CHAPTER 1
INTRODUCTION

Braille is an important language used by the visually impaired to read and write. It is vital for communication and educational purposes. The Braille code has become the main system for the majority of those blind people who read and write using tactile approach. Tactile means sense by touching or rubbing the surface of the corresponding output device.

Braille uses a group of six raised dots which are arranged in a matrix of three rows to two columns. These six positions of raised or flat are used in combination to give 64 ($2^6$) different Braille characters. Therefore there is one to one correspondence between Braille characters and English text. If the blind person touches these raised dots, he or she understands the equivalent characters of the English Language.

1.1 Braille History

Louis Braille was a genius blind man who gave rays of light to the blind people across the world. He invented the Braille system of reading for the blind and opened the horizon of the colourful world to the blind people. He enabled them to enter the world of knowledge.

Figure 1.1: Louis Braille
Louis Braille was born in France in 1809. He was a son of saddle maker. When he was a child of 3 years, a tragedy struck him. Once he was playing with a tool used to stitch leather. He stumbled and the tool pierced his eye. Thus he lost one eye in the accident. His second eye also became blind at the age of five. His father got him admitted in a school for blind at the age of ten. During his school days, a retired soldier taught him to read books with the help of embossed dots [DW92].

Louis’s desire was to unleash the world of books to the blind people who were lonely. So, he spent his time trying to devise a code with symbols for words. Later, he heard about an army officer who had developed a system of writing in raised dots and dashes to be used in the darkness. The army message could be read by touching even in the dark. Louis was inspired by this system to develop a reading system and open up the world of knowledge for the blind. He made impressions of words and punched them on the thick paper so that they could be felt with fingers and read.

Louis Braille worked hard to perfect this reading system. His system gained acceptance during his lifetime. He died at the young age of 42. The script that he developed came to be called Braille script. Today, books, magazines and other types of literature are available in this script as mentioned in Figure 1.2 [HM11].

Figure 1.2: Braille Raising Script
1.2 Concept of Braille

All over the world, persons who are visually impaired have used Braille as the primary means of accessing information. Also, the concept of Braille has been accepted as a universal approach that works across the boundaries of the world. Different countries of the world have adapted the system of Braille to suit their languages. Irrespective of these changes or modifications, visually disabled persons understand the standard Braille for the English language making it possible to exchange information in a consistent fashion across different countries [JG12].

Standard Braille is used to creating documents which could be sensed through touch. This is accomplished through the concept of a Braille cell consisting of raised dots on thick sheet of paper. The protrusion of the dot is achieved through a process of embossing. A cell consists of six dots arranged in the form of a rectangular grid of two dots horizontally and three dots vertically. With six dots arranged this way, one can obtain sixty four different patterns of dots. A visually impaired person is taught Braille by training him or her in discerning the cells by touch, accomplished through his or her fingertips as shown in Figure 1.3 [PB97].

![Figure 1.3: Braille sheet](image)

The visually impaired person can touch the raised position of each Braille cell from left to right in the Braille sheet using their fingertips and understand the equivalent English letter value.
The Braille code was adapted by Louis Braille in the early part of the nineteenth century from a military system which used raised dots to send messages at night. Compared with other systems developed for visually challenged people, the Louis Braille has become the main system for the majority of those blind people who read and write using tactile means, and can be found in many countries around the world. Braille uses the raised dots and represented by a 3 x 2 matrix (Figure 1.4) that are numbered from 1 to 6.

![Figure 1.4: Braille cell](image)

A printed sheet of Braille normally contains upwards of twenty five rows of text with forty cells in each row. The physical dimensions of a standard Braille sheet are approximately 11 inches by 11 inches. The dimensions of the Braille cell are also standardized but these may vary slightly depending on the country. The dimensions of a Braille cell, as printed on an embosser are shown below.

