A Multi-Purpose Remote Controller Based on Bluetooth Mobile Phone

Chih-Hung Wu\textsuperscript{1}, Li-Shan Ma\textsuperscript{2}, Yu-Jyun Cai\textsuperscript{2}, and Ting-Fu Yeh\textsuperscript{2}

\textsuperscript{1}Department of Electrical Engineering
Chienkuo Technology University
Changhua, Taiwan
zhwu@ctu.edu.tw

\textsuperscript{2}Department of Electronic Engineering
Chienkuo Technology University
Changhua, Taiwan
malishi@ctu.edu.tw

Abstract—In this study, a multi-purpose remote controller based on Bluetooth mobile phone (MRCBMP) is proposed to provide users for a convenient control interface. The IR, RF and Bluetooth modules are integrated into the microcontroller module cooperated with Bluetooth mobile phone by Bluetooth module. By MRCBMP, users can control IR, RF and Bluetooth controlled objects without the numerous conventional remote controllers.

Keywords—Remote Controller, IR, RF, Bluetooth, Mobile Phone

I. INTRODUCTION

With the more household appliances entering everyone’s home today, the more and more remote controls are created to be accompanied with increasing variety and brands of appliances. The numerous remote controls make the operations inconvenient, because user needs to switch from one control to another when user wants to control different appliance [1].

In the commercial market, the called universal controllers are promoted to reduce increased the amount of remote controllers. A universal controller support fixed brands and types. When the controlled objects are not listed in a universal remote controller, the control process is invalid. In addition, universal remote controllers are mostly designed respect to IR, so the wireless or the other types control technologies cannot be supported by universal remote controllers. The roller shutter controller, the vehicle controller, and others are designed by the RF technology. In daily life, we should bring many of them with us. In fact, it is inconvenient. Therefore, how to release the universal IR remote controller limitation on brands and types and how to provide RF technologies compatible are important issues [2-4].

At present, traditional mechanical keys are still applied for the entrance mechanism. For the advanced security reason, inputting the passwords or using induction technologies are mainstream applications. For example, the RFID is an induction application. The RFID reader induces the tag and read the data from tag to control entrance mechanism. Sometimes, users may forget to bring the RFID card with themselves or passwords, so they are kept out of the door. In daily life, we always bring a lot of different remote controllers for controlling entrances or for some enable functions. Unfortunately, we often lose them. It is very inconvenient and embarrassed [5-8].

On the other hand, the mobile phones are the necessary hand-held equipments. The development movements of the mobile phone are smaller, more multifunction, more portable, and easier use. The mobile phones are applied for voice and data communication. Additionally, the build-in Bluetooth is applied as wireless communication interface. The Java relative applications are also included in it.

In this work, three wireless control interfaces hardware including IR, RF and Bluetooth are integrated in a portable mobile phone. The integrated hardware can co-work with Bluetooth interface and JAVA program in a mobile phone. We can input the control data of the different brands and types into the mobile phone. The data will be stored in the memory of mobile phone. The users can control different controlled objects without changing the controller hardware in the mobile phone. Compared with traditional universal controllers, this work provides more flexible extension. The users can save the hardware cost for universal remote controllers. The user can download the control data and programs from the websites. The life circle of this design can be extended longer. This work can provide smart entry for entrance mechanism with the Bluetooth technology too. The users can avoid the embarrassed situation of forgetting bringing key. Furthermore, the checking password operation in the Bluetooth technology enhances the security of entrance mechanism.

This study proposes a multi-purpose remote controller based on Bluetooth mobile phone, and the block diagram for daily applications is shown in Fig. 1.

This paper is organized as follows. Section 1 is an introduction. Section 2 describes system structure of MRCBMP. The functions of HWCP are addressed in Section 3. Conclusions and suggestions are finally drawn in Section 4.
II. SYSTEM STRUCTURE OF MRCBMP

A. Hardware design

The hardware block of MRCBMP, shown as Fig. 2, consists of microcontroller module, Bluetooth module, IR module, RF module and Bluetooth mobile phone. When the user wants to control an object and then presses the button on the mobile phone, the running Java program will send the control command to the controlled object via IR, RF or Bluetooth wireless communication. This study firstly integrated Bluetooth module, IR module and RF module into microcontroller module. This integrated module with Bluetooth, IR and RF wireless communication technologies based on microcontroller module is connected with Bluetooth module via RS232 interface to communicate with Bluetooth mobile phone. According to which wireless communication used by controlled object, the integrated module passes this control command received from Bluetooth mobile phone to IR or RF module. The IR or RF module transforms control command to transmission code, and then transmits this code via IR or RF wireless communication to the controlled object. The descriptions of microcontroller module, Bluetooth module, IR module, RF module and Bluetooth mobile phone are addressed as the following sections.

1) Microcontroller module

This module uses the PIC16F877A as microcontroller to deal with the control command received from Bluetooth mobile phone by Bluetooth module. If the controlled object is an electric fan or TV, the microcontroller module will drive the IR module to send the control command via IR wireless communication to the controlled object. If the controlled object is a car or roller shutter, the microcontroller module will drive the RF module to send the control command via RF wireless communication to the controlled object. The hardware block and prototype of microcontroller module is shown as Fig. 4.

