ENABLING THE DISABLED WITH TRANSLATION OF SOURCE TEXT TO BRAILLE

Thesis Submitted in partial fulfillment of the requirements

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In

Software Engineering

Submitted By

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JULY - 2010

CERTIFICATE

I hereby certify that the work which is being presented in my thesis titled, "**Enabling the Disabled with translation of source text to Braille**", submitted by me in partial fulfillment of the requirements for the award of degree of Master of Engineering in Software Engineering, submitted in Computer Science and Engineering Department of Thapar University, Patiala, is an authentic record of my own work carried out under the supervision of *Mr. Parteek Bhatia* and refers other researcher's works which are duly listed in the reference section.

The matter presented in this thesis has not been submitted for the award of any other degree of this or any other university.

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This is to certify that the above statement made by the candidate is correct and true to the best of knowledge.

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Abstract

When in this beautiful world we see someone not capable of seeing this world means who is visually handicapped how much full of darkness life he have. They cannot have all that knowledge which a normal sight people have from the books about his surroundings.

In whole the world persons with visually impaired have used Braille as the primary means to read information. Also, the introduction of Braille has been accepted as a universal approach that works across the boundaries of the world. Irrespective of these changes or modifications, visually impaired persons understand standard Braille for the Roman alphabet (English Braille) making it possible to exchange information in a consistent fashion across different countries. Braille also contains equivalents for punctuation marks and provides Braille symbols to show letter groupings. Braille is read by moving the hand or hands from left to right along each line. Both hands are usually involved in the reading process, and reading is generally done with the index fingers. It will be very useful to computerize Braille translation for the fast translation of different languages text to Braille.

This report presents the translation of English and Hindi text to grade 1Braille representation. For this translation we have used some look-up tables. When any input text of English or Hindi is entered firstly that text is broken into corresponding letters and then those letters are matched with the look-up table if any match found then the corresponding Braille to that letter is displayed. We discuss the importance of Braille, localization of Braille. We have presented that Braille can be used as the second script for the writing of Indian languages as Indian languages are based on a writing system which is essentially phonetic in nature. This fast conversion of English and Hindi text will enrich the literature available for blinds as there is very little literature available due to its size bulkiness, high paper cost and the very low attention which is paid till now. By this blind people will get be benefitted a lot.

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Chapter 1

Introduction

1.1 Introduction

The Braille system was based on a method of communication originally developed by Charles Barbier in response to Napoleon's demand for a code that soldiers could use to communicate silently and without light at night called night writing. The main problem with Barbier system was that it was very complex for soldiers to learn. The second problem with this system was that the human fingertip could not feel all the dots with one touch. So, the system of Barbier was rejected by military and then the Louis Braille system came into effect [6,7].

Louis Braille created a reading method based on a cell of six dots. The six dots embossed system for the Blind has been derived from the inventor of six dot system -Mr. Louis Braille of Coupery near Paris in France. Braille was a Blind person who lost his one eye at the age of three and the other eye due to sympathetic Ophthalmia. Louis Braille was enrolled at the National Institute of the Blind in Paris, spent nine years developing and refining the system of raised dots that has come to be known by his name. In 1829, Louis Braille published the first Braille book entitled, "The method of writing words, music and plain song by means of dots, for use by the blind and arranged by them". This crucial improvement meant that a fingertip could encompass the entire cell unit with one impression and move rapidly from one cell to the next. Braille has come into light for nearly two centuries and today, in the twenty first century, one is amazed at the foresight of those who developed the scheme of Braille codes.

The six dots embossed pattern invented by Braille gradually came to be accepted throughout the world as the fundamental form of written communication for blind individuals. This system remains as the same as he invented it. Over time, there has been some modification to the Braille system, particularly the addition of contractions representing groups of letters or whole words that appear frequently in a language. The use of contractions allows faster Braille reading and helps in reducing the size of Braille books, making them less bulky. Several groups have been established over the last century to modify and standardize the Braille code. A major goal is to develop easily understood contractions without making the code too complex.

