

## Design of Intelligent Home Control System Based on a Variety of Network

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**Abstract.** An intelligent home system controlled via GSM, GPRS and the Internet was developed to investigate the control system of intelligent home. The home environment including concentration of carbon dioxide, UV intensity, light intensity, smoke concentration, temperature and humidity were real-time transmitted to the host computer monitoring platform. The intelligent home system supports four different control methods with the remote control functions of household appliances, security locks of doors, lighting system and smart curtains realized through a variety of network.

### Introduction

Home automation has been a feature of science fiction writing for many years, but has only become practical since the early 20th Century following the widespread introduction of electricity into the home, and the rapid advancement of information technology [1,2].

The popularity of home automation has been increasing greatly in recent years due to much higher affordability and simplicity through smart phone and tablet connectivity. The concept of the "Internet of Things" has tied in closely with the popularization of home automation [3,4].

Home automation is the residential extension of building automation. It is automation of the home, housework or household activity. Home automation includes centralized control of lighting, air conditioning, appliances, security locks of gates and doors and other systems, to provide improved convenience, comfort, energy efficiency and security [5-8]. Home automation for the elderly and disabled can provide increased quality of life for persons who might otherwise require caregivers or institutional care.

In this paper, an intelligent home system was developed. All devices in home were connected through a variety of network to allow control by personal computer or smart phone, which results in convenience, energy efficiency, and safety benefits.

### System Structure

The intelligent home system developed in this paper supports four different control methods, the monitoring and control functions of intelligent home were realized by GSM, GPRS and the Internet network, which described as follow.

**2.1 Intelligent home controlled through GSM.** The intelligent home was controlled via the GSM network by SMS in this control mode and does not require a computer server which is the cheapest solutions for realization of intelligent home. What we need is just a cell phone, either ordinary mobile phones or smart machines. The system structure of this mode is shown in Fig. 1.

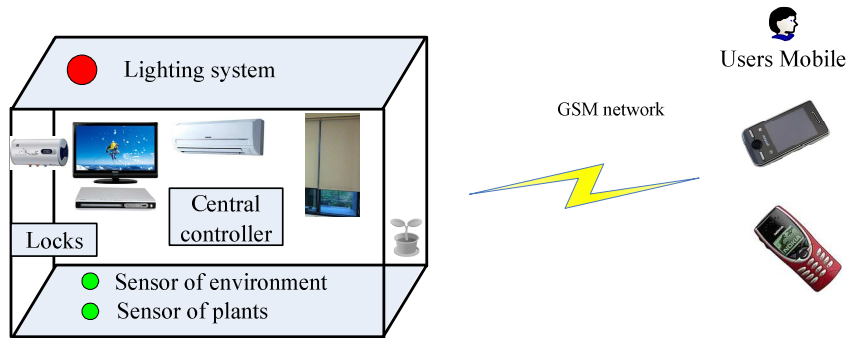


Fig. 1 Intelligent home controlled through GSM

In this mode, the devices in intelligent home were controlled through the following ways. (1) Intelligent home central controller communication with remote controller through GSM module. (2) For ordinary mobile phone, it can be controlled by direct input Chinese or English SMS text messages.(3) For smart phone, you can enter Chinese or English SMS text messages, or you can control via software interface. (4) Either ordinary mobile phones or smart phones can query the all current environment parameters of intelligent home.

**2.2 Intelligent home controlled through GPRS.** The intelligent home was controlled through GPRS network with a remote computer server which does not require a local computer server in this mode. The intelligent home can be controlled by smart phone through WIFI, smart phone through GPRS, smart phone through GSM, ordinary phone through GSM, remote personal computer through Internet. Meanwhile, the intelligent home also supports news release function of twitter. The system structure of this mode is shown in Fig. 2.

