Chapter 7
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A VIBRATORY ALARM FOR A VENTILATOR

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INTRODUCTION

The purpose of this design project was to construct a non-auditory alternative to the audible alarm found on a commercial ventilator unit. The client, who has a hearing impairment, is the caretaker of a patient on a ventilator. The system consists of a vibratory-motion wireless transmitter and receiver, both battery powered, contained in two separate cases. The transmitter connects to the alarm output of the ventilator. The receiver is contained in a case that can be worn as a beeper. The unit is small, lightweight and inexpensive.

SUMMARY OF IMPACT

A patient recovering from a stroke was discharged to his home to be cared for by a close relative who has a hearing impairment. The patient was confined to a ventilator with an audible alarm that would sound if the ventilation exceeded preset limits. Because the caregiver could not hear the alarm, he was confined to the patient's room, afraid to leave in case the respirator were to malfunction. The alternative design allows the caregiver unlimited freedom of motion within the house, up to a distance of 50 feet from the ventilator. The vibratory alarm is similar to that of a beeper.

Other uses for such a device are envisioned. For example, a non-audible alarm is suitable in any noisy environment. One potential use of this device would be for nurses moving around hospital floors. Another would be for caregivers at home who may otherwise be worried about operating a vacuum cleaner or other noisy appliance, or about moving to a part of the house distant from the patient.

TECHNICAL DESCRIPTION

This project features an RF transmitter unit and RF receiver unit that can operate up to 50 feet apart without requiring line-of-sight transmission. This allows the two units to be in different rooms with walls or doors between. The transmitter unit is attached to the ventilator with a two-wire cable. When the ventilator alarm is activated, the transmitter is triggered and it, in turn, sends a signal to the receiver. The signal is continuously sent as long as the alarm is active. The receiver signals the caregiver through a motor, which creates a vibratory output.

Several difficult issues were overcome in order to develop this project. One issue concerned the interface between the ventilator and the transmitter unit. It was first hypothesized that the circuitry of the ventilator would have to be modified. However, the ventilator that was used had a BNC connector to allow the use of remote alarms. This remote alarm connector could be modified by jumper settings within the ventilator. The option chosen provided a normally open circuit (no alarm condition) that became short-circuited under alarm conditions. This option was used to turn the transmitter on and off.

The second issue was related to the mode of signaling the caregiver. Possible options included vibratory and visual indicators. The vibratory option was selected and the receiver was designed as a beeper with a vibratory output. A motor similar to a beeper motor was used with a head which, when contacting the case, provided a strong vibratory output.

The transmitter is housed in a case of 1.5 by .75 by 2.5 inches. It is powered by a 12-volt alkaline battery, type MN21 or A23. A small LED is illuminated when the transmitter is on and the brightness of the LED indicates the condition of the battery.

The receiver is lightweight and is housed in a case of 4.5 by 2.5 by 1.0 inches. It operates on two AAA alkaline batteries, for a total of 3 volts. It has a clip for attaching the unit to an article of clothing. The strength of the motor's vibration can be adjusted by a potentiometer inside the case.

The cost for the entire prototype unit (excluding the ventilator) is about $100.00. The electronics for the transmitter and receiver were purchased as a package so that no design or construction of these circuits was necessary.

Figure 7.1. A Vibratory Alarm for a Ventilator.

VOICE ACTIVATED COMPUTER REBOOT SYSTEM

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INTRODUCTION

The goal of this project was to design and develop a low cost voice activated computer reboot device for people who have difficulty using a computer keyboard or control buttons. Rebooting a computer becomes necessary in several different situations. First, if a computer becomes hung up, the only option may be a reboot. Second, a laptop with a power saving feature will shut down if it is not used for some period of time. If a person is using the computer in a voice operated mode and the computer shuts down, the voice operation also becomes inactive and there is no way to re-start the machine by voice. A voice activated system was designed to interface with and provide signaling to a computer to make it reboot or re-start. The project was designed to be an independent device, functioning independently of the host computer.

SUMMARY OF IMPACT

Computers are becoming almost indispensable to many, including people with disabilities. Therefore, it is important to design computers and peripherals so that all people can at least turn the computer on and off and perform simple word processing tasks. For many people with disabilities, the voice is the best or the only means of interfacing with a computer. There are several voice operated word processing systems available to address this problem. However, the computer itself must also be controlled by voice. Persons who require voice activation features need desktop computers to have voice activated booting and rebooting functions, as well as a means of turning the computer on from an off condition. Such persons have these same requirements for laptops, as well as a need to circumvent the additional problem of a power-saving feature that shuts down the computer after a period of non-use, such that voice operation becomes inactive. A stand-alone voice activated system, separate from the computer it is controlling, was designed. The system was to have an output that could be used to control the computer.