Creation of document in Braille is accomplished through the concept of a Braille cell consisting of raised dots on a thick sheet of paper. The projection 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 three different patterns of dots. A visually handicap person is taught Braille by training him or her in sensitive the cells by touch, accomplished through his or her fingertips. The figure 1.1, shows how this is done. Each arrangement of dots is known as a cell and will consist of at least one raised dot and a maximum of six. On a Braille sheet, the dots are created by embossing using a special printer or even a manual machine that simultaneously embosses the dots. Today, we also have Braille printers which may be connected to computers on standard printed interfaces. These are generally known as Braille Embossers.

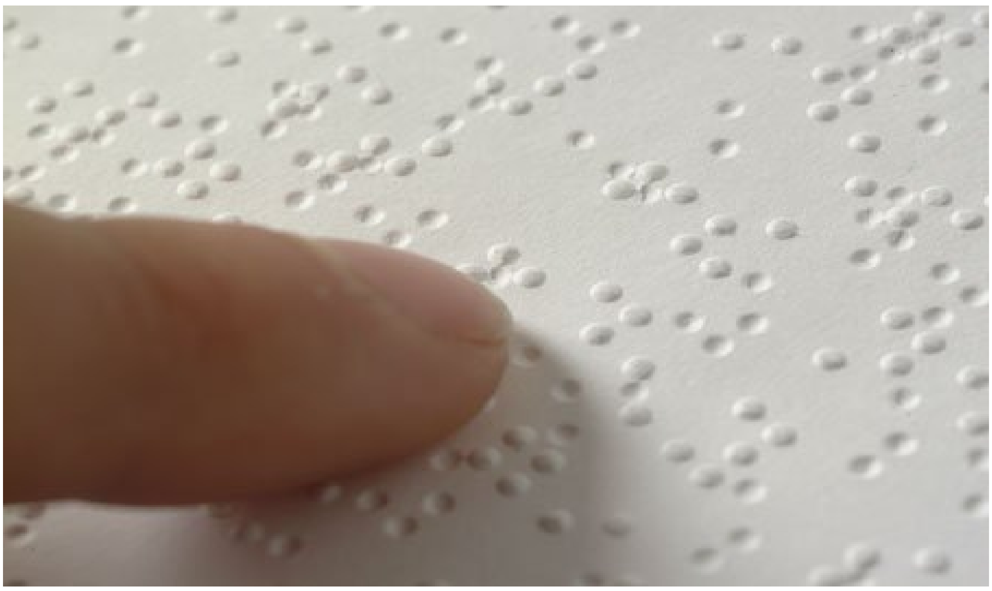


Figure 1.1: Braille Sheet [6]

1.2 Braille Cell

Each Braille character or cell is made up of six dot positions, arranged in a rectangle containing two columns of three dots each. A dot may be raised at any of the six positions to form sixty-four (2^6) permutations, including the arrangement in which no dots are raised. For reference purposes, a particular permutation may be described by naming the positions where dots are raised, the positions being universally numbered 1 to 3, from top to bottom, on the left, and 4 to 6, from top to bottom, on the right. The numbering of positions in Braille cell can be shown as in figure 1.2.

Figure 1.2: Braille Cell [11]

Dot height is approximately 0.02 inches (0.5 mm); the horizontal and vertical spacing between dot centers within a Braille cell is approximately 0.1 inches (2.5 mm); the blank space between dots on adjacent cells is approximately 0.15 inches (4 mm) horizontally and 0.2 inches (5.0 mm) vertically .A standard Braille page is 11 inches by 11.5 inches and typically has a maximum of 40 to 43 Braille cells per line and 25 lines are there in a Braille sheet.

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, for example the letter *m* is shown below in the figure 1.3.

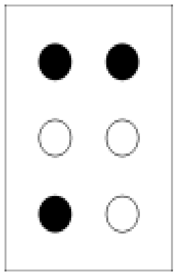


Figure 1.3: Braille cell for m

The lines of horizontal Braille text are separated by a space, much like visible printed text, so that the dots of one line can be differentiated from the Braille text above and below. Punctuation is represented by its own unique set of characters.

1.3 Standardization of Braille

Every major Braille producing country has standards for Braille character spacing and minimum height of the dots in each Braille cell. The majority of countries have adopted the Braille character standard produced by the Perkins mechanical Braille writer. When this standard was first established decades ago, extensive testing was done with a large number of Braille readers to determine the optimum characteristics for good quality Braille. This is the standard used today by the United States Library of Congress and several other international agencies that oversee the production of books, magazines and other materials in Braille [6].