![Figure 1.5: Braille Cell Dimensions](image)
The six dots forming the cell permit sixty three different arrangements of dots, strictly it is sixty four arrangements but the last one is a cell without any dots and thus serves the purpose of a space. A Braille cell is thus an equivalent of a six bit character code, if we view it in the light of text representation in a computer. However, it is not related to any character code in use with computers [BS07], [SM07].

1.3 Braille Fundamentals

There are two predominate forms of Braille, one more complex than the other. Grade 1 Braille is the simplest form which consists of fully spelt words, punctuation, numbers and composition signs. However Braille cells have a minimum physical size below which they become difficult to read and this limits a page of Braille to just 25 lines of 40 characters. This means that Braille books can become quite bulky. To try and reduce the size of these books and increase the speed at which Braille can be read Grade 2 or contracted Braille was introduced [KI98].

Grade 2 Braille, the most common form used, expands on the Grade 1 Braille alphabet by using contractions, whereby letter groups or even whole words may be represented by one or two Braille characters. In addition to this a Braille character representing a letter group may be context sensitive. This means that the character will have a different meaning depending on its placement within a word. For example the Braille cell 2-3-5 stands for “to” when placed at the beginning of a word (total), “ff” when placed in the middle of a word (buffet) and “!” when placed at the end of a word (stop!). But most of the notations in Grade 2 Braille are in under research [PRA95].

There are some rules concerning syllabification and pronunciation. For example the contraction for the letter group “the” may be used in the translation of “another” but may not be used on the translation of “sweetheart” where the letter group extends over a syllable boundary. This is further complicated by regional dialects. For example the contraction of “of” in the word “professor” would be used in the U.K. but not in North America. This is probably due to the way the word is pronounced in the different regions.

Worldwide there are two main systems for English Contracted Braille. These are the American System and the British System. These systems are very similar with both employing the same contractions. They differ in some finer details such as syllabification as mentioned above and the more stringent use of capital signs in the American System.
Being trained in one system does not prevent someone from reading the other, as the two systems are so similar [SH11]. Australia has adopted a hybrid system, combining both the American and British systems. This has resulted in a lack of standardized code specifications and teaching manuals in Australia. Consequently there is a move to standardize Australia’s system. The General Assembly of the International Council on English Braille in 2004 approved a Unified English Braille code that may be adopted by many countries including Australia. The translation programs have been written according to the British system as this is closer to the current Australian hybrid system [AS02], [SV13].

It is the numerous rules of Grade 2 Braille that make the translation process quite complex. Consequently many translation algorithms have been developed to try and overcome these complexities. M.Y.Hussan. published a paper in English Characters into Braille using Neural Networks in 2011[HM11]; he gives the types of Braille code like Grade I Braille, Grade II Braille, Nemeth Braille Code, Computer Braille Code and Music Braille code. There are differences in Braille alphabet codes used in various English speaking countries, which prevent the exchange of Braille materials. Other Braille codes are presently under development, some require the use of 8 dots or other raised symbols. But in this research Braille fundamentals and symbol representations are derived from Grade 1 only.

1.3.1 Dot position

Each Braille character or "cell" is made up of 6 dot positions, arranged in a rectangle comprising 2 columns of 3 dots each. A dot may be raised at any of the 6 positions, or any combination. Counting the space, in which no dots are raised, there are 64 such combinations (that is, $2^6 = 64$).

![Braille Numbering](Image)
The six dots of the cell are numbered and are referred to as dot 1, dot 2, dot 3, dot 4, dot 5 and dot 6. This is helpful in describing the combinations of dots that makes different Braille signs.

The positions being universally numbered 1 through 3 from top to bottom on the left, and 4 through 6 from top to bottom on the right. For example, dots 1-3-4 would describe a cell with three dots raised, at the top and bottom in the left column and on top of the right column. In French, and also in English and all other languages written in the Roman alphabet, that pattern would most often be used for the letter, but it can also have other meanings depending on the language [PG01],[JG12].