TECHNICAL DESCRIPTION

The voice activated reboot system consists of two main subsystems that are interfaced together. The control subsystem is implemented by a R-31J evaluation board and READS (Rigel's Embedded Applications Development System). It has an Intel 8031 microcontroller, 32K of SRAM, 32K of monitor EPROM, 4 I/O ports, 12 general purpose digital input/output bits and an RS232 serial port. The voice recognition subsystem is centered around the HM2007 voice recognition chip, which was selected because it provides the basic required functions and is available at low cost and in small quantities. The chip was purchased as part of a development system from Images Company. It features single chip speaker dependent isolated word voice recognition, recognizes a maximum of 40 words, supports two control modes (manual and CPU), has a response time of less than 300 ms, and operates from one 5-volt supply. It can be connected to a microphone at its analog front end and to 64K SRAM. The voice recognition subsystem acquires the input from the microphone and processes the voice pattern. The control subsystem monitors and controls the operation of the voice recognition unit.

The HM2007 voice recognition chip has six control functions of which four were used in this project: RECOG, TRAIN, RESULT and RESET. In addition, the HM2007, in the CPU mode, has a K bus and S bus available, which are connected to the I/O pins of the microcontroller through bus transceivers. When the microcontroller sends the TRAIN command to the HM2007, the HM2007 begins training for a selected word. The RECOG command causes the HM2007 to initiate the recognition process for the word spoken into the microphone. The RESULT command causes the HM2007 to send the recognition result to the microcontroller. The RESET command will clear the patterns in the SRAM of the HM2007.

Once the training mode is completed, the normal operating mode is as follows. When the user issues a voice command, the voice recognition system processes the voice input and sends the result of the recognition to the control unit. The control unit then examines the resulting word number and decides if the result is a reboot command, a clear command, or no match. If a reboot command is found, the control unit sends a pulse to the host computer reset pins and causes the computer to reboot. If the clear command is recognized, the control unit commands the voice recognition unit to clear all the voice patterns in its memory and change into the training mode. Figure 7.2 is a block diagram of the operation of the system.

The device was successfully completed and tested. Future work will address the problems encountered with the HM2007, including its poor performance in noisy environments. The costs for the project totaled approximately $200 due to the use of voice recognition and microcontroller development systems.

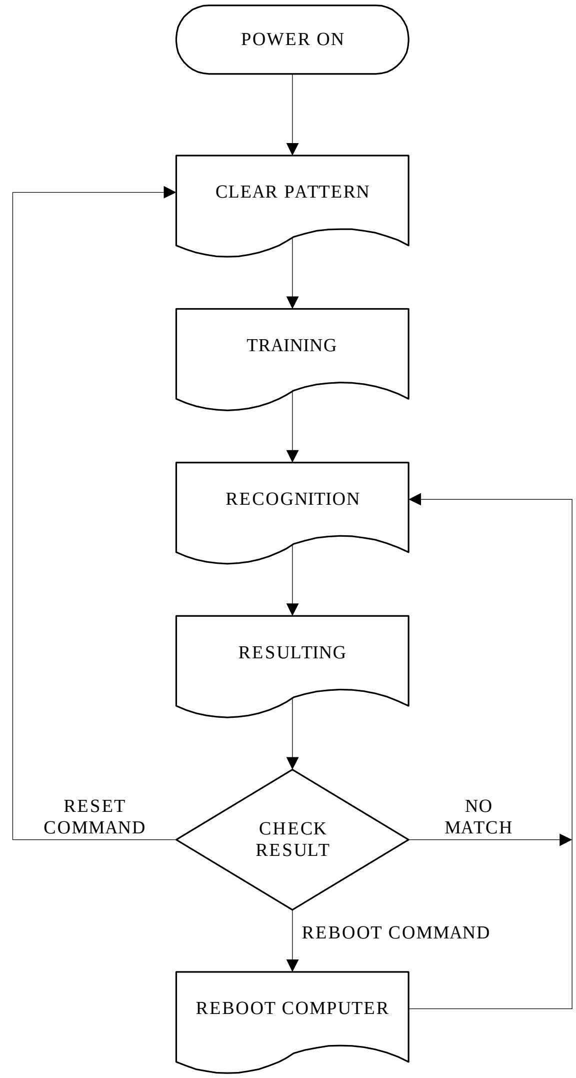

Figure 7.2. Block Diagram of the Operation of the System.

INTERFACE FOR TELEPHONE VOICE ACCESS

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INTRODUCTION

The goal of this project was to design and develop an inexpensive voice control interface for telephone use by persons with disabilities. The device provides telephone features commonly used today, including dialing, flash for call waiting, redialing, phone on/off hook, and speed dialing. It also provides access to features provided by the telephone company. Additionally, the interface can answer incoming calls. The device is placed between the telephone set and the subscriber line connected to a central office. It contains a voice recognition module interfaced to a microcontroller. The user operates the interface through a microphone that provides both the voice control and voice input to the telephone line after a connection is made. The device contains a speaker that allows the user to receive feedback during the dialing (control) process and to hear the person at the other end of the connection.

