ICAT '99

Information System based on Multimodal Interface for the Blind

Heonjoo Lee, Byungtae Jang

Computer & Software Technology Laboratory,
Electronics and Telecommunications Research Institute,
161 Kajong-Dong Yusong-Gu, Taejon, 305-350, KOREA
hjoo@etri.re.kr

Abstract

The significant number of people with visual impairments and their need to gain access to computers have been driving the development of nonvisual techniques for human-computer interaction. We design and develop an information system for the blind. Our system enables the visually handicapped to access the personal computer and to use a great deal of existing information with ease and convenience.

Key words: Tactile Device, Braille, TTS, Multimodal Interface

1. Introduction

Humans exchange and share their thoughts through assorted media. A variety of communication media, such as speech, letters, symbols, and gestures are presently used. Most communication is done primarily via visual or auditory media. It is difficult, however, for the blind to communicate through visual media. Thus, persons lacking eyesight are eager for a method that can provide them with access to progress in technology.

As personal computers have evolved, they have become essential tools in the personal, educational, and professional lives of people who are blind. The significant number of people with visual impairments and their need to gain access to computers have been driving the development of nonvisual techniques for human-computer interaction. Apart from visual enlargement, the auditory and tactile channels have been explored extensively as possible solutions to the problem.

Braille was devised for blind people to use to read and write letters. Braille display is an example of a tactile display allowing haptic exploration, with simulators constructed as passive raised dots. In the meantime, auditory access has been very successful for the interaction between persons with visual impairments and character-based computers. Therefore, use of the braille as well as use of voice is accomplished simultaneously for the delivery of character information generally.

Over the last decade, blind people have already learned to use speech technology and tactile displays to access computer systems. Acceptance of this technology has allowed blind people to integrate more easily into society.

We design and develop an information system for the blind. The features of our system are as follows:

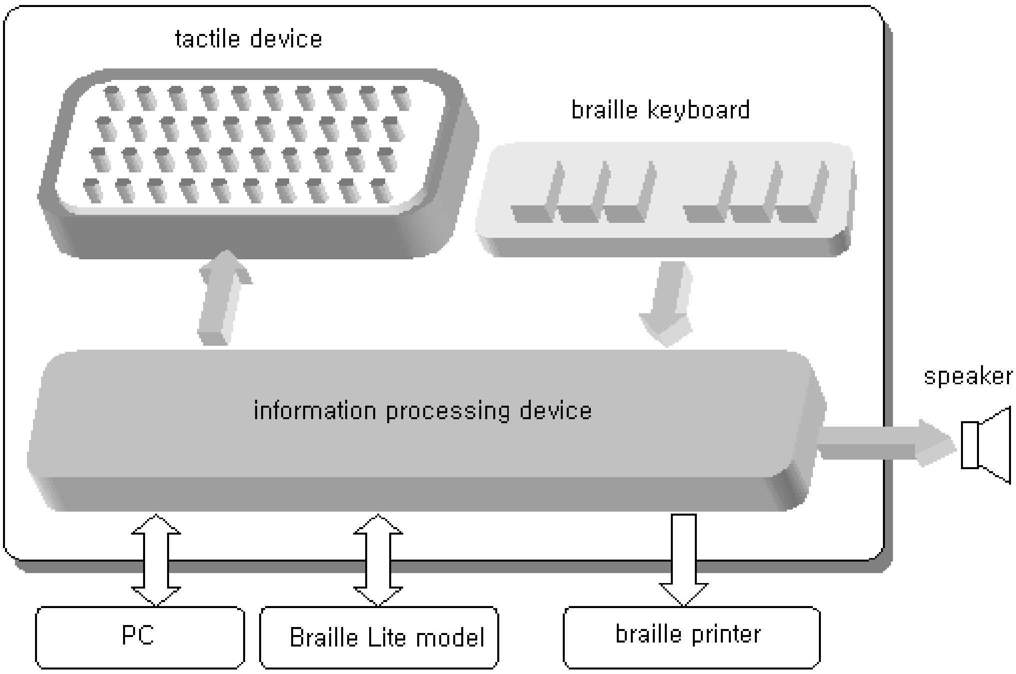
1) The use of multimodal interface, i.e., tactile and auditory senses are used for perceiving information,
2) Two-way communication, i.e., the system enables a blind person to read and write textual information,
3) Portability, i.e., the system is designed to miniaturize and to lighten so that it can be more convenient for the handicapped to carry it.

2. Related work

Many attempts have been continuously made to enhance the features of personal computers and to make them user-friendly so that handicapped people can access and use the personal computers in their daily life.

Electronic devices, such as the Optacon[1], braille word processors, screen readers, and etc., have also been developed. Optacon which is an equipment reading the forms of English alphabets and delivering them to the

Fig. 1 An information system for the blind (Blazie Eng.)



finger tactile nerve was developed by Bliss in 1969, which has been known to be the most general equipment since then. However, in Hangul, shapes of Korean alphabets are more complicated than those of English, and therefore, it is still difficult to understand Hangul as in the form of Optacon.

