Wisdom Appliance Control System

Hendrick, Jyun-Teng Jheng, Chen-Chai Tsai, Jia-Wei Liou, Zhi-Hao Wang, and Gwo-Jia Jong
Department of Electronic Engineering, National Kaohsiung University of Applied Sciences, Kaohsiung, Taiwan
Email: aa81330@gmail.com;

Abstract. Intelligent appliances wisdom involves security, home care, convenient and energy saving, but the home automation system is still one of the core unit, and also using micro-processing electronics technology to centralized and control the home electrical products and systems, such as: lighting, television, fan, air conditioning, stereo, it composed of front-controller systems and back-controller panels, user using front-controller to control command, and then through the back-controller to powered the device.

1. Introduction
The principle of this seminar will control all of electrical products in our home via smart phone or tablet and it can also monitor your home electrical usage. Using the Application to synchronize the Bluetooth and then transmit the signal to the relay station, Thorough the infrared rays signal to control appliances.
Currently in our society, wasteful consumption by our negligence, or often forget the remote control where we put, and now just using your smart phone, you can easily control all electrical appliances at home, the idea of this system is not to energy saving but also the reduce the loss caused by the waste. [1]

2. T Research method
Using the smart phone to combined the micro-controller, and via Bluetooth to transmit the data as a communication, another micro-controller the relay station of the signal, the relay station controls transmit infrared LED, and transmit infrared code (data length 32bit), to control the motor and the situations bulb.
On the use of electrical appliances it has a fixed or infrared code, so using this topic to retrieve the infrared receiver to control the electrical infrared code, and its receiving frequency is 38 kHz, in using a microcontroller to store the encoded data, after the completion of this action which can be used to control appliances. The control range is wisdom involves, as long as the infrared control of home electrical products can be controlled, such as television, electric water heaters, air conditioners, electric fans, and others electrical appliances. [2]
3. System Architecture

3.1. System Architecture Process
As shown in Fig.1, the system using Bluetooth to establish a wireless transmission module, user using a mobile phone connect to the Bluetooth module and complete the linear control, Bluetooth, infrared control the TV, stereo, lights and switch in our home, so if the person who go out instantly they don’t need to worry about the appliances whether is turn off or not, to save time and home security to the win-win situation. [3]

![System Architecture flow chart](image1)

**Figure 1.** System Architecture flow chart

3.2. Infrared Transceiver System
As shown in Fig.2, the infrared signal using amplification Darlington circuit, in order to improve the emission from the shortage. Darlington amplifier is another form of direct coupling and the amplifier, between transistors connected in series in a straightforward manner, without adding any coupling element. The main effect is to provide the high-current amplification gain.

Darlington pair is the electronics by two (or more) bipolar transistor (or other similar integrated circuits or discrete components) to composed, first through this bipolar transistor amplified current can be further enlarged. Such a structure may provide the higher current gain than the others.

In the case of using the integrated current, the Darlington transistor can make the chip than two discrete transistor device the less space, because the two transistors can share a collector. Darlington transistor is usually packaged in a single chip, the look from the outside like a bipolar transistor [4].

![Infrared emission NPN Darlington circuit](image2)

**Figure 2.** Infrared emission NPN Darlington circuit.
3.3. **Infrared transceiver circuits**

Receiving circuit will record the home appliance infrared code by its learning mode, after the record and then switch to remotely control mode, the signal will emit from the infrared transmitter circuit. As shown in Fig.3 and Fig.4.

Learning remote control base on the principle of demodulation, and then receive the square wave record completely, you can ignore the protocol by it advantage, to avoid additional unknown problems. Each button needs to re-learning; a complete record of the square wave multiplied the number of buttons, each data code is not the same every time after emitted, often use different coding instructions, or certain remote control have copy protection, deliberately let the signal different each time (for example, garage door remote control), in which will be converted into different coding remote control, also it might not be used.

Usually most of the remote control instruction within 0.1 to 0.3 seconds, and as in the use just need a few bytes of data to be transmitted for using the time savings, if the instruction time stretch, it will make the reaction rate becomes slow, so the learning remote control signal can be set in the range of 0.3 to 0.5 seconds when it is identifying.

In addition, learning remote control records the amount of data size will be based on the type of protocol as a modification, the number of multi-byte instruction, the amount of data square wave variation is varying, then the use of relatively is large. Use 256bytes to record amount every single button more appropriate, if we don’t consider the use of space-saving, the best record of the amount of data is512~1Kbytes. [5]

![Figure 3. Infrared receiver circuit](image)

**Figure 3. Infrared receiver circuit**

![infrared receiver and transmitter circuitry](image)

**Figure 4. Infrared receiver and transmitter circuitry**

3.4. **Microcontroller Bluetooth module, protocol**

FIG. 5 is a microcontroller Bluetooth module, this topic using Bluetooth as a medium of communication to hardware, data transmission and reception. It works in the 2.45GHz band. Each Bluetooth technology of connect devices has base on the IEEE 802 standards developed by the 48-bit address; can be connected to one or one more, Bluetooth transmission range within 10 meters (0dBm) to 100 meters (20 dBm) about 1600 times per second using frequency hopping spread spectrum technology.
In the data transmission, Bluetooth with ACL (Asynchronous Connection-Less) type of connection, to provide the highest download data 723.2kbps and asymmetric nature upload data transmission rate 57.6kbps or symmetrical nature of the transmission rate 433.9kbps. In the parts of speech to SCO (Synchronous Connection-Oriented) type of connection, providing audio transmission rate of 64kbps. In addition, frequency hopping spread spectrum in the synchronous case, the transmitting and receiving via narrowband radio waves to transmit signals specific pattern, in order to avoid a specific frequency bands affected by other noise interference, sending and receiving transmit data in a short time, it will also switch to another frequency band, due to the constant switching frequency, and therefore more able to reduce a particular channel disruption. The launching of frequency hopping spread spectrum signals to follow specifically designed to avoid noise or duplicate channels and frequency hopping signals must follow the FCC (Federal Communications Commission) requirements, the use of more than 75 signal hopping and hopping a frequency to the maximum time interval of 400ms, in IEEE 802.11 the maximum time interval is typically set with 250ms, i.e. Frequencies 4 times per second. Moreover, the Bluetooth signal emitted must be less than 10 pico-W, it will emit one to three watts of transmit power when GSM phone starts, compared to mobile phone, Bluetooth damage caused is much lower. [6]