SUMMARY OF IMPACT

A universal device such as a telephone should be accessible by all, including persons who are unable to use their hands because of deformity, amputation, paresis, or paralysis. Currently, many persons with disabilities are deprived of the means to telephone access. This device provides a hands-free means of accessing the control functions of the telephone to either initiate or receive a call, and to send and receive spoken information after the call is completed. The control is performed through voice recognition of simple one- or two-word commands, which include dialing information. The user receives feedback as to the progress of the dialing. In order to be as versatile as possible, the interface provides access to all commonly available features of the telephone system including speed dialing, call waiting, and redialing.

TECHNICAL DESCRIPTION

A block diagram of the system is shown in Figure 7.3. A description of the blocks follows:

The telephone is a simple line telephone of the type commonly used in homes. No modifications are made to the telephone. The transducers are a microphone and speaker. The microphone is used as the interface between the user and the voice recognition circuit. It provides control information to the unit and allows the user to speak to the person at the other end of the connection. The speaker allows the user to listen to the person at the other end, and provides feedback to the user regarding the progress of the control.

The switch is used to determine whether the telephone or the voice recognition circuit is connected to the telephone line. The voice recognition circuit determines the position of the switch.

The voice recognition circuit provides all the control signals for the interface unit. It sends control signals to operate the switch as well as signals to the touch-tone generator.

The touch-tone generator receives input from the voice recognition circuit. The tones sent out from this unit to the central office are used for dialing, and depend on the signal from the voice recognition unit as well as the number requested by the user.

The memory allows for such features as speed calling, redialing and call forwarding. The controller provides the overall control of the system. The voice recognition unit accepts the following commands:

?? Access - to switch the system from manual mode to voice command mode

?? Answer – to answer an incoming call

?? Dial - causes desired number to be sent over the telephone line

?? On hook - terminates existing call

?? Redial - redials last number dialed

?? Mute - activates mute service (distant end cannot hear local conversation)

?? Clear - deactivates mute

?? Flash - generates a switch hook flash for custom calling features (call waiting, conference, speed calling).

Voice recognition is performed by a HM2007 voice recognition chip and was purchased as a development system from Images Company. This system is interfaced to an 8751 microcontroller and uses integrated circuits for touch-tone dialing and telephone line interface. In addition, a voice switched speakerphone integrated circuit is used to provide the two-way conversation ability.

The interface unit has been built and tested. The cost for the unit is approximately $300. Further information on this project is available from the principal investigator.

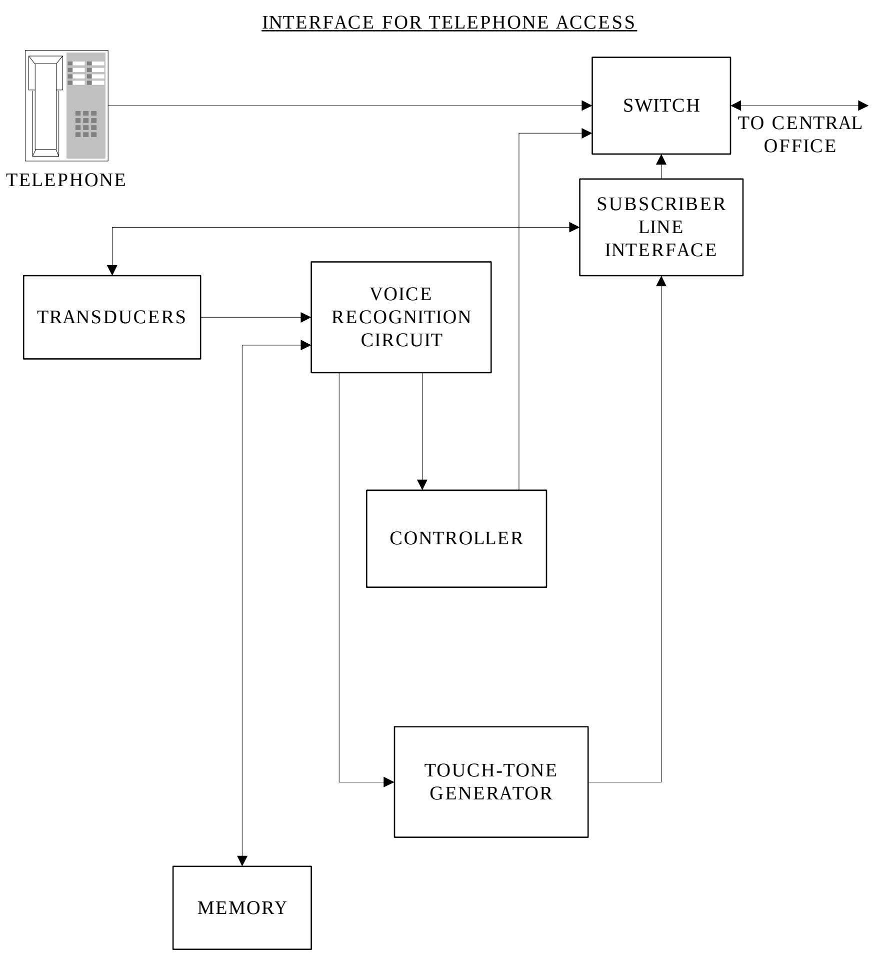

Figure 7.3. Block Diagram of the Interface for Telephone Voice Access.