A Braille computer notebook with Thai and English processing capability for visually impaired people

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Abstract
This paper addresses the need of low-cost Braille computer notebooks with Thai and English processing capability as it would gain opportunities for visually impaired people in Thailand to work or to be employed in the field of Information Technology. In this regard, a prototype of an inexpensive product is being developed from the local-supplied parts and off-the shelf components, such as embedded PC and industrial Braille cells. By working in this manner, our developed system could potentially yield for high reliability, flexibility and compatibility with most commercial ones at ease. In this paper, we summize our design concept of this system (both hardware and software) and show how open-sourse softwares can be contributed to our system-under-development.

Keywords
Braille computer notebook, Thai and English processing, visually impaired, usage investigation, design and improvement

1 Introduction

The widespread use of computers can be seen nowadays, but surprisingly not in the world of visually impaired people, where electronic-notetaker devices are more popular. As their processing power and memory are limited, these devices can offer users with features mainly for taking notes and simple utilities, and hence some tasks like web serving or computer programming are not usable. For supporting these sophisticated tasks, more powerful machines like Braille-capable notebook computers are required, but normally on the expense of high prices. This is why they are not popular among visually impaired people especially in Thailand, regarding its richness in features. To make feasible the lower price version of Braille notebook, our research is then set up and aimed in particular at Thai and English processing capabilities that are rarely found in imported (rather high-cost) systems [1-2].

We believe that our developed notebook will enable Thai visually impaired people to have a portable computer that has the functionality of general PCs so that the users can run normal applications, write or compile programs, and access the Internet at a much lower cost. It will also give an equal opportunity to the disabled and improve their quality of life and profession. The aim also is to reduce the cost of imported devices for visually imparied people and offer them the opportunity to use information technology.

The outline of the paper is in the following. In the first section, we introduce our approach for the system design. Then, we give details of system architecture including hardware and software components. The first-year prototype is also shown. In the final section, we conclude our paper.

2 Design Approach

The approach of our system design is that of system integration, where off-the-shelf products (such as embedded PC and industrial Braille cells) and open-source software are based and minimal in-house parts are complemented. This does not only accelerate our system development greatly, but also brings reliability and flexibility to the system. It is in the sense that some advanced functions such as ports for display monitor, printer, external USB devices (such as thumb-drive or even mobile phones) and Internet connectivity can be included into the system at ease. Therefore, it is clear that our system compromises price and performance at some level, rather than attempting to keep the system price low but featuring only limited functions.

As shown in Fig. 1, our developed computer notebook is designed to have the Braille input, processing and output functions. Instead of being equipped with dozens of buttons, it will come with fewer buttons using a Braille keyboard to facilitate easy typing. The Braille keyboard will work like the shorthand that makes it possible to write messages, or execute any computer applications using just combinations of these keys. Its size is therefore only one-third the normal keyboard size.

Also, there is a Braille-character display system to enable users to easily read and check what they type. It is designed to output through both an LCD monitor and a Braille display unit to allow the visually impaired and sighted people to concurrently "see" the same message.

In the software side, the notebook also includes Thai-and-English ASCII language and Thai-and-English Braille Grade 1 and 2 translation capabilities [3-5]. ASCII is short for American Standard Code for Information Interchange. It represents English characters as numbers, with each letter assigned a number from 0 to 127.

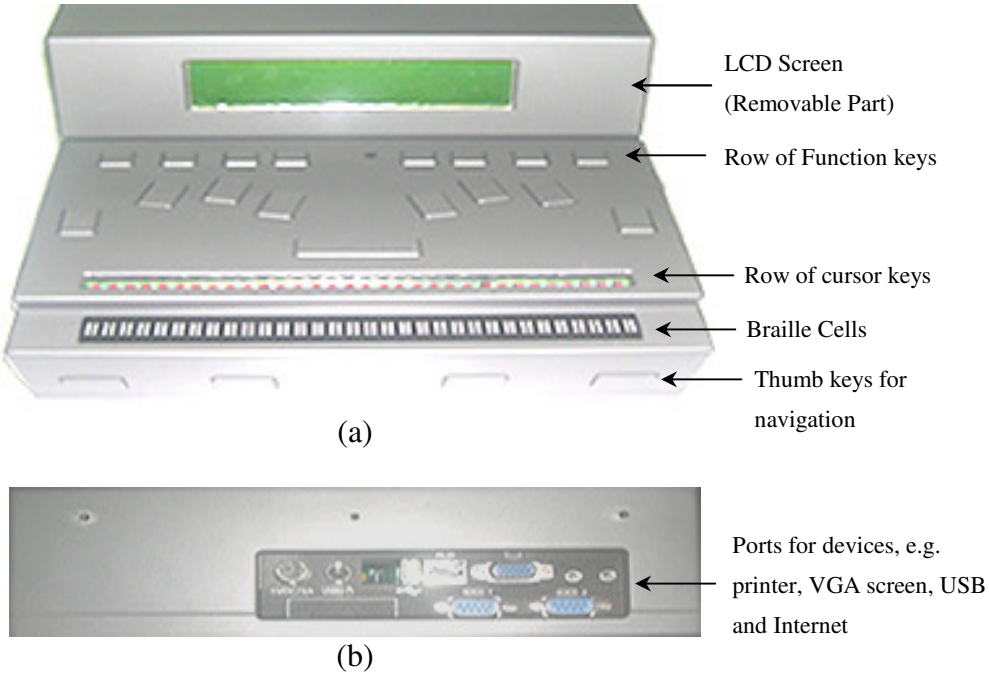

Fig. 1. The first-year Prototype: (a) Front view (b) Rear view

2.1 Hardware Design

The notebook is designed to have a 32-cell Braille display unit. Generally, in Braille printing, a page consists of 30 Braille characters. Therefore, the Braille display will give the feel for the printing. The text LCD is also provided with Thai and English for the