![Figure 5. Microcontroller Bluetooth Module](image)

Bluetooth protocol is divided into Radio, Baseband, Link Manager, L2CAP, HCI and Application Framework and other components, which is mainly responsible for the synthesis and Radio frequency noise filtering, Baseband main message handling code, and the code error resend hopping mechanism work, Link Manager is responsible for establishing the related Link, release, and even secrecy, etc., L2CAP is responsible for multi-tasking of different protocols, packet cutting and restructuring and quality of service and so on. HCI provides the interface between the Host and control Bluetooth, and as a hardware-independent standard control commands. As shown in Fig.6. [7]

![Figure 6. Bluetooth Module](image)
3.5. Arduino microcontroller

Arduino, is an open source microcontroller, which uses Atmel AVR microchip is a low-cost microcontroller, this is the century we using smart phone very often, Android is the open-source software and hardware platform. It provides a I / O interface, and can be used with the high-level language similar to Java, C language development environment.

Arduino is an open authorization interactive development environment technology, interactive installations everywhere, such as air-conditioning sensors to detect the temperature, the indoor temperature is adjusted automatically; the radar using on car, if the car too closed to the object the alarm will warning the driver. These devices increase the number of life safety and convenience. [8]

In the past, we need engineer to deal with the related electronic equipment, each single piece together a small element of the whole circuit. Most of the tools are designed for engineers; in addition to external circuits also we require extensive knowledge to complete the circuit. Fortunately, the microprocessor has made substantial progress, the reducing prices makes learning easily.

Open Source (open-source) is one of Arduino’s features, not only the open source software but also the hardware. Software development environment available for free download on the Internet, while the Arduino circuit design also available to download from the official website, but must follow with Creative CC license terms (Creative CC license terms). As shown in Fig.7. [9]

![Arduino ATMEGA328](image)

Figure 7. Arduino ATMEGA328

3.6. User interface

In the current ubiquitous intelligent application system, we need a powerful and efficient platform interoperability. Android's open source architecture that provides developers and users a very high flexibility, not only to attract a lot of smart developers have been put into the system, and there is a growing number of end-user devices are willing to import the Android platform.

Android is a Linux 2.6 kernel-based software platform and operating system, mainly developed by Google, after Google and semiconductors, mobile phones, telecommunications services and other manufacturers have established the Open Mobile Alliance (Open Handset Alliance), jointly for the subsequent development services. Because Android has been used as a complete, open and free mobile platform, so, Android mobile phone operating system by the community attention. As an open wisdom OS, Android system includes a number of features and a huge library of code. As shown in Fig.8. [9]
Android is a complete system for mobile phone, can be divided into two layers, the upper use Java to write applications, while the lower system program uses in C language. If we subdivided into two layers, it can be divided into the application layer on top of the Java application framework (Application Framework) and applications (Applications), and then the C language system layer is divided into the system library (Libraries) and the Linux operating system layer, thus forming a four-layer architecture as shown below in Fig.9.

![Android System Architecture](image)

**Figure 9.** Android System Architecture

4. Conclusion
Smart home combined the computer, communications, consumer electronics products, our home life can completely control via the computer, such as air conditioning, lighting, energy equipment, health care, energy saving and carbon reduction, to make the life more comfortable. Although the digital home is not equivalent to the wisdom of the family, but based on the digital home past few years we established, so that in recent years, smart home can be implemented quickly. It is necessary for a smart
home to integrate security, IT, networks, service-related industries, science and technology into the building, the future will be safe, convenient and comfortable. The study designed a smart home control system; the results can be confirmed through the integration of a variety of wireless sensor modules to be customized production. And we developed a system can control appliances correctly, such a system can be designed and expand for the features we need to carry out development portfolio, but some electrical equipment we need to modify to control, such as air conditioners or dehumidifiers and other household electrical equipment, to achieve the most comfortable environment. The most difficult in modify is to realize the different types of component specifications, welding circuit design, coordination and communication between each other. [10]

References
[1] G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. (references)
[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.86–73.
[3] I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
[4] K. Elissa, “Title of paper if known,” unpublished.
[5] R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
[6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” ASME Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
[7] M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.
[8] Electronic Publication: Digital Object Identifiers (DOIs):
[9] D. Kornack and P. Rakic, “Cell Proliferation without Neurogenesis in Adult Primate Neocortex,” Science, vol. 294, Dec. 2001, pp. 2127-2130, doi:10.1126/science.1065467.
[10] H. Goto, Y. Hasegawa, and M. Tanaka, “Efficient Scheduling Focusing on the Duality of MPL Representatives,” Proc. ASME Symp. Computational Intelligence in Scheduling (SCIS 07), ASME Press, Dec. 2007, pp. 57-64, doi:10.1109/SCIS.2007.357670