N. Sriskanthan and K. R. Subramanian have developed a braille display terminal which enables visually handicapped people to have real time interaction with the computers. The terminal essentially serves as a display monitor for visually handicapped [2]. Hiroki Minagawa, Noboru Ohnishi, and Noboru Sugie have proposed a tactile-audio diagram, represented by a tactile pattern and linguistic information as a new media for the blind. They have developed a vision substitution system which enables blind persons to read and write a diagram in the form of a tactile-audio diagram. The system consists of a personal computer, a tactile display with digitizer, an auditory information input/output device, and a command keyboard [3].

NOMAD[4] is a touch pad with a sythesizer. Users place a tactile diagram with raised dots on the pad. By touching the diagram, they can comprehend the rough layout of the diagram. When they press the area of the tactile diagram in which they are interested, they hear synthesized speech giving detailed information about that area, and thus they can read diagrams using tactile and auditory sense. With this system, however, blind users can only read diagrams but not write them.

Research to device alternative forms of communication for the visually impaired has been conducted down through the years, and recent progress in computer science promises to yield further rewards. For instance, several types of software that select visual information which can be converted into text form and transmit it as synthesized speech or braille are already on the market. Studies in this field are reviewed in [5]. Efforts are also under way to improve accessibility of GUI’s by combining auditory response with tactile display [6].

3. Information system for the blind

3.1 System design

The schematic illustration of the proposed system is shown in Fig. 2. The system is composed of a tactile device, a braille keyboard, an information processing device, a speaker, and serial/parallel ports. The braille keyboard inputs braille information and commands to the information processing device. The information processing device consists of a processor, RAM, flash memory, and a sound card for output as voice. The conventional braille printer and personal computers are interfaced with our system through the serial/parallel ports. The tactile device and the speaker are output devices for braille display and sythesized voice respectively. Also, the proposed system includes a rechargable battery module for the portability. The system is designed to miniaturize and to lighten so that it can be more convenient for the handicapped to carry it.

3.2 Hardware configuration

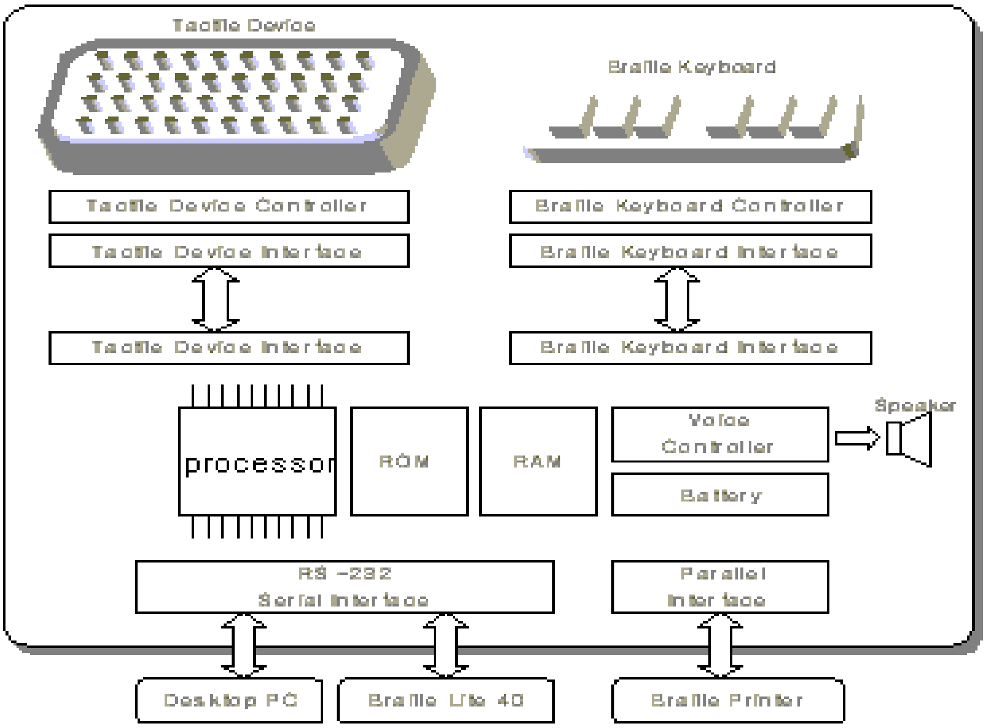


Fig. 3 Hardware configuration

The hardware configuration of our system is shown in Fig. 3. Our prototype tactile display device has a 16-cell unit. Each cell has 4 x 2 pins. Each character shall be represented by a 6-pins (3 x 2). The reading of braille display shall be by tactile means, i.e., by running the fingertips across the display device and sensing the raised pins, just like reading a braille book. The rising of the pins shall be around 1 to 2 mm. The tactile pin actuator is implemented using bimorph. The character information is displayed simultaneously in terms of voice through a speaker. Integrating tactile and audible voice channel can guarantee accurate delivery of information to the blind.