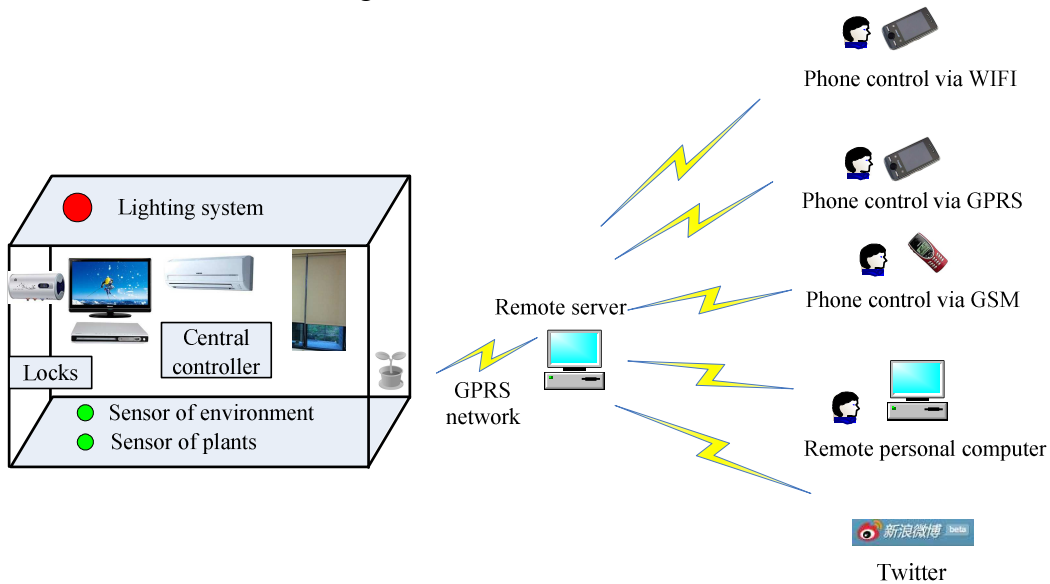


Fig. 2 Intelligent home controlled through GPRS

In this mode, the intelligent home was controlled as follows. (1) This mode also supports intelligent home controlled through GSM method which described as section 2.1. (2) Central controller of intelligent home communication with remote server through the GPRS network. (3) All devices of intelligent home can be controlled by remote server. (4) Connect to the remote server via WIFI, intelligent home can be controlled by smart phone. (5) Connect to the remote serve via GPRS, TDSCDMA or WCDMA network by smart phone, all functions of intelligent home can be realized. (6) Connect to the remote server through internet by personal computer, all devices of intelligent home can be controlled. (7) Intelligent home also supports news release function of twitter which regularly updated environment parameters of intelligent home.

**2.3 Intelligent home controlled through GSM with local server.** The intelligent home was controlled through GSM network with a local computer server in this mode. The system structure of this mode is shown in Fig. 3.

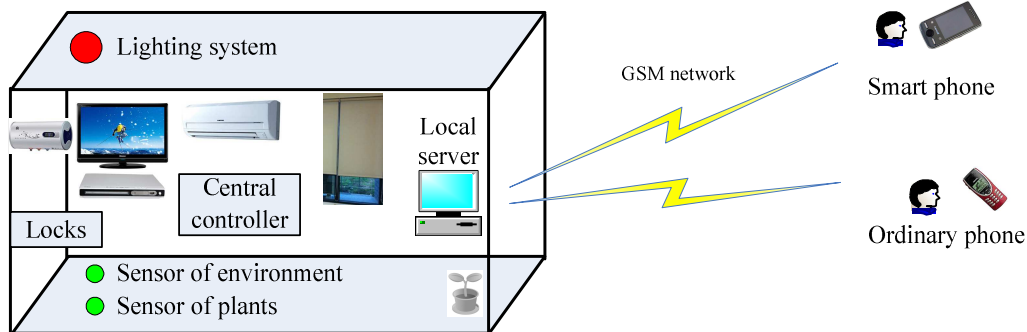


Fig. 3 Intelligent home controlled through GSM with local server

In this mode, all devices of intelligent home were controlled in the same way as the intelligent home controlled through GSM mode described as section 2.1 except that local server can control all functions intelligent home.

**2.4 Intelligent home controlled through Internet with local server.** The intelligent home was controlled through Internet with a local computer server in this mode. The system structure of this mode is shown in Fig. 4.

