

Chapter 16. Digital Control using PC with IR

1. Introduction

This chapter is based on a student project, "DigiHouse" by Scotty Mazyck II completed in Spring 2003, which aims to control home appliances using a PC. The essence of "DigiHouse", in PIC 16F877 application point of view, uses two hardware components, one with a 16F877 and other necessary parts and elements, and the other without any microcontroller but with an IR decoder circuit. The one hardware component, IR Master station, contains a 16F877 microcontroller, IR encoder, IR receive, and a serial communication level converter chip RS232 chip. The RS232 chip, when you use a USB based PIC board such as PIC-40-USB from Olimex, is not necessary. The USB control chip in the PIC board handles all serial communication from 16F877. The other component, IR Receiver/Controller, contains an IR receiver and IR decoder circuit. The IR decoder circuit has three LED outputs to simulate the three home appliances this project intends to control. Scotty Mazyck's report on his project DigiHouse contains many interesting aspects: IR transmission, IR encoding, IR reception, and a Visual Basic-based Windows program which, in place of the HyperTerminal, allows a serial communication link between a PC and the IR Master station. This comprehensive work, however, is not properly documented. The project report submitted to me, less than 4 page length, only briefly touches its components and coding.

So I reconstructed his project with much more detailed explanation in words and illustrations. However, I did not change his code except the file register bank changing operations. For example, moving from bank 0 to bank 1 to access TRISC register, the original code bothers to set the RP1 bit of STATUS register. This works fine and perfect. However, we can use the MPLAB directive `banksel` to ignore in which bank we are, and to move any bank where the register we try to access is located. With `banksel`, we do not have to frequently look up the file register table to see where a particular register is located.

2. Digital Control using PC - overview

In the Internet age, everybody gets lazy, and our life hinges on network and computer. Now I am very sorry that I provide one more convenience so that you become lazier and more inactive. This example is to control your home appliances like lamps, microwave, heater, or A/C from and using your PC. Of course computer alone cannot do the job. A microcontroller would be just fine to fit in to the case. The term "control" here means a simple on/off control of the appliances.

As we know IR remote control is everywhere and for most of our electronic appliances at home and office. We use IR remote to turn on/off of TV, VCR, CD player, DVD player, etc. But how do we do the same functions using a PC instead of an IR remote? There must be a way to communicate from PC to "IR remote" like device, which can transmit IR information as an IR remote does. This requirement is realized by the IR Master Station. The IR Master station is built around the PIC 16F877 which establishes serial communication with PC and transmits IR data to the IR-ready electronic appliances. In chapter 5, we already discussed about the serial communication, therefore, the communication between PC (using the Hyperterminal in Windows) is not bit a problem. However, if you want to open up your own window in the PC screen with your name or your log, the Hyperterminal cannot be used. Instead, a windows

program based on Visual tool such as Visual Basic is needed. This Visual Basic code is discussed in a separate section.

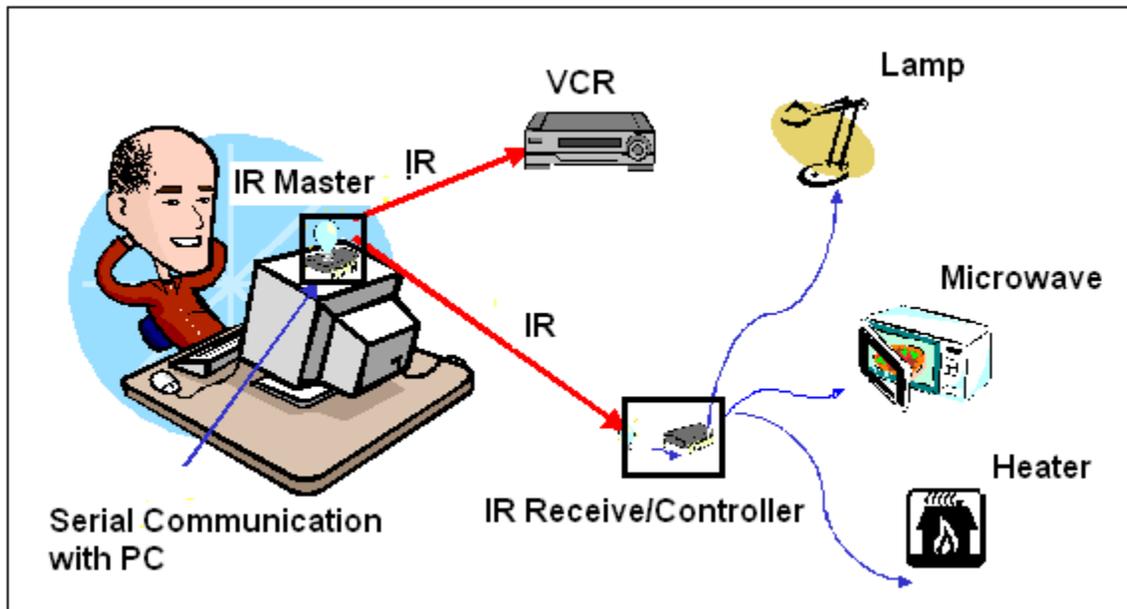


Fig. 101 Control of Home appliances from and using the PC

Then, how do we control those appliances that are not equipped with IR receiver. Most of the home appliances like lamp, microwave, heater, etc are all not IR-ready devices. Here comes the IR Receiver/Controller which is built around an IR receiver and decoder so that a select line could be turned on or off (of course logically). This logical on/off (High or Low, or +5V or 0V) can turn on/off an electronic switch connected to the appliance. In this example, however, we simplified the control part by LED on/off at the IR Receiver/Controller side. In the circuit we installed 3 LEDs, one for each appliance's place, and if an LED is on, for example, the corresponding appliance would be on.

Another function we added in the IR Master is IR learning function. For example, using a real IR remote controller, if you assign the button "2" as the command for the microwave, you aim your remote toward the IR receiver of the IR Master so that it learns the IR command pattern for the appliance. This pattern is stored in the memory, and later, when the microwave control is needed, the stored pattern is used to transmit directly from IR Master (without using any IR remote controller) to the IR Receive/Controller.

3. Hardware Description

IR Master Station: IR Master, implemented on a breadboard as pictured below, consists of 16F877 microcontroller operating at 20MHz, and IR transmitter/receiver. In addition to the essential elements, it has several LEDs as indicators. Also, it has an IR LED to send out pulse IR encoded message generated by an encoding circuit.