communication with the sighted people. On-the-fly text translation software between Braille and ASCII will also be provided [6]. The notebook has a Braille keyboard. However, a 101-key or PC keyboard can be plugged in using a USB port. There is an I/O interface with other PC devices such as USB devices, printers, monitors, and modems, too. The Braille notebook is designed to have batteries so that the users can keep on working. The Braille notebook is also designed to have a hard disk or a flash drive so that it has enough storage for supporting more complicated applications than that of basic notetakers like general computer notebooks can do.

2.2 Software Design

The distinctive intention of this research is to build a Braille notebook that

- works as a general computer notebook, not just a notetaker,
- can process Thai language,
- enables the visually impaired to communicate or exchange with the sighted people concurrently.

In order to support the above functionalities, not only hardware but also software plays an important part. The Linux operating system and opensource utilities are selected for providing the system software and applications for the Braille notebooks because of freely availability and cost saving.

As shown in Fig. 2, several works need to be done to achieve Thai language processing. For example, BRLTTY (Braille Terminal Driver on Linux) [7] needs to be modified to enable Thai language processing. So are Editor for Braille, Braille translation (Grade 1 and 2 and Thai to Braille and Braille to Thai). The Linux OS used in this work also needs to be Thai-enabled.

Concurrent communication using the Braille display and a text LCD is a speciality that is not provided in other products, especially, on-the-fly translation between Thai and Braille.

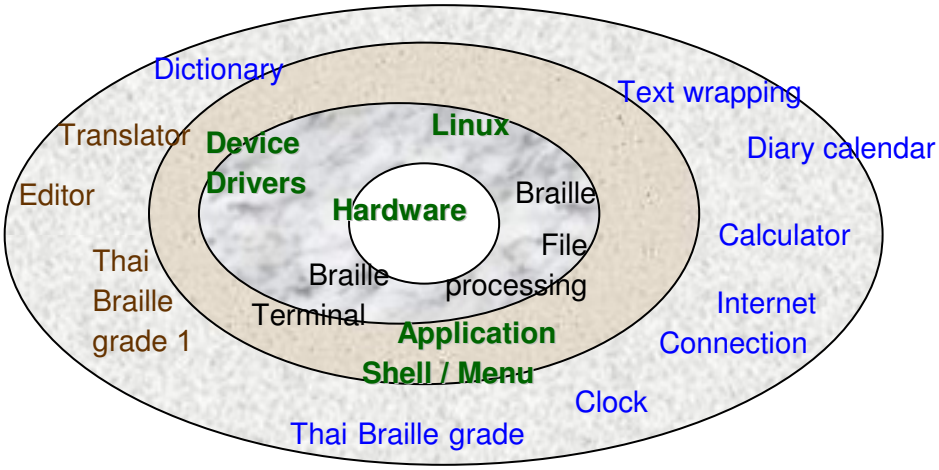

Fig. 2. System software architecture

2.2.1 Thai to Braille and Braille to Thai Translation

This work concerns an enhancement of the Braille translation software, Nfbtrans [7], by adding Thai processing ability. The Braille translation software translates normal text (ASCII code) to Braille Computer Code in order to allow the text to be printed by an embosser or displayed by a Braille display read by the visually impaired. Vice versa, the Braille to text translation software enables the visually impaired people to communicate to other people more easily and efficiently by using computers. Nfbtrans is

an opensource software that translates only English Braille. The Thai to Braille translation software [8-9] translates Thai text in ASCII code into Thai Braille Computer Code in both Grade 1 and 2. Grade 2 is like a short note style of Braille that makes text concise and fast to be read for professional. The Braille to Thai translation [10] does the opposite. This program supports both Thai and English and receives a text file as an input. C is the programming language used in this work.

2.2.1 On-the-fly Translation

On-the-fly translation of Thai and Braille is developed for Thai Braille computers, which display both Braille and ASCII characters simultaneously. This system consists of Thai-to-Braille and Braille-to-Thai translations. Thai-to-Braille translation translates Thai sentences with meaning and no-meaning. Braille-to-Thai translation handling Braille input from the user. As the Thai language has compound vowels and many more characters, the translation algorithms are not as easy as the English one.

3 Conclusion

We have presented a design and development of a Braille-capable computer notebook that could handle both Thai-and-English characters. By ulizing "the system integration" approach, our system can be made simple through embedded Linux PC hardware working in conjunction with Braille input and output units, i.e. a Braille-enabled keyboard and display matrix of raised dots for touch reading accordingly. For the software operation, it significantly entends beyond the the BrailleTTY – open-source software. Our inexpensive Braille notebook is expected to provide a favorable means for visually impaired people to use computers with ease, thereby gaining an opportunity to be employed in the field of Information Technology. Currently, the first year protype is finished but yet requiring further enhancements.

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