The basis of the various Braille codes for the world's natural languages is a straightforward assignment of most of the dot patterns to letters of the alphabet, punctuation marks and other symbols. This is done with a certain consistency, quite often with reference to Louis Braille's original assignments, to the extent possible given the great variety of alphabets, accent marks, vocalization marks, etc., [ADS98].

Because the 64 distinct characters are never enough to cover all possible print signs and their variants, it is necessary to use multi-character sequences for some purposes. Often this is accomplished by using certain characters as "prefixes" or "indicators" that affect the meaning of subsequent cells. For example, in English a dot 6 before a letter indicates that the letter is a capital, whereas otherwise it is understood to be lower case.

Separate Braille codes may be used for notation systems other than natural languages, such as music, mathematics and computer programming, and even for highly specialized pursuits such as chess. The basis of such codes remains an association between the 64 possible Braille characters, or distinct sequences of such characters, and the symbols and other notational elements of interest.

The size of the Braille cell is such that only about 25 lines of about 40 cells each, that is 1000 characters, can fit on a page of the usual size, which is about 11 inches wide by 11 or 12 inches deep. This contrasts with the 3500 or so characters that will fit on a standard, smaller, typed page. Moreover, Braille paper must be much heavier to hold the dots, and the dots themselves considerably increase the effective thickness of a page. The
result is that paper Braille is very bulky. To overcome this problem somewhat, larger Braille books are published in "interposing", that is with the embossing done on both sides of each sheet, with a slight diagonal offset to prevent the dots on the two sides from interfering with each other. But even in interposing, a standard desk dictionary is likely to occupy a whole bookcase in Braille [PB97], [MSG05].

As mentioned earlier Braille generally consists of cells of six raised dots arranged in a grid of two dots horizontally by three dots vertically. The dots are conventionally numbered 1, 2 and 3 from the top of the left column and 4, 5 and 6 from the top of the right column. The presence or absence of dots gives the coding for the symbol. English Braille is used to code the letters, punctuation symbol, some double letter signs and word signs directly but capital letters and numbers are dealt with by using a prefix symbol.

1.3.2 Small Letters in Braille

Paul Blenkhorn, founder of Dolphin Systems for people with Disabilities Ltd., presented a paper in Print into Braille. He clearly represented all English small letters and corresponding Braille values. He also viewed Braille as a script built upon primitive shapes which are dots positioned on a grid. In conventional scripts the letters are drawn using primitive shapes which are stroked. The Braille cells cannot be reckoned as equivalent to the strokes but each cell corresponds to a letter of the alphabet or a special symbol used in writing a language [PB97] [VE97]. Based on that small letters of Braille consists of various arrangements of raised dots within a six dot pattern, combined with short dashes. For example the Braille letter,’a’ is formed by raising dot 1 as follows:

![Braille Letter ‘a’](image)

Figure 1.7: Braille Letter ‘a’
Similarly, the Braille letter ‘b’ is formed by raising dots 1 and 2 as described in the below figure.

![Figure 1.8: Braille Letter ‘b’](image)

The Braille letter ‘c’ is formed by raising dots 1 and 4 as represented in the below figure:

![Figure 1.9: Braille Letter ‘c’](image)

Sometimes the rectangular border around the cell has been added to make it easier for the visible reader to identify the dots correctly. This border is not part of the definition of a Braille cell and will not be seen in embossed documents.
Combining different Braille cells creates small letters from ‘a’ to ‘z’ is represented in Figure 1.10.

![Braille Alphabets](image)

**Figure 1.10: Braille Alphabets**

### 1.3.3 Capital Letters in Braille

Braille does not have a separate alphabet of capital letters as there is in print. Capital letters are indicated by placing a dot in the 6th position of the Braille cell in front of the letter to be capitalized. Two capital signs mean the whole word is capitalized. Also a cell without any dots denotes the value for space.

![One Letter Capitalized](image)  ![Entire Word Capitalized](image)
For example Raj MBA is represented by Braille in the Figure 1.11.