There are other standards that have been created for specific applications. The European Union has recently adopted a standard known as Marburg Medium Braille that has been specifically designed for use on pharmaceutical labels. In the figure 1.4, dimension of Braille cell is shown these all dimensions are in millimeters. By this we can conclude that a sheet may appear to hold information about thousand characters.

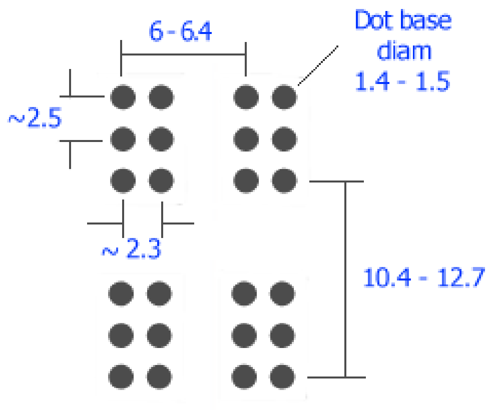


Figure 1.4: Braille cell dimension [8]

1.4 Overview of Thesis Report

In this thesis we have presented a system for translation of English and Hindi text to Braille representation. Braille is a dotted pattern which is read through feel of perception. In this translation first the word will be tokenized into its constituent letters and then look-up table is seen for the corresponding letter and if matches then the corresponding Braille is displayed. This translation will be very fast and we may serve those Blind people by providing them enough literature. In this report we have discussed the importance of Braille in the life of visually impaired people. A brief discussion of Braille, discussion of Braille for English, Braille for Hindi and Braille reading technique is discussed in chapter 2. In chapter 3 problem statement is discussed. Implementation and flowchart of the developed system is discussed in chapter 4. Testing of the developed system is discussed in chapter 5. The conclusion and future scope is discussed in chapter 6.

Chapter 2

Literature Review

2.1 Braille for English

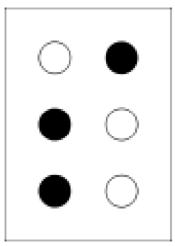
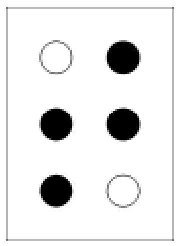
In Standard English Braille, many of the sixty three cells will correspond to a letter of the Roman alphabet, or a punctuation mark. A few cells will represent short words or syllables that are frequently encountered in English. This is done so that the number of cells required showing a sentence may be reduced, which helps in minimizing the space requirements while printing Braille. These special cells are used in specific ways along with regular cells to form sequences which are known as contractions. Contractions are specified for most frequently used syllables and words and there is a standard list of contractions in English Braille. Braille for English can be divided into three parts [6].

- Grade 1 Braille
- Grade 1 and ½ Braille
- Grade 2 Braille

2.1.1 Grade 1 Braille

Each letter of the Braille word is fully spelled out. It is generally sufficient to learn Grade I for those who do not read and write Braille extensively [10, 12].

For example: the word "stand" can be represented as shown in figure 2.1.

