An Interactive Wireless Morse Code Learning System

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INTRODUCTION

Morse code has been shown to be a valuable tool in assistive technology, augmentative and alternative communication, and rehabilitation for some people with various conditions, such as spinal cord injuries, non-vocal quadriplegics, and visual or hearing impairments. In this article, a mobile phone human-interface system using Morse code input device is designed and implemented for the person with disabilities to send/receive SMS (simple message service) messages or make/respond to a phone call. The proposed system is divided into three parts: input module, control module, and display module. The data format of the signal transmission between the proposed system and the communication devices is the PDU (protocol description unit) mode. Experimental results revealed that three participants with disabilities were able to operate the mobile phone through this human interface after four weeks' practice.

BACKGROUND

A current trend in high technology production is to develop adaptive tools for persons with disabilities to assist them with self-learning and personal development, and lead more independent lives. Among the various technological adaptive tools available, many are based on the adaptation of computer hardware and software. The areas of application for computers and these tools include training, teaching, learning, rehabilitation, communication, and adaptive design (Enders, 1990; McCormick, 1994; Bower et al., 1998; King, 1999).

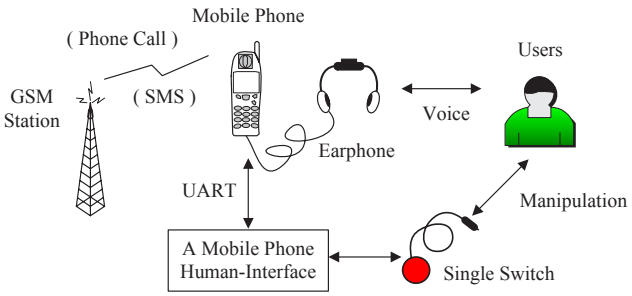
Many adapted and alternative input methods now have been developed to allow users with physical disabilities to use a computer. These include modified direct selections (via mouth stick, head stick, splinted hand, etc.), scanning methods (row-column, linear, circular) and other ways of controlling a sequentially stepping selection cursor in an organized information matrix via a single switch (Anson, 1997). However, they were not designed for mobile phone devices. Computer input systems, which use Morse code via special software programs, hardware devices, and switches, are invaluable assets in assistive technology (AT), augmentative-alternative communication (AAC), rehabilitation, and education (Caves, 2000; Leonard et al., 1995; Shannon et al., 1981; Thomas, 1981; French et al., 1986; Russel & Rego, 1998; Wyler & Ray, 1994). To date, more than 30 manufactures/developers of Morse code input hardware or software for use in AAC and AT have been identified (Anson, 1997; http://www.uwec.edu/Academic/Outreach/Mores2000/morse2000.html; Yang, 2000; Yang, 2001; Yang et al., 2002; Yang et al., 2003a; Yang et al., 2003b). In this article, we adopt Morse code to be the communication method and present a human interface for persons with physical disabilities.

The technology employed in assistive devices has often lagged behind mainstream products. This is partly because the shelf life of an assistive device is considerably longer then mainstream products such as mobile phones. In this study, we designed and implemented an easily operated mobile phone human interface device by using Morse code as a communication adaptive device for users with physical disabilities. Experimental results showed that three participants with disabilities were able to operate the mobile phone through this human interface after four weeks' practice.

SYSTEM DESIGN

Morse code is a simple, fast, and low-cost communication method composed of a series of dots, dashes, and intervals

Figure 1. System schematics of the mobile phone human-interface



in which each character entered can be translated into a predefined sequence of dots and dashes (the elements of Morse code). A dot is represented as a period ".", while a dash is represented as a hyphen, or minus sign, "-". Each element, dot or dash, is transmitted by sending a signal for a standard length of time. According to the definition of Morse code, the tone ratio for dot to dash must be 1:3. That means that if the duration of a dot is taken to be one unit, then that of a dash must be three units. In addition, the silent ratio for dot-dash space to character-space also has to be 1:3. In other words, the space between the elements of one character is one unit while the space between characters is three units (Yang et al., 2002).

In this article, the mobile phone human interface system using Morse code input device is schematically shown in Figure 1. When a user presses the Morse code input device, the signal is transmitted to the key scan circuit, which translates the incoming analog data into digital data. The digital data are then sent into the microprocessor, an 8051 single chip, for further processing. In this study, an ATMEL series 89C51 single chip has been adopted to handle the communication between the press-button processing and the communication devices. Even though the I/O memory capacity of the chip is small compared to a typical PC, it is sufficient to control the device. The 89C51 chip's internal serial communication function is used for data transmission and reception (Mackenzie, 1998). To achieve the data communication at both ends, the two pins, TxD and RxD, are connected to the TxD and RxD pins of a RS-232 connector. Then the two pins are connected to the RxD and TxD of an UART (Universal Asynchronous Receiver Transmitter) controller on the mobile phone device. Then, persons with physical disabilities can use this proposed communication aid system to connect their mobile communication equipment, such as mobile phones or GSM (global system for mobile communications) modems, and receive or send their messages (SMS, simple message service). If they wear an earphone, they might be able to dial or answer the phone. SMS is a protocol (GSM 03.40 and GSM 03.38), which was established by the ETSI (the European Telecommunications Standards Institute) organization. The transmission model is divided into two models: text and PDU (protocol description unit). In this system, we use the PDU model to transmit and receive SMS information through the AT command of the application program (Pettersson, 2000). Structurally the mobile phone human-interface system is divided into three modules: the input module, the control module, and the display module. The interface framework is graphically shown in Figure 2. A detailed explanation is given below.

INPUT MODULE

A user's input will be digitized first, and then the converted results will be sent to the micro controller. From the signal processing circuit can monitor all input from the input device, the Morse code. The results will be entered into the input data stream. When the user presses the input key, the micro-operating system detects new input data in the data stream, and then sends the corresponding characters to the display module. Some commands and/or keys, such as *OK, Cancel, Answer, Response, Send, Receive, Menu, Exit,* and so forth, have been customized and perform several new functions in order to accommodate the Morse code system. These key modifications facilitate the human interface use for a person with disabilities.

Figure 2. Interface framework of mobile phone for persons with physical disablities