![Braille Representation of Raj MBA]

Figure 1.11: Example of Braille Capital Letter Representation

In the above example letter R is a Capital letter, so it starts with capital sign. Similarly two continuous capital signs denote before the value MBA, so it means that all letters are capital.

1.3.4 Punctuation in Braille

A "period" is written with dots 4 and 6 as follows. It denotes the Braille punctuation symbol. It is represented as follows:

![Braille Punctuation Symbol]

Figure 1.12: Braille Punctuation Symbol

1.3.5 Numbers in Braille

Numbers are made by placing the number sign # before the letters ‘a’ through ‘j’. For example the number sign placed before the Braille letter ’a’ makes the number 1 and ’b’ is 2. Similarly ‘ab’ is 12,’aj’ is 10,’aij’ is 100. The # sign value is indicated a dot in the position 3, 4, 5 and 6 and it is represented in Figure 1.13.

![Braille Number Symbol]

Figure 1.13: Braille Number Symbol
The Braille numbers are represented in the Figure 1.14.

<table>
<thead>
<tr>
<th>#</th>
<th>Braille Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td># 0</td>
<td><img src="image" alt="Braille 0" /></td>
</tr>
<tr>
<td># 1</td>
<td><img src="image" alt="Braille 1" /></td>
</tr>
<tr>
<td># 2</td>
<td><img src="image" alt="Braille 2" /></td>
</tr>
<tr>
<td># 3</td>
<td><img src="image" alt="Braille 3" /></td>
</tr>
<tr>
<td># 4</td>
<td><img src="image" alt="Braille 4" /></td>
</tr>
<tr>
<td># 5</td>
<td><img src="image" alt="Braille 5" /></td>
</tr>
<tr>
<td># 6</td>
<td><img src="image" alt="Braille 6" /></td>
</tr>
<tr>
<td># 7</td>
<td><img src="image" alt="Braille 7" /></td>
</tr>
<tr>
<td># 8</td>
<td><img src="image" alt="Braille 8" /></td>
</tr>
<tr>
<td># 9</td>
<td><img src="image" alt="Braille 9" /></td>
</tr>
</tbody>
</table>

Figure 1.14: Braille Numbers

Larger numbers only need one number sign. The comma in Braille is dot 6, and is used in numbers and with words, too.
1.3.6 Special Symbols in Braille

The Special symbols in Braille consist of various arrangements of raised dots within a six dot pattern as shown in Figure 1.15.

![Braille Symbols](image)

1.4 Usage of Braille System

The Braille system is the preferred medium for written communication by persons with total blindness or very low vision. Braille is used mainly by people who are blind, deaf and blind or visually impaired. It is critically important to the lives of these people as the ability to read and write in Braille. It opens the door to literacy, intellectual freedom, equal opportunity, and personal security. Teachers, parents and others who are not visually impaired ordinarily read Braille with their eyes. Students with severe vision impairment are taught in mainstream schools. The method of notes taking, assignment, homework presentation and general recording of verbal instruction is achieved on a manual Braille typewriter and it is printed in Braille sheets. Many of these students are learning to use both media and to make choices about which are the best for a given situation. Teaching Braille to blind students is a great deal on the teachers, parents, and students having a positive attitude about Braille. It is important that Braille is not only viewed as a symbol of weakness or as "just for blind people" [DW92],[BL13].
It is important to use methods and materials which motivate the blind students to learn Braille. These methods and materials may include Braille menus and schedules. Reading material which is relevant and of interest to the child. Braille can also be written in several ways. The Braille equivalent of paper and pencil is the slate and stylus. The slate or template has evenly spaced depressions for the dots of the Braille cells. The stylus is used to create the individual Braille dots. With paper placed in the slate, tactile dots are made by pushing the pointed end of the stylus into the paper over the depressions. The paper bulges on its reverse side to form "dots". Because they are easy to carry, the slate and stylus are especially helpful for labeling and taking notes during lectures. It is important to encourage students with low vision not to "peek" at the dots. So students with low vision, blind and, blind and deaf may or may not need instruction in the reading process. It is based on the own interest, self confident and sensing capabilities [DM11].