Cell for s  cell for t 

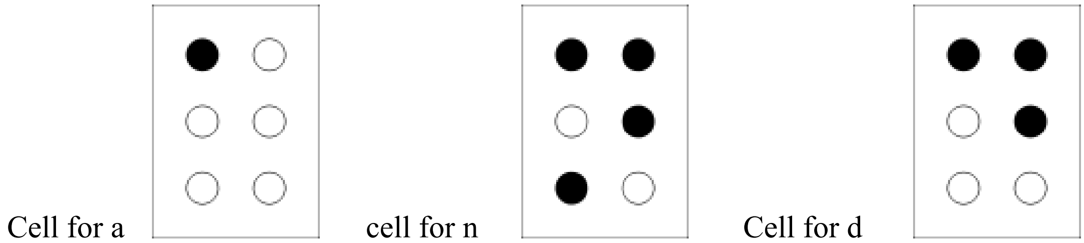
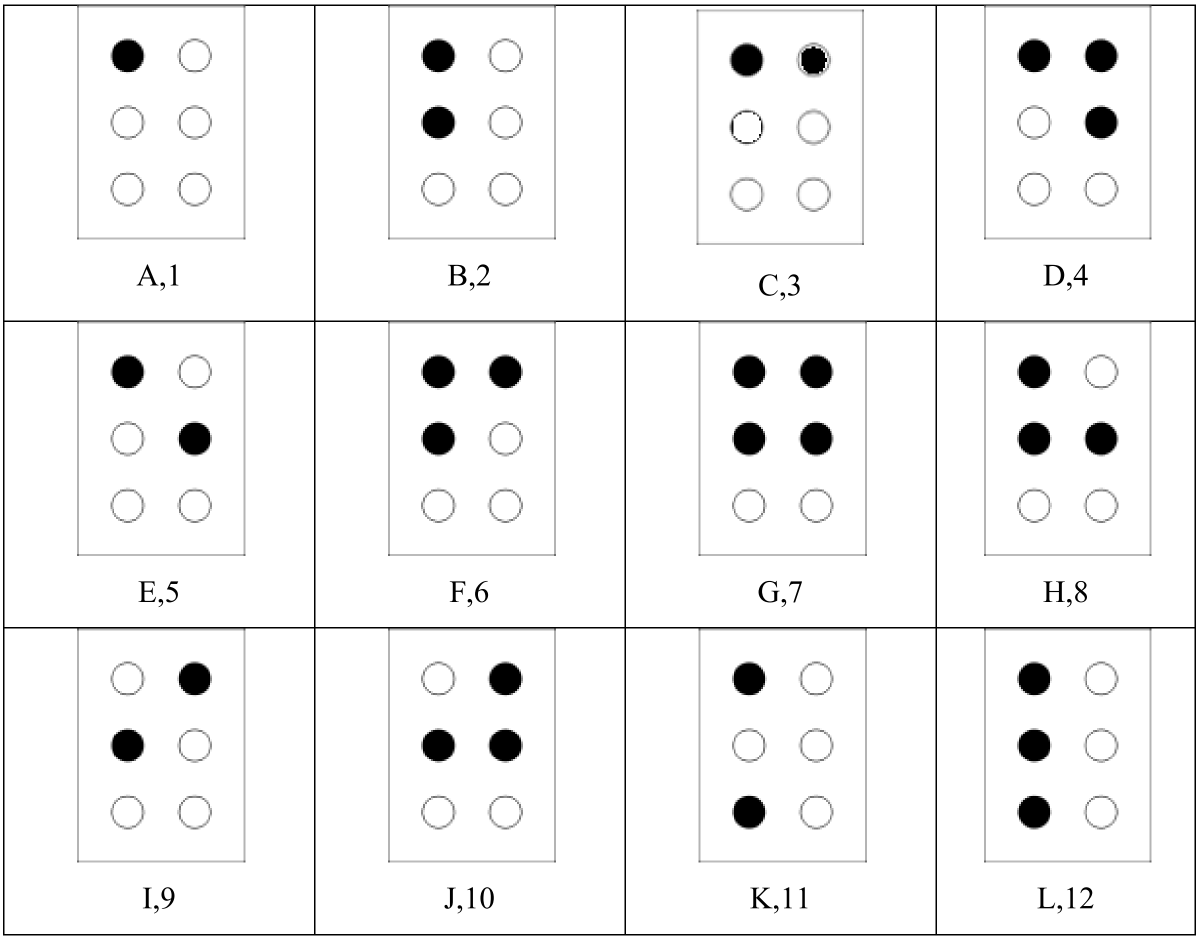


Figure 2.1: Grade 1 Representation for stand

Following is the Braille representation shown in figure 2.2, for the different letters of English.



