it can determine if there is anyone in a room by reading related sensors. If there is no human activity in a room for a time period, the system will switch off appliances in it. For home security monitor, the researchers have completed basic sensor testing such as reed switch and infrared sensor. The result shows the system can detect when sensors are activated and indicate it on web pages so that users can easily control home security. Users will still be notified of sensor activation by short messages even if they are not at home. They can also accurately record when and which sensors are activated. This system has been established and reached expected goals after testing; therefore, it can be used in home automation system in the future.

REFERENCES

[1]B.T. Hou (2005), The Design and Implementation of A Microarray Data Analysis Tool Using Embedded Database(in Taiwan). 85-90.
[2]C.A. Yu (2006), , Implementation of ARM-9 Based Wireless Internet Radio, (in Taiwan). 45-48.
[3]C. T. Lin(2005), Home-Agent Systems On ARM9 Develop Platform(in Taiwan). 32-35.
[4] Industrial Development Bureau Ministry of Economic Affairs：http://support.oss.org.tw
[5]C.L. Chen[1], Y. H. Chiang[2],D.Y. Wong[3] [2008],Embedded Community Network System of Security Monitor,, The 3rd Intelligent Living Conference (in Taiwan).
[6]Hu, Y. C. and Chang, C. C.(1999),A progressive Codebook Training Algorithm for Image Vector Quantization, Proceeding of the Fifth sia-Pacific Conference on Communications and Fourth Optoelectronics and Communications Conference(APCC/OECC 99'), Beijing, China,vol. 2 , pp.936-939,