1.5 Braille in the Digital Age

In today's fast-paced world driven by technology, Braille is still relevant. Access to information that the digital age provides is vital for all people, especially for blind and visually impaired people, who traditionally have had many barriers to information access. NBP believes that it is critically important for blind people to have equally accessible and affordable technology for staying connected through text messaging and e-mail, downloading textbooks, and reading novels.

The Braille in papers will not disappear in the immediate future, it is imperative that NBP provide Braille information faster and more efficiently, in a variety of formats, and with new technologies that allow blind people to keep pace with the world around them. This transition into e-Braille technologies is the cornerstone of National Braille Press's new direction as we move forward to ensure the general integration of accessible technology into mainstream products for work, daily living, household items, and public information.

1.6 The Crisis Faced by the Blind People World Wide

The World Blind Union (WBU) is a global organization. According to World Blind Union Publication, WBU-Bulletin 2013(pertuni) estimates that 285 million people worldwide who are blind or partially sighted. WBU members are organizations of and for
the blind in some 190 countries and international organizations working in the field of vision impairment. WBU conducts its work through six regions like Africa, Asia, Asia-Pacific, Europe, Latin America and North America & the Caribbean. The WBU has its administrative office located in Toronto, ON Canada. The vision of the World Blind Union is a global community where people who are blind or partially sighted are empowered to participate on an equal basis in any aspect of life they choose. WBU wants to eliminate prejudice towards blind and disabled people, promote belief in the proven abilities of blind people and achieve full participation in society. These goals are worked on through the committees and working groups set up to deal with specific issues like technology, mobility and transportation [DPH07].

The Blind People’s Association (BPA) is an organization in India which promotes comprehensive rehabilitation of persons with all categories of disabilities through education, training, employment, community based rehabilitation, integrated education, research, publications, human resource development and other innovative means. India is now home to the world's largest number of blind people. Of the 285 million people across the globe who are blind, over 24 million are from India. 75% of these are cases of avoidable blindness. Nearly 4% of Assam’s population are blind. UP with 15.6 lakh blind has the highest number of sight-disadvantaged persons in India followed by Delhi at 15.5 lakh, Andhra Pradesh at 10 lakh, West Bengal with 9.5 lakh, Karnataka has 9.3 lakh blind and Maharashtra has 9.1 lakh. Other states like Orissa have 5.13 lakh blind people, Madhya Pradesh 7 lakh, Bihar 6.46 lakh, and Haryana 3.98 lakh. As far as prevalence is concerned, after Assam, 2.24% of Andhra Pradesh’s population is visually disadvantaged.

The National Federation of the Blind (NFB) in USA is the oldest, largest, and most influential nationwide membership organization of blind people .. Founded in 1940, the NFB advocates for the civil rights and equality of blind Americans, and develops innovative education, technology, and training programs to provide the blind and those who are losing vision with the tools they need to become independent and successful American[EJE13]. It reports that fewer than 10 percent of people who are legally blind in the United States and fewer than 40 percent of the estimated number who are functionally blind are Braille readers. The American Printing House for the blind, one of the leading Braille material suppliers estimates the Braille literacy rate among children to be around 10 percent. Experts estimate 1.3 million blind people live in the United States, and
approximately 75,000 people lose all or part of their vision each year. [AN13]. These numbers may increase dramatically as the baby-boom generation reaches retirement age. The most common form of blindness in older Americans is likely to increase as these population increases, particularly since Americans are living longer. The nation’s leading cause of blindness, diabetes, has reached epidemic proportions in this country, so a higher incidence of blindness can be expected [AN90], [DPH07].