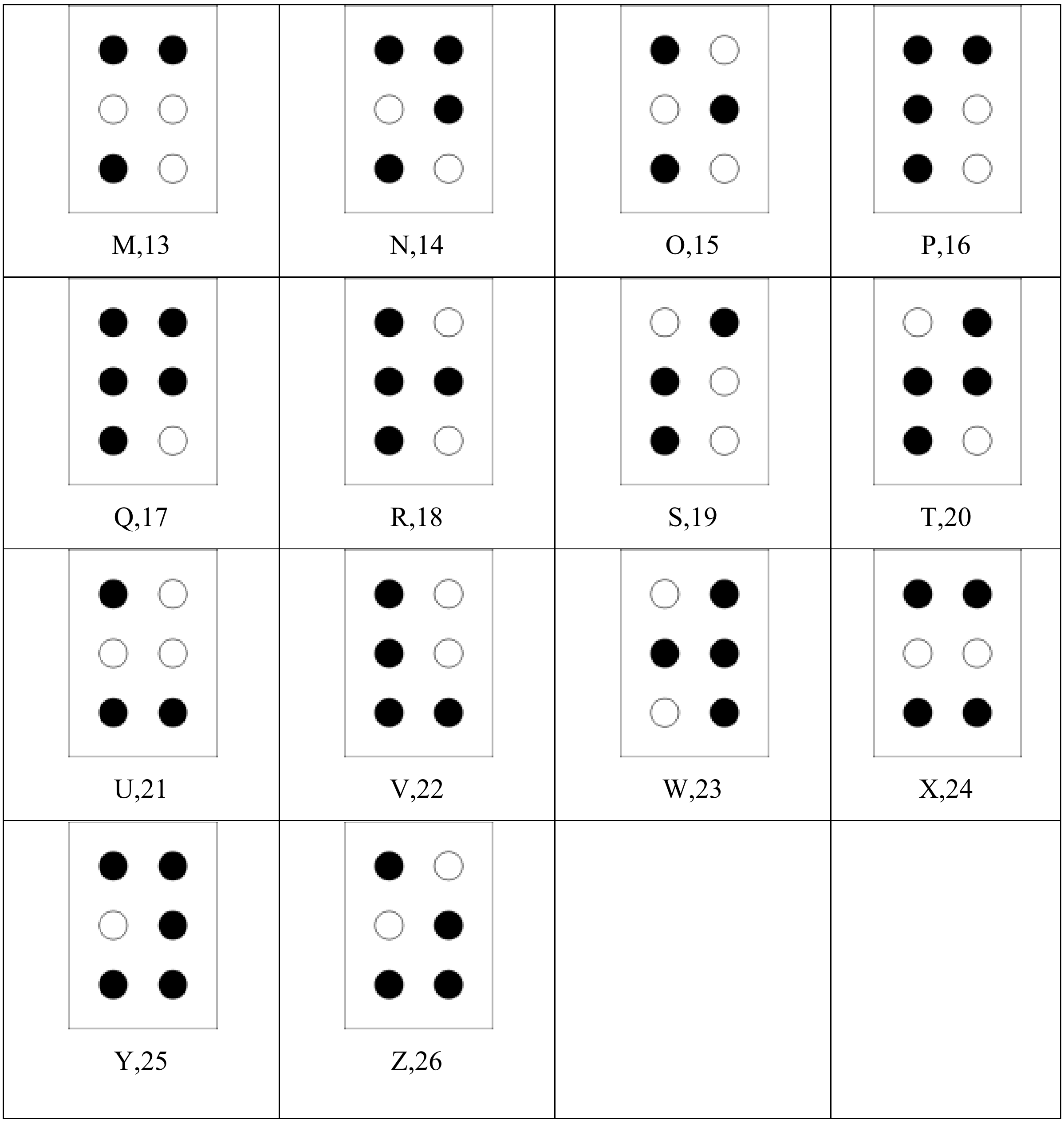


Figure 2.2: English characters Braille representation [11,12]

Punctuation Symbols

Punctuation symbols are the special symbols in which cells are assigned for the capital letters means how we can change lower case letter to upper case letter, numbers follows (means by using this cell we can convert a normal English alphabet into numerals), symbol for apostrophe, full stop, comma, semicolons, exclamation point, opening quotation mark, closing quotation mark *etc.* Cell assignment for punctuation symbols are shown below in the figure 2.3.