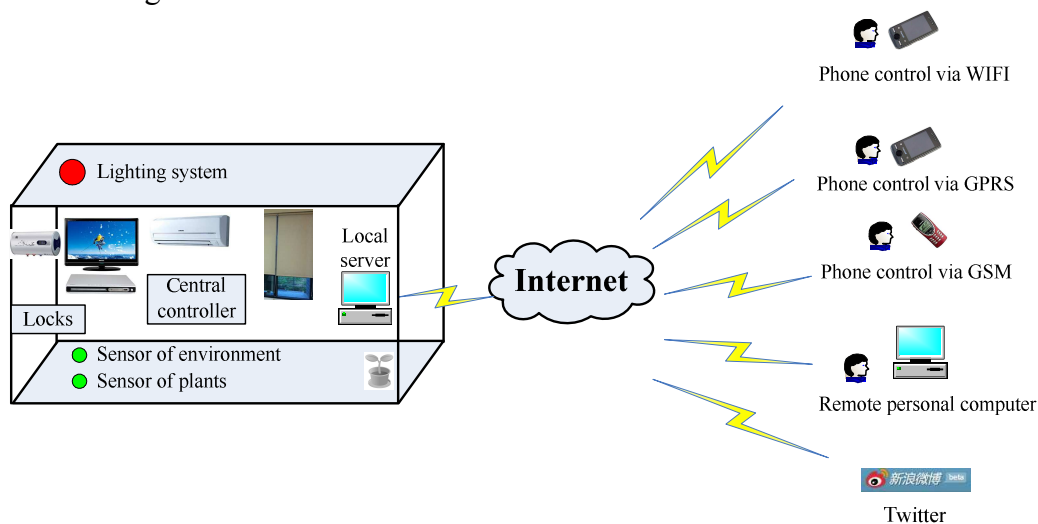


Fig. 4 Intelligent home controlled through Internet with local server

In this mode, the intelligent home was controlled as follows. (1) This mode also supports intelligent home controlled through GSM method which described as section 2.1. (2) All devices of intelligent home can be controlled by local server. (4) Intelligent home can be controlled by smart phone through WIFI. (5) All functions of intelligent home can be realized by smart phone through GPRS, TDSCDMA or WCDMA network. (6) All devices of intelligent home can be controlled by remote personal computer via internet. (7) This mode also supports news release function of twitter which regularly updated environment parameters of intelligent home.

### Detection of home environment

The aim of design of intelligent home is acquiring the comfortable family environment. The intelligent home developed in this paper can real time detecting the home environment which including concentration of carbon dioxide, UV intensity, light intensity, smoke concentration, temperature and humidity. Meanwhile the pyroelectric sensor was applied for human body detection to ensure home safety. In order to monitor the growth of green plants in home, the soil temperature and humidity sensor was applied in the intelligent home. It can alert the owner through the twitter for watering. The system structure of home environment detection is shown in Fig. 5.

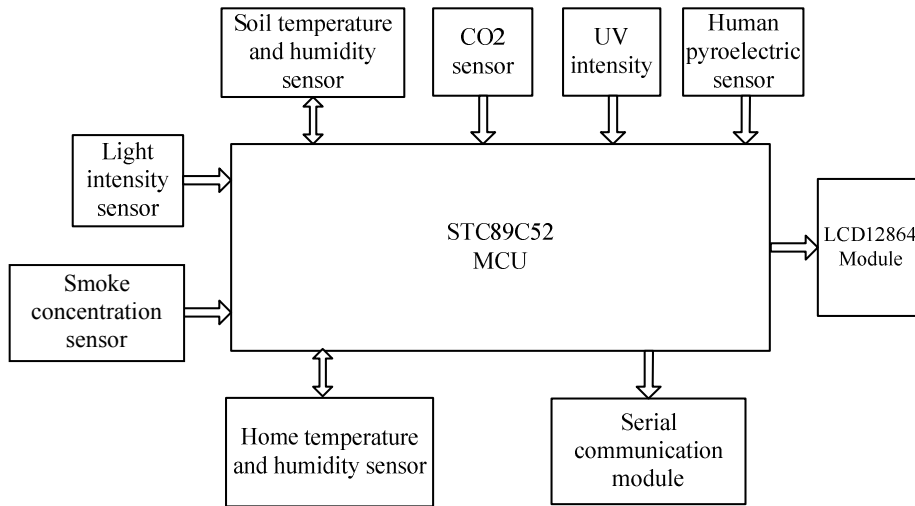


Fig. 5 System structure of family environment detection

Finally, the detection data of home environment were transmitted to the central controller of intelligent home through the serial port module.

**Control of household appliances**

The household appliances including television, DVD player, air conditioning, water heater were controlled through infrared remote control by local server and remote controller via a variety of networks. A universal infrared remote control based on STM32F107 was developed for the control of household appliances. The control of household appliances was realized in following two ways. (1) Universal infrared remote control communication with local server through TCP protocol by WIFI, which relate with the mode of section 2.3 and section 2.4. (2) Universal infrared remote control communication with the central controller of intelligent home through RS232, which relate with the mode of section 2.1 and section 2.2. The communication modes of universal infrared remote control described above are shown in Fig. 6 and Fig. 7.