2) Bluetooth module

The Bluetooth module is responsible for communication between microcontroller module and Bluetooth mobile phone. It receives the control command from Bluetooth mobile phone, and then sends this command to microcontroller module via RS232 interface. The hardware block and prototype of Bluetooth module is shown as Fig. 4.
3) IR module

The IR control transmitter in IR module combines the control command with custom code to generate the transmission code. The transmission code is modulated with carrier to be sent to the controlled object via IR led driver circuit. The hardware block and prototype of IR module is shown as Fig. 5.

4) RF module

The RF encoder IC in RF module combines the control command with address code to generate the transmission code. The transmission code is sent to the controlled object via RF transmitter. The hardware block and prototype of RF module is shown as Fig. 6.

5) Bluetooth mobile phone

This study chooses the SonyEricsson K600i with Bluetooth-enabled and Java-supported capabilities to run the hybrid wireless control program (HWCP) written in Java language. The prototype of MRCBMP is shown as Fig. 7.

B. Software design

1) Hybrid wireless control program (HWCP) on Bluetooth mobile phone

The HWCP is written in Java language to provide user with control interface for controlled objects based on MRCBMP. This program detects which controlled object on HWCP is selected by user, and then sends this control command to MRCBMP via Bluetooth wireless communication. The HWCP uses the JSR-82 to drive the Bluetooth module in mobile phone to communicate with microcontroller module in MRCBMP. The JSR-82 is the official Java Bluetooth API standardized by the Java Community Process in 2002, which allows Java program to use Bluetooth on supporting devices [9]. The diagram of protocol layers and profiles of HWCP and Bluetooth module is shown as Fig. 8.

2) Program on microcontroller module

The program on microcontroller module is written in C language to provide the HWCP with capability of hybrid wireless control. The Bluetooth module connected with microcontroller module receives a control command from Bluetooth mobile phone via Bluetooth wireless communication, and then sends it to microcontroller module through RS232 interface. When the control command reaches the microcontroller module, this coming of control command will generate an USART receive interrupt to inform microcontroller module to process this control command. According to which wireless communication used by controlled object, the microcontroller module passes this control command to IR or RF module.
III. FUNCTIONS DESCRIPTION OF HWCP

The MRCBMP applied on daily applications can control objects via IR, RF or Bluetooth wireless communication. The IR controlled objects include TV and electronic fan. The RF controlled objects include roller shutter and car. The Bluetooth controlled object is the Bluetooth door lock controller.

The operation flow chart of HWCP is shown as Fig. 9. The squares in Fig. 9 represent the menu and selection items. The ellipses in Fig. 9 represent the button functions. The detail descriptions of menu, selection items and button functions are written as the following sections.

A. Main control menu

The main control menu has three parts including IR menu, RF menu and Bluetooth door. User can select one control item by up and down key, and then presses the “Enter” button to enter the submenu. If user presses the “Exit” button, the HWCP will be terminated. The operation diagram of main control menu is shown as Fig. 10.

B. IR menu--TV

This menu has two control items of turn-on and turn-off for TV power. After selecting one control item, user can press the “Send TV Control” button to control TV power, or press “Exit” button to return to main control menu. The operation diagram of IR control menu of TV is shown as Fig. 11.
C. IR menu -- electronic fan

This menu has two control items of turn-on and turn-off for electronic fan power. After selecting one control item, user can press the “Send Air Control” button to control electronic fan power, or press “Exit” button to return to main control menu. The operation diagram of IR control menu of electronic fan is shown as Fig. 12.

D. RF menu -- roller shutter

This menu has three control items of UP, STOP and DOWN for roller shutter operation. After selecting one control item, user can press the “Send Roller Shutter Control” button to operate roller shutter, or press “Exit” button to return to main control menu. The operation diagram of RF control menu of roller shutter is shown as Fig. 13.

E. RF menu -- car

This menu has three control items of FORWARD, STOP and BACK for car driving. After selecting one control item, user can press the “Send Car Control” button to drive the car, or press “Exit” button to return to main control menu. The operation diagram of RF control menu of car is shown as Fig. 14.

IV. CONCLUSIONS AND SUGGESTIONS

This study has proposed a multi-purpose remote controller based on Bluetooth mobile phone. IR, RF and Bluetooth wireless communication technologies are integrated into MRCBMP design to provide users for a convenient control interface. By MRCBMP, users are able to control IR, RF and Bluetooth controlled objects without numerous conventional remote controllers. The suggestions of future works are given as follows. We will integrate microcontroller module, Bluetooth module, IR module, RF module and Bluetooth module into a chip to reduce the hardware size of MRCBMP. Besides reducing size, we will set up a controlled object database with common household appliances and daily applications. If users buy a new household appliance, they can download its control data from internet to change their controlled object in the HWCP without any additional cost.

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REFERENCES