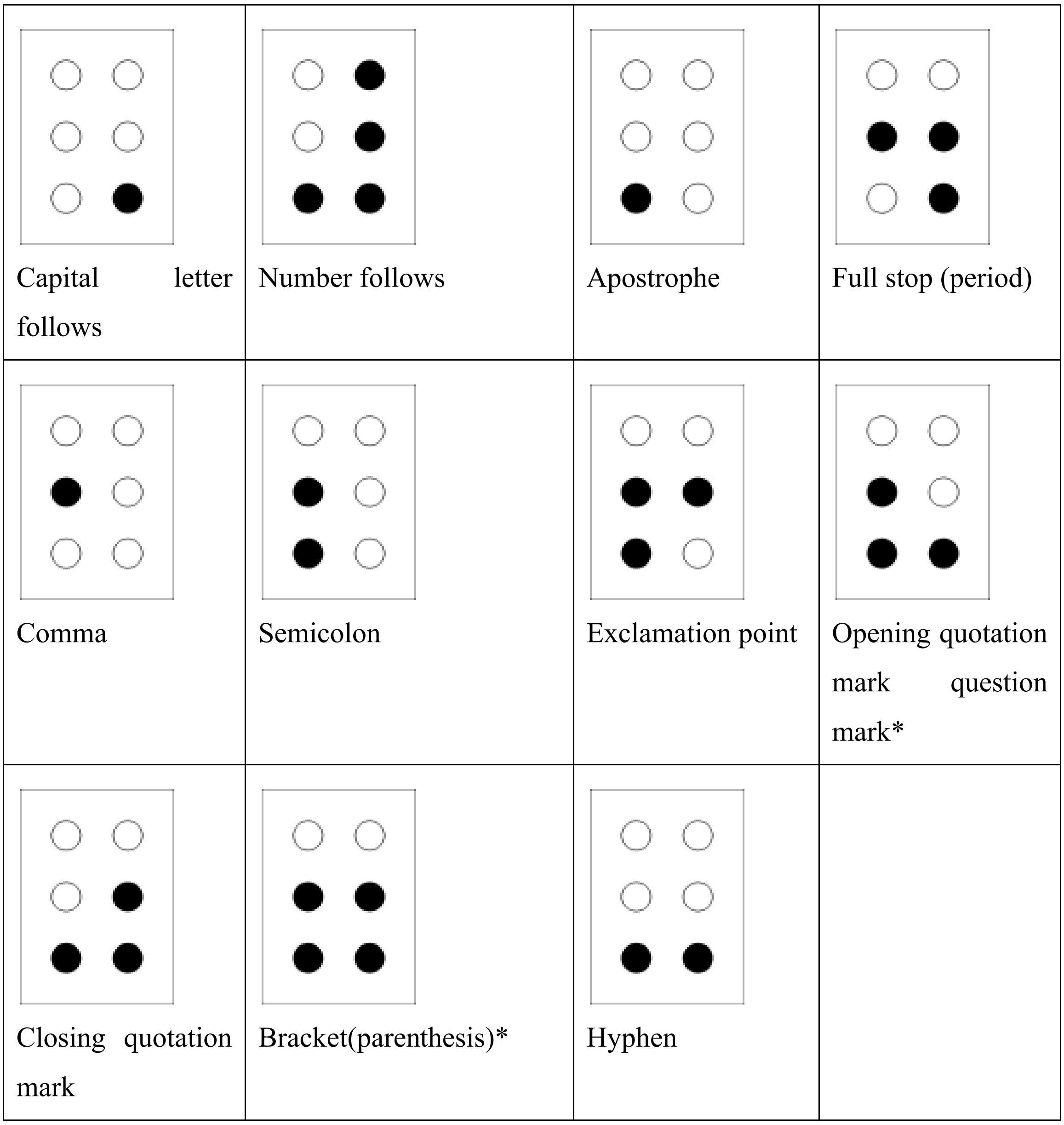


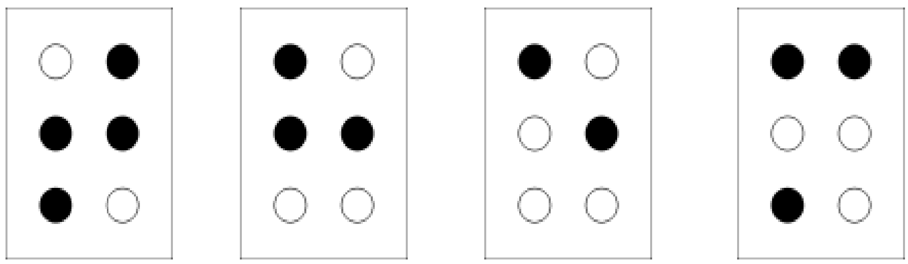
Figure 2.3: Punctuation symbols Braille representation [13]

* When we want to represent the question mark then it is represented by dots 2-3-6—the same as the opening quotation mark. So, the placement of the dots—before a word or after a word—will determine for which symbol the cell is used.