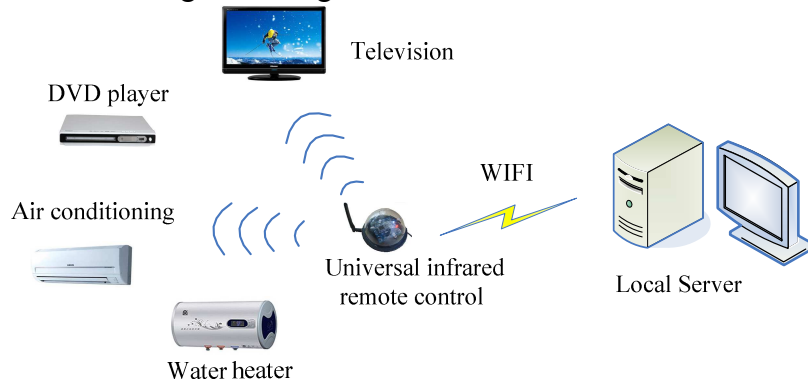


Fig. 6 Universal infrared remote control through TCP mode

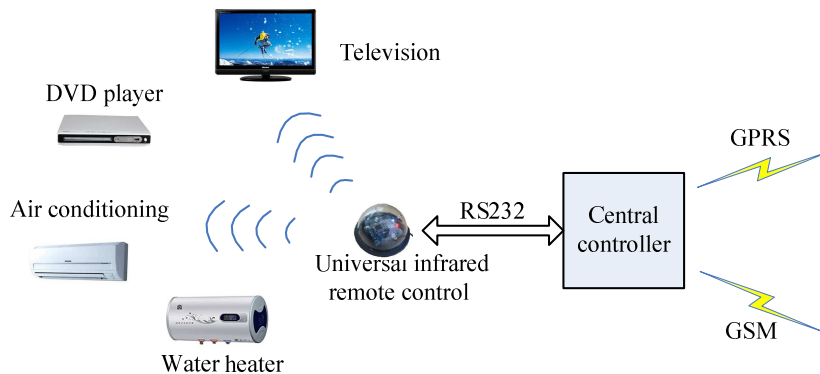


Fig. 7 Universal infrared remote control through RS232 mode

## Summary

An intelligent home was developed in this paper, which supports four different control methods. Home environment was real-time monitored based on multi-sensor. Among smart phone, ordinary phone and personal computer could get the home environment via a variety of network. All devices in intelligent home could be well controlled without local server. The security locks of doors, lighting system and smart curtains could also be well controlled by remote controller. The household appliances including television, DVD player, air conditioning, water heater were controlled through infrared remote control by local server or remote controller via multi methods. Meanwhile the green plants in home were also monitored by the soil temperature and humidity sensor, which could remind the owner for watering through twitter. This system is easy to use and with affordable characteristics which can provide increased quality of life for persons.

## References

- [1] Dong-Sun Kim, Sang-Seol Lee, Byeong-Ho Choi, "A real-time stereo depth extraction hardware for intelligent home assistant robot", *IEEE Transactions on Consumer Electronics*, Vol. 56, Issue 3, 1782-1788, 2010.
- [2] Y. Ozturk, D. Senthilkumar, S. Kumar, G. Lee, "An Intelligent Home Energy Management System to Improve Demand Response", *IEEE Transactions on Smart Grid*, Vol. 4, Issue 2, 694-701, 2013.
- [3] JinSung Byun, Boungju Jeon, Junyoung Noh, Youngil Kim, Sehyun Park, "An intelligent self-adjusting sensor for smart home services based on ZigBee communications", *IEEE Transactions on Consumer Electronics*, Vol.58, Issue 3, 794-802, 2012.
- [4] F. Corno, F. Razzak, "Intelligent Energy Optimization for User Intelligible Goals in Smart Home Environments", *IEEE Transactions on Smart Grid*, Vol. 3, Issue 4, 2128-2135, 2012.
- [5] Liguu Liu, "Autonomy on intelligent home network", *Information Technology Journal*, Vol. 9, No. 2, 282-289, 2010.
- [6] Kuo-Lan Su, Song-Hiang Chia, Sheng-Ven Shiau, Jr-Hung Guo, "Developing a module-based security system for an intelligent home", *Artificial Life and Robotics*, Vol. 14, No. 2, 242-246, 2009.
- [7] Zoref Lior, Bregman David, Dori Dov, "Networking mobile devices and computers in an intelligent home", *International Journal of Smart Home*, Vol. 3, No. 4, 15-22, 2009.
- [8] Wang Zhixiao, Zhang Kewang, Yan Wenyao, Shehadeh Youssef El Hajj, Gao Ang, "A Next-generation Broadband Multi-Mode Intelligent Gateway for a smart home system", *International Review on Computers and Software*, Vol. 7, No. 5, 2378-2383, 2012.
- [9] Chien Hung-Yu, Lee Chin-Feng, Liu Shih-Bin, Wu Tzong-Chen, "Enhancing convenience and situation-aware intelligence of smart home services using passive RFID and intelligent controls", *International Journal of Internet Protocol Technology*, Vol. 5, No. 3, 166-173, 2010.
- [10] Jae Chul Moon, Soon Ju Kang, "A multi-agent architecture for intelligent home network service using tuple space model", *IEEE Transactions on Consumer Electronics*, Vol. 46, Issue 3, 791-794, 2010.
- [11] Sin-Min Tsai, Shyi-Shiou Wu, Shya-Shiow Sun, Po-Ching Yang, "Integrated Home Service Network on Intelligent Intranet", *IEEE Transactions on Consumer Electronics*, Vol 46, Issue 3, 499-504, 2000.