1.6.1 The Teacher Crisis

World Wide Blind education faces a chronic shortage of teachers qualified to teach Braille due to lack of supporting materials of Braille. For example in USA, there were approximately 6,700 fulltime teachers of blind students serving approximately 93,600 students [SS03]. Far too few teachers of blind children have graduated from accredited programs. This report observed that the total number of new professionals graduating from university programs to work with students who are blind or have low vision fluctuated between 375 and 416 per year. Not all of these teachers are qualified to teach Braille. Many teachers who are considered qualified to teach Braille have not necessarily learned it themselves due to their own interest. There is no national consensus on what it means to be certified to teach Braille, and states have a patchwork of requirements for certification. Local school districts depend upon state education agencies to set the certification standards for teachers. All states have specific certification standards for those who teach children who are blind or have low vision; however, these standards are varying from country to country due to growth of the country and technological Improvement [VE97].

Teachers of blind students must often teach a number of skills, including cane travel and the use of technology such as a computer with text-to-speech screen access software, and there is evidence that Braille instruction is not prioritized. The methodology of teaching is based on their own skill. According to one survey respondents spent an average of 35 percent of their instructional time using assistive technology with students in grades 7-10[TMS01]. The primary goals most often cited for instructional time were “become a proficient user of assistive technology” (42 percent) and “read using a combination of approaches” (30 percent), with “become fluent Braille reader” (18 percent) selected less often. Respondents spent an average of 27 percent of reading instruction time on direct instruction of how to use assistive technologies to assist in
reading, 20 percent of time in supported reading aloud, and only 9 percent of time in
direct instruction of phonemic strategies (Braille or print). Furthermore, anecdotal
evidence suggests that a teacher of blind students spends more time tutoring than teaching
blindness skills [AS02].

1.6.2 The Spiral of Misunderstanding

Attitudes about Braille are based on myths and misconceptions about the system
and a barrier to proper Braille instruction. One of the major reasons for the increasing
illiteracy of the blind and those with low vision is the historical emphasis on teaching
children with residual vision to read print [SO89]. Majority blind children have some
residual vision; they are legally blind but not totally blind. But many students who have
residual vision cannot read print efficiently even with magnification; attempting to read
print results in eye strain, headaches, and other nerves problems. Furthermore, many
degenerative eye conditions are progressive, meaning that the student’s vision will
continue to decrease over time, making print harder and harder to read. Students with low
vision are particularly at risk for not receiving appropriate instruction in Braille. These
students tend to receive less direct service from teachers of blind students and are
surrounded with more emphasis on “vision” over non visual skills and learning
techniques. Additionally, if Braille is not introduced early, student motivation to accept
Braille will greatly decrease due to frustration in learning Braille, emotional issues with
looking and other acting different from one’s peers, and issues involving emotional
acceptance of additional vision loss. It is important for educators to give these students
appropriate instruction based on their needs in the long term rather than simply
considering only their most immediate needs.

Another major misconception about Braille that has contributed to the decline in
Braille literacy is the idea that reading Braille is always slower than reading print and that
Braille is difficult to learn. While some studies suggest that Braille is slower than print
and difficult to learn because of its English contractions, symbols and letter combinations
that reduce the size of Braille books by making it possible to put more Braille on a page
instead of spelling each word out letter-by-letter. Also Braille is an efficient and effective
reading medium [FM79], [WD96]. Furthermore, the experience of Braille instructors
shows that reading speed exceeding 200 words per minute is possible when students have
learned Braille at an early age [DC06].
1.6.3 The Paradox of Technology

It is often said that technology obviates the need for Braille. The availability of text-to-speech technology and recording audio texts, for example, is advanced as an argument against the use of Braille. But literacy is the ability to read and write. While using speech output and recorded books is a way for students to gain information, it does not teach them reading and writing skills. Students who rely solely on listening as a means of learning find themselves deficient in areas like spelling and composition. Most teachers of blind students [WP96] agree that technology should be used as a supplement to Braille rather than as a replacement, even though as cited above, many of them spend more instructional time working with technology than teaching Braille. No one would seriously suggest that alternate sources of information, like television and radio, replace the need for a sighted child to learn to read; the same should be true for Braille.