* Opening and closing parentheses are shown with the same symbol. Therefore, the placement context will determine whether the cell is assigned for the opening parenthesis or closing parenthesis.

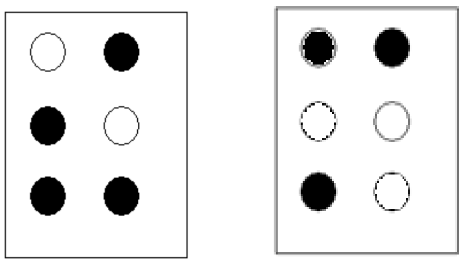
2.1.2 Grade 1 and ½ Braille

It represents normal (open) Braille with group symbols which are moderately contracted. For example: The group symbol for 'THE' is dots 2-3-4-6. Thus if dots 2-3-4-6 in one cell are followed by dots 1-3-4 (cell for m) in the second cell, the combination is read as 'Them' [14]. The individual cells assignment is shown in figure 2.4, and cell assignment with the help of grade 1 and grade ½ is shown in figure 2.5.



Cell for t Cell for h Cell for e Cell for m

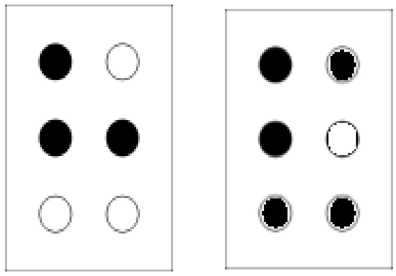
Figure 2.4: Grade 1 representation of them [11]



Cell for the Cell for m

Figure 2.5: Grade 1 and ½ representation of them [14]

Similarly, the group symbols for the word hand are indicated below in figure 2.6.



Cell for h cell for and

Figure 2.6: Grade 1 and ½ representation of hand [11]

This is done because we have placed cell of h before and so it denotes hand.

2.1.3 Grade 2 Braille

Grade 2 denotes contracted form of grade 1 Braille, in general books for blind are written in grade 2 Braille. Contraction is used in Braille so that space requirement for any text to Braille translation can be minimized so that cost can also be reduced for this translation. Grade 2 Braille can be divided in two categories.

- Contraction with one cell only.
- Contraction with two cells.

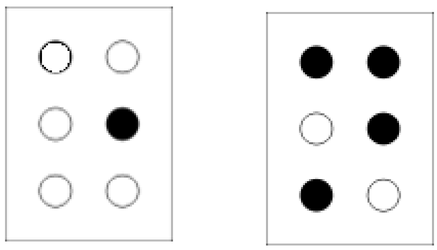
Contraction with one cell

In this for a group of letters a cell is assigned. For example, B in Braille stands for BUT, C stands for CAN means if we have to use these words we can replace them with their contraction for saving space [14, 15].

- B in Braille stands for BUT.
- C in Braille stands for CAN.
- D in Braille stands for DO.
- E in Braille stands for EVERY.
- K in Braille stands for KNOWLEDGE.
- P in Braille stands for PEOPLE, etc.

Contraction with two cells

In this two cells are used for contraction as shown in figure 2.7. In this figure, the cell which has dot 5 embossed is placed before the cell assigned for N. Then, this will result cell for NAME.

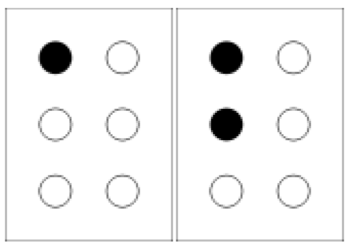


Dot 5 N stands for NAME

Figure 2.7: Grade 2 Braille for NAME [15]

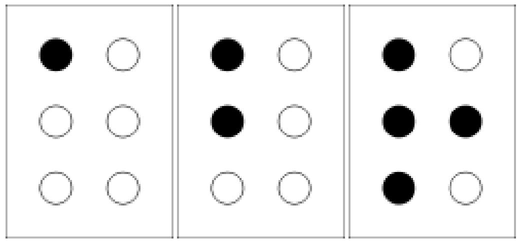
Abbreviation

These are the short words assigned for the larger word. For example, if we combine cell ‘a’ with cell ‘b’ then this will form ‘about’ and if we combine ‘a’, ‘c’ and ‘r’ then it will form ‘across’. Abbreviation is shown in figure 2.8 and 2.9.



