

Personal Communications Device for Individuals with Speech Impairments

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INTRODUCTION

The Personal Communications Device for Individuals with Speech Impairments (PCDISI) that we constructed is designed to aid a person in communicating with another individual. It gives the user more independence and decreases their dependence on others. We designed our device based on a current production model of the LightWRITER™ (LW) manufactured by Toby Churchill Ltd.

Our design concept is simple in nature: mimic the LW. A LW is a device that allows a user to type sentences or phrases via an attached keyboard. The sentences or phrases are displayed on a pair of LCD screens. One screen faces the user and the other faces the person the user is “talking” to. In addition to the display our design includes a speech output that speaks what the user types.



Figure 1. Personal Communications Device for Individuals with Speech Impairments.

SUMMARY OF IMPACT

The design criteria for the PCDISI were established by Wyoming New Options in Technology (WYNOT). Currently, they have one LW and were interested in purchasing more, however additional LWs are beyond their budget. So, they were looking for alternatives. More than that, they were looking for proof that a device with similar functionality could be built and tailored to the specific needs of a given individual.

TECHNICAL DESCRIPTION

The personal communications device consists of a standard PS/2 keyboard, a Motorola HC11E9 microprocessor, twin 4 line by 40 character LCD displays, and a RC Systems text-to-speech (TTS) processor. Our design utilizes off-the-shelf components in an effort to reduce component cost and to simplify the design. An HC11E9 running in single chip mode controlled the keyboard, LCD screens, and the TTS processor. The various devices use TTL compatible voltage levels, therefore enabling a direct interface to the HC11, simplifying the design.

We are using several different ports on the HC11 to control the various components. The text-to-speech processor uses the Serial Communication Interface port. The LCD screens and the keyboard use generic input/output (I/O) ports. Our design utilizes most of the available I/O resources of the HC11. Our rationale for this was to maximize resource efficiency and to minimize programming, packaging, and power consumption.

The HC11 will receive input from the keyboard, convert it into an ASCII value, and output that ASCII value to the LCD displays and the TTS processor. The HC11 is just under the white plastic connector in Figure 2. The board on the left in Figure 2 is the TTS. Also shown is the speaker for the TTS, the internal battery pack, and the volume control (upper left).

The keyboard outputs characters by means of a scan code; different from the standard ASCII character set. The LCD screens and the text-to-speech processor take only ASCII input. This presents a problem, somehow the keyboard input must be converted to ASCII so that it can output to the LCD screens and the text-to-speech processor. The keyboard's PS/2 interface contains two wires of interest here, the data and clock lines. Both lines were connected to generic I/O pins of the HC11. The clock line was monitored for a transition from the idle state (high) to the start state (low). Starting with that transition data is "read" by the HC11. Data is shifted one bit at a time into an internal register as it is received by the I/O port. This must be done for the data is sent serially by the keyboard as the character's scan code. The HC11 checks this scan code against known values. When it finds a match, it outputs the associated ASCII value to the LCD displays and the TTS processor. The program includes checks for CAPS LOCK key, Shift key, etc.



Figure 2. Picture of Internal Components
(TTS is on the left and HC11 on right)

The LCD displays and the TTS processor receive the ASCII value separately. The LCD displays require parallel data. The TTS could operate with parallel data, however, due to the limited number of I/O pins on the HC11 and to maintain upgrade capability of the TTS, the data is sent serially through the SCI port of the HC11. Configuration of those ports on the HC11 was matched to the needs of the device. Default configurations were used on the LCD displays and the TTS.

An infinite loop dominates the programming. The keyboard input is read, displayed on the LCDs and "spoke" by the TTS. Those three steps are then repeated. The unit does contain a battery voltage level indicator. The battery voltage is checked while waiting for input from the keyboard. When the battery voltage drops below approximately eight volts, the LED color will turn from green to red, alerting the user that the battery needs charged via an external connector visible in the upper right of Figure 2.

The cost of parts/material was about \$400.