Advances in technology have made Braille more available than it ever was in the past. Computer software can translate any document into literary, contracted Braille quickly and accurately, although work still needs to be done to make other Braille codes machine-translatable. Braille displays and embossers can be attached to computers to generate Braille documents on the fly. Thousands of Braille books are available online from Internet-based services like the Web-Braille service offered by the National Library Service for the Blind and Physically Handicapped of the Library of Congress (NLS) and the online community. While scarcity of Braille is still a problem, it is not nearly as bad as it has been in the past. Certainly improvements can still be made in Braille production methods and computer based technology. So that more Braille will be available, and this is one of the goals of the Braille Readers is Leaders campaign of the National Federation of the Blind. Assuming a commitment to Braille instruction and Braille literacy is renewed in America and proper steps are taken to ensure the production and distribution of more Braille materials, there will be no need to avoid teaching Braille because of a shortage of books.

1.6.4 The Truth about Braille

A recent survey of five hundred respondents by the National Federation of the Blind (NFB) Jernigan Institute [AN13], conducted on a national random sample selected from a list of 10,000 people who had had contact with the NFB, demonstrated that contact
with the NFB increases the likelihood of knowing Braille. Unlike the general sample of blind individuals, where the AFB estimates that only 10 percent read Braille, more than half (59 percent) of those interviewed in the NFB Jernigan Institute study are Braille literate. This is probably due to the Federation’s emphasis on Braille literacy; those who have had contact with the National Federation of the Blind tend to believe strongly in the efficacy of Braille and to be committed to learning and reading it. In this sample the ability to read Braille was also correlated with a higher educational level, a higher likelihood of employment, and a higher income level. These relationships were statistically significant.

1.7 Objectives of the thesis

For over 150 years Braille has been recognized as the most effective means of reading and writing for the blind. Braille an indispensable tool in their education, their work, and their daily lives, even as professionals in the field of blindness continued to debate the merits of the system. There can be no doubt that the ability to read and write Braille competently and efficiently is the key to education, employment, and improvement for the blind. Despite the undisputed value of Braille, however, only about 10 percent of blind children in World Wide are currently slowly learning it. Society would never accept a 10 percent literacy rate among sighted children; it should not accept such an outrageously low literacy rate among the blind.

In the recent past technology has made a great impact in each one of our life. Today there are many research carried out to help visually challenged people communicate with outside world with the help of technology. The objective of this research has been to:

- Design and develop Software which converts the English text to equivalent Braille code
- Design and develop a low cost Braille Hand Glove which vibrates in the appropriate points to identify the equivalent Braille Code.
- Validate the proposed method using the real time experiment to verify the relevance of the proposed methodology.
1.8 Organization of Chapters

A review of literature about Braille system, Braille Tactile Applications, Braille hardware Devices, Braille Technological aids, Empirical Reviews and assessment of current trends in various Braille Hardware and Braille Translation methods are discussed in Chapter 2. Also, the chapter explains the justification of computer Braille translation mechanism and various drawbacks in existing systems.

Chapter 3 discusses the problem definition and in detail explains about the software design of proposed system Braille Code Vibration Translation System (BCVTS). The chapter also includes the components of Braille software editor.

The low cost hardware design of BCVTS system such as the components of Braille hand glove, ASCII procedure number, working nature of hand glove and advantage of proposed system is discussed in chapter 4.

The experimental result of the Braille Code Vibration Translation System is presented in Chapter 5. Various categories of Blind people were chosen to test the proposed system. The result shows that proposed technology is boon to visually challenged people.

Chapter 6 summaries the whole thesis and gives the major strength of research work, limitations and the direction of future work.