CHAPTER 9
NEW JERSEY INSTITUTE OF TECHNOLOGY

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PC INTERFACE ENVIRONMENTAL CONTROL UNIT

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INTRODUCTION

The purpose of this project was to develop a PC interface to activate an environmental control unit.

SUMMARY OF IMPACT

This device allows the control of appliances, lights, etc. by means of the PC. Whatever means are used to control a PC can be used to control the environment. Since the power line is used for transmission, the control PC can be placed anywhere in the home.

TECHNICAL DESCRIPTION

The unit consists of two parts, a PC interface and X10 technology. The PC interfaces with the control unit by means of an RS 232 cable connected to a serial port of the computer. Codes from the PC are passed through the RS232 port to the microprocessor, where they are converted into X10 codes. These codes are then sent to an X10 transmitter that puts the codes on the power line, and are picked up by the appropriate receiver to control the corresponding device.

X10 technology entails a communications language that allows compatible products to talk to each other via the existing 110-volt electrical wiring in the home. A Lynx 10 microprocessor is used to decode the signals from the PC and send them to the X10 transmitter module.

The signaling sequence consists of 11 bits that include a two-bit start sequence, a four-bit house code, and a 5 five-bit key code. A bit is represented by bursts of 120 KHz carrier superimposed on the 60 Hz AC power and is produced by gating the carrier for about 1 ms., synchronized with the zero crossings of the 60 Hz signal.

The X10 units are first addressed by sending the house code and unit code. This operation tells the units to expect a command. In this way, several units on the same house code can be addressed simultaneously. Next, a command or series of commands is sent to the units.

The approximate cost for the prototype unit was $120. This includes the microprocessor and X10 modules.

SPEECH RECOGNITION FOR AN ENVIRONMENTAL CONTROL UNIT

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INTRODUCTION

This project investigated the use of speech recognition technology to control an environmental control unit. This unit allows for control of up to four devices.

SUMMARY OF IMPACT

Speech recognition is an increasingly attractive choice for control of appliances, tools, toys and computers. Persons with disabilities can benefit greatly from being able to control their environment through voice commands. With this project, radio frequency (RF) technology allows control from a different room or from a different part of the room. The person with disabilities can therefore remain stationary and control appliances, temperature, and lighting anywhere in his / her home.

TECHNICAL DESCRIPTION

The system consists of three modules: a voice recognition module, a logic circuit with RF transmitter / receiver, and four line carrier decoders. The voice recognition module recognizes spoken commands and relays the command to the logic circuit, which decodes the signal and provides a pulse to the transmitter. The transmitter in turn sends a signal to the receiver that activates a device, such as a door, lamp, or television. The hardware was chosen because of its ease of use and minimal expense.

The voice recognition chip used is the HM2007, which was trained to recognize four words. Once trained, a word is spoken into the microphone and a number 01, 02, 03, or 04 is displayed. The voice kit was purchased pre-assembled except for the outputs from the board that would then connect to the logic circuit.

The HM2007 voice kit has an accuracy of detection in the 60 to 70 percent range. Although this is not acceptable for a commercial system, it is acceptable for this prototype system. The fact that the kit comes assembled and is inexpensive made it appropriate for this project, despite its reduced accuracy. One possible reason for its poor performance is the quality of the microphone. Future work will investigate the use of a better microphone. The logic circuit consists of three sub-modules. The first sub-module receives a signal from the voice board and classifies it. The second sub-module takes the output of the first sub-module and provides a single one-second pulse. The third sub-module uses the one-second pulse to provide an electronic contact closure for use on the RF transmitter. The contact closure simulates the push of a button on a remote control, thereby sending a signal to the RF receiver. Originally a microcontroller was to be used instead of the logic circuit. However, no timing information was available from the voice board so that a microcontroller could not be synchronized with the voice board. The RF transmitter / receiver module is connected to the logic circuit. Once a signal pulse is received from the logic circuit, the transmitter (RC5000 PHR02 Home Automation Remote) relays the pulse to the receiver. The receiver (RC5000 PAT01 Home Automation) then sends a signal through the home's 120-volt AC circuitry. A line carrier decoder (PAM01 AGC Appliance Module) decodes the signal. If that decoder is set to receive that particular signal, it will turn on the device to which it is attached. The approximate cost for the prototype unit was $245, including the voice recognition board. Future iterations of this project may be made less expensive if the voice board is custom made.

SPEECH RECOGNITION FOR ENVIRONMENTAL CONTROL OF A WHEELCHAIR

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INTRODUCTION

This project is a continuation of the previous project (Speech Recognition for an Environmental Control Unit). The goal was to increase the command capability of an environmental control unit to control not only the environment but also the wheelchair motion of an electric wheelchair by voice commands. To accomplish this goal, the hardware and software of the previous project were expanded to allow up to 16 commands to be recognized (the previous project recognized four commands). The device employs RF technology so that a person using a wheelchair can control the environment from a different room.

SUMMARY OF IMPACT

People who use wheelchairs may have limited use of their hands or arms, leaving them unable to control wheelchair motion or environmental functions. Such patients whose speech functions are within normal limits can use speech recognition to perform control functions. A device that integrates wheelchair motion control and environmental control would be an asset to such individuals.

TECHNICAL DESCRIPTION

This project is based on the design for the project previously described. A voice recognition board is interfaced to a logic circuit that decodes the voice commands and then controls a transmitter to send a signal to an X10 transceiver, which is connected through the power line to X10 receiver modules. For this project the HM2007 voice recognition board was used as well as the HK10A Super Remote Home Automation System, which includes a 6-in-1 IF/RF remote already interfaced with two X10 modules, one transceiver module and one lamp module.

In order to use voice recognition for wheelchair control in addition to environmental control, a sequence of two or three commands is necessary to achieve the final result. For example, in order to turn on a light, the user would say, “lights, turn, on”. This multiple command sequence adds a great deal of complexity to the hardware and software.

The approximate cost for the prototype unit was $295, including the pre-assembled HM2007 voice recognition board. Future iterations of this project would be less expensive if a custom designed voice board were used.