Modern Tools and Technologies for the Visually Impaired

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INTRODUCTION

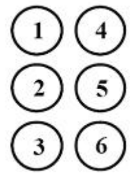
Today, people all over the globe are reaping the fruits of modern technology. One can now use a hoard of devices, ranging from desktop PCs (personal computers) to handy palmtops, for accessing information in one's day-to-day life. But, unfortunately the visually impaired have hardly gained anything form such a mammoth information revolution. Over the past few decades their only means of availing information was through embossed Braille books and audio books. Braille books relating to any particular subject are almost impossible to find, and in most cases they do not even exist. On the other hand Audio books were typically stored on magnetic tapes, and this did not facilitate navigation to different portions of the text.

However, the recent developments in the field of assistive and accessible technologies have opened the gateway to the world of information for the visually challenged. They can now access information very easily using various hardware and software tools. These include text-to-Braille translation software, sophisticated Braille embossers, tactile Braille displays, screen readers, and navigable audio books. In the following sections we will get a glimpse of how some of these technologies can enable the visually impaired to benefit from the information age.

THE BRAILLE CODE

In 1829, Louis Braille modified an alphabet code used by the French army and developed what later came to be known as the Braille code. Over the last couple of centuries the Braille code has been accepted throughout the world as the fundamental form of written communication for the visually impaired. The Braille code uses cells or blocks, each having six dots as shown in Figure 1. Some of the dots in each cell are raised, and based on the pattern thus formed, cells can represent the letters, numbers, and symbols of the language to be written. This enables the visually impaired to read by touch. Sometimes a Braille cell consists of eight dots instead of six (e.g., European Braille).

Figure 1. A Braille cell with six dots



A Braille text can be represented in either of two forms:

- **Grade – I:** This involves the character-by-character translation of some language into its corresponding Braille. Each character being represented by a single Braille cell.
- **Grade – II:** Since Braille books are much larger and bulkier than printed ones numerous contractions or abbreviations have been introduced to make them take up less space and faster to read. This contracted Braille is known as grade – II Braille.

TEXT TO BRAILLE TRANSLATION

Braille was originally written by hand using slate and stylus, later Braille typewriters were introduced (e.g., the Perkins Brailler). Trained Braille transcribers were required for translating printed text into Braille and embossing it. Today, the task has been simplified to a great extent. A number of software applications exist which can translate printable text in various languages to their corresponding Braille representations. Such software can accept text in variety of standard formats like ACSII text files, HTML, Microsoft Word files and produce corresponding Braille output. This may then be fed to electronic Braille embossers to obtain text that can be easily read by the visually impaired.

Examples of such software include Duxbury DBT (Duxbury Systems, 2000) and Sparsha (Basu Anupam). Duxbury DBT supports 18 different languages, including grade 1 and grade 2 translations of English, Spanish, French, Portuguese, Arabic, Malaysian, and Swedish. Sparsha was developed at the Indian Institute of Technology, Kharagpur, India as a research project. Its primary objective was to provide text to Braille translation for Indian languages. Also the cost of commercial Braille translation software like Duxbury DBT was unaffordable for those in low socio-economic situations in developing nations in the region. Sparsha supports a number of Indian vernaculars including Hindi, Bengali, Marathi, and Oriya, as well as English. Both of these software programs support conversions of elementary images into their tactile representations, as well as translation of mathematic and scientific notations into Braille (Nemeth, 1972; Cramer, 1991).

Other Braille translation software include WinBraille (Index Braille), NFBTRANS (National Federation of the Blind), and Monty (Quantum Technology, 2004).

Some other related software includes:

- **WinDOTS:** provides a tactile representation of the Microsoft Windows on a Braille display.
- **GOODFEEL, Toccata:** translation software for musical notes to Braille.
- **TGD Pro, SparshaChitra:** can convert images into tactile Braille representation and print them out using Braille embossers.

The output of such software is typically fed to a Braille embosser. Braille Embossers are available from manufacturers like Index (Index Braille), Thiel, and Braillo. Alternatively Braille output may be sent to refreshable Braille displays. There are special Braille embossers from manufacturers like Index (Index Braille) and Tiger that extensively supports tactile graphics.

REFRESHABLE BRAILLE DISPLAYS

A refreshable Braille display consists of a line of electronic Braille cells. Each cell is composed of six or eight moveable pins corresponding to the dots in a Braille cell. These pins are electronically controlled to move up or down, thus forming a string of Braille characters. Each pin is moved up or down by a tiny solenoid or piezo-electric crystal. Commercial refreshable Braille displays provide a wide range of other accessibility features. Some of the more common features of such Braille displays will now be discussed in detail.

A refreshable Braille display is usually connected to a PC. Applications like screen readers running on the PC feed the Braille display with text to be displayed in Braille. A Braille PDA (Personal Digital Assistant) or "Note-taker" is another related device. It consists of a refreshable Braille display, memory for storing documents, a keyboard for entering data, rechargeable batteries and enough processing power such that the Braille PDA can be used even when it is not connected to a PC. More advanced Braille PDAs also include speech support (using text-to-speech engines), an internal modem, Ethernet and wireless (802.11-WiFi) connectivity.

Refreshable Braille displays are available in various sizes depending on the number of Braille cells, which usually range from about 20 to 80 cells. Each Braille cell usually consists of eight dots, in order to support both six-dot and eight-dot Braille formats. While displaying Braille in the six-dot format the two extra dots may be used to indicate uppercase characters and the cursor position.

Most refreshable Braille displays also provide various function keys for navigating through any text. As previously mentioned PDAs and "Note-takers" also include a 6-key Braille keyboard or a standard QWERTY keyboard. Some Braille displays and PDAs also include other proprietary navigation interfaces like cursor keys or easy access bar.

Refreshable Braille displays and PDAs usually provide a number of different communication ports for interfacing with other devices including a PC. These ports may include serial and parallel interfaces, USB, Ethernet, modem, and audio input/output.

Other than refreshable Braille displays, refreshable tactile graphic displays are also available (KGS Corporation, 2004). A refreshable tactile graphic display consists of a rectangular array of rounded pins which can be raised to form the desired pattern or image, and hence can display tactile graphic images that can be felt by visually impaired users. This allows them to get a first hand experience of images like maps and geometrical figures.

Thus, we see that refreshable Braille displays can be a viable alternative to the traditionally bulky Braille books. Refreshable Braille displays are available from manufacturers like KGS Corporation (KGS Corporation, 2004), ALVA, and Papenmeier. However, current refreshable Braille displays are prohibitively expensive and this continues to be a major drawback in their use.

SCREEN READERS

Screen reader software attempts to audibly read out loud whatever is being displayed on the computer screen. In today's GUI based environments this includes window titles, menus, toolbars, and application specific information like text in a word processing application. The screen reader is also responsible for providing audio feedback for the actions performed by the user. This includes audio response for each key press, for menus that are activated and dialogue boxes that pop up as a result of user inter-

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