The braille keyboard is composed of the Perkins-style nine-key layout, 8 braille keys and 1 space bar. The system can be interfaced with personal computers and braille printers. The transfer of data is via the RS232C and parallel interface respectively. The keyboard controller encodes braille codes inputted through the braille keyboard, and then transfers them to the information processing device. The tactile device controller decodes the data transmitted from the information processing device and forwards them to the tactile device.

3.3 Software configuration

Fig. 4 shows the software configuration of our system. The system utilizes Windows 95 for operating system. Braille/Character conversion module is responsible for translating character data into braille codes, and also converting braille codes into character information. The braille conversion has been established based on Korean braille regulations of Announcement No. 1997-58 of the Ministry of Culture and Athletic (12/17/97). One braille character is composed of six dots (3 dots lengthwise, 2 dots widthwise) which form one column as in the basic principles of Hangul braille writing. The braille codes are displayed on the tactile device.

The TTS module is responsible for converting text data into synthesized speech. The contents outputted through the voice display are translated into braille codes and also outputted to the tactile device. Tactile characters written by users can be saved as electronic files. Files can be uploaded to personal computers and downloaded from them. Applications include note pad for word processing, clock, calendar, schedule management, and etc. The system enables a blind person to read and write textual information and to manage the files in terms of auditory and tactile channels.

4. Conclusion

In this paper, we design and develop an information system based on the multimodal interface for the blind. Our system enables blind persons to manipulate character information by tactile and auditory channels. The features of our system are: 1) the use of multimodal interface, i.e., tactile and auditory senses are used for perceiving information, 2) two-way communication, i.e.,

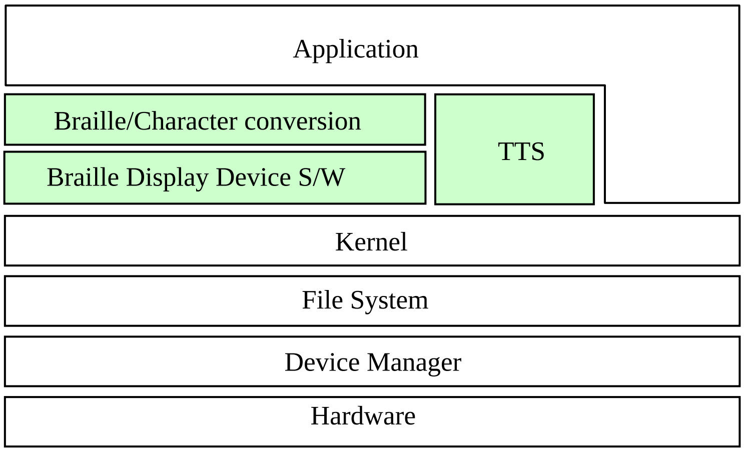


Fig. 4 Software configuration

the system enables a blind person to read and write textual information, and 3) Portability, i.e., the system is designed to miniaturize and to lighten so that it can be more convenient for the handicapped to carry it.

First, our proposed system is being implemented on a prototype form, and then the system is aimed to be commercially available. Our system enables the visually handicapped to access the personal computer and to use a great deal of existing information with ease and convenience. The subjects for the future study are: how to manipulate image data and how to access to the Internet.

Reference

[1] J. C. Bliss, "A Relatively High-Resolution Reading Aid for the Blind," IEEE Trnas. Man-Machine System, Vol. 1, MMS 10, No. 1, pp. 19-25, 1969.

[2] N. Sriskanthan, K. R. Subramanian, "Braille Display Terminal for Personal Computers," IEEE Trans. Consumer Electronics, Vol. 36, No. 2, pp. 121-128, MAY 1990.

[3] Hiroki Minagawa, Noboru Ohnishi, Noboru Sugie, "Tactile-Audio Diagram for Blind Persons," IEEE Trans. Rehabilitation Engineering, Vol. 4, No. 4, pp. 431-437, DECEMBER 1996.

[4] D. Parkes, "NOMAD: Enabling access to graphics and text-based information blind and visually impared and other disability groups," in Proc. World Congress Tech. People Disabil., 1991, pp. 689-716.

[5] T. P. Way, K. T. Barner, "Automatic visual to tactile translation-Part 1: Human factors, access methods and image manipulation," IEEE Trans. Rehab. Eng., vol. 5, pp. 81-94, Mar. 1997.

[6] G. Weber, "Modeling interaction of blind using graphical interfaces," in Proc. Information Processing '92, F. H. Vogt, Ed. Amsterdam, The Netherlands: North Holland, 1992, vol. 3, pp. 39-46.

[7] Masami Shinohara, Yutaka Shimizu, Akira Mochizuki, "Three-Dimensional Tactile Display for the Blind," IEEE Trans. Rehabilitation Engineering, Vol. 6, No. 3, pp. 249-256, SEPTEMBER 1998.

[8] Hui Tang, David J. Beebe, "A Microfabricated Electrostatic Haptic Display for Persons with visual impairments," IEEE Trans. Rehab. Eng., vol. 6, No. 3, pp. 241-248, Sep. 1998.

[9] J. M. Loomis, "Tactile letter recognition under different modes of stimulus presentation," Perseption Psychophys., vol. 16, no. 2, pp. 401-408, 1974.