Cell for a Cell for b

Figure 2.8: Abbreviations for about [14]



Cell for a Cell for c Cell for r

Figure 2.9: Abbreviation for across[14]

2.2 Representation of Numerals in Braille

The limit on the number of cells poses some problems when it comes to representing the numerals and related symbols. In standard Braille, as well as in Bharati Braille, numerals in normal text are represented in terms of the first ten letters of the alphabet for example, a, b c, d, e, f ...... j.

1 2 3 4 5 6 7 8 9 0

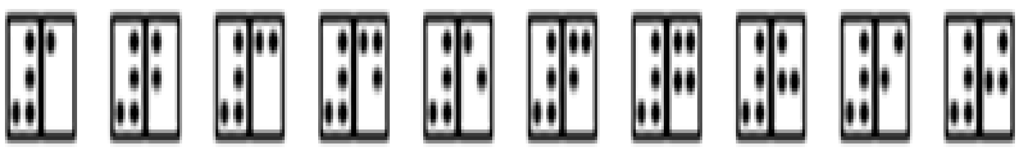


Figure 2.10: Numerals Braille representation [6]

To distinguish the numeral from the letter of the alphabet, a special cell is placed before the numeral. This cell is known as the Number sign. In standard Braille, the rule followed in using this special number sign is that it is placed in front of a string of numerals where the string has a specific interpretation. The number sign is not placed before every numeral. It is present at the beginning of any group of numerals that have specific interpretation.

2.3 Braille for Indian Language

The adjustment of the six dot system for the languages of India is taken into account in Bharati Braille. Indian Institute of Technology madras has worked a lot in the field of Bharati Braille under the guidance of Professor Kalyana Krishnan. They have worked for the conversion of Indian languages to Braille representation. The history of Bharati Braille starts form the period prior to India's independence. Schools for the blind had already been established in the country during the later part of the nineteenth century. Braille had found acceptance as an appropriate medium for educating the blinds. The complexities of the writing systems of Indian languages had somewhat hindered the development of Braille specific to the Indian environment.

The beauty of Braille is that it is based on phonetics. Thus be it any language, Hindi, Japanese, German or Chinese, the same sounding letters will have the same Braille sign. For example, “ba” in Hindi has the same dot as “b” in English [27].

It is interesting to observe here that Braille can be viewed as a script for writing a language. Indian languages are based on a writing system which is essentially phonetic in nature. Hence some people had suggested Braille as one of the scripts that could be used for writing text in the different Indian languages. In fact India had made a recommendation to UNESCO to consider a universal standard for Braille, based on a Phonetic representation of sounds using the six dot system.

2.3.1 Uniform Schemes for Indian Languages

It turns out that Bharati Braille achieves this uniformity in remarkable way and the recommendations apply to all the regional languages of India along with Urdu. The basic idea behind Bharati Braille may be summarized as below.

- The six dot system is viewed as another script to write the languages of India. The compromise effected is that a syllable will always be represented through its consonants and vowels by explicitly writing the consonants and vowels one after the other. Ligatures are therefore eliminated. True, this would mean that more cells would be required but considering the fact that one gets uniformity and grade-1 Braille in English also follows this convention, the system is indeed viable.
- Bharati Braille assigns the cells to the basic sounds of the Indian languages (these are called aksharas) in a manner where vowels and consonants that find direct equivalents in English are given the same representation as in English. This way, with minimal effort one would able to read both English text and Indian language text. This arrangement is essential if the visually handicapped are required to communicate with their counterparts in other countries.
- Bharati Braille retains all the basic conventions relating to the representation of numerals, punctuation and special symbols just as in Standard English Braille.

There are no concepts in Bharati Braille like the lines in English Braille. We have to necessarily learn the cell assignments for the different vowels and consonants and hence the initial period of training has to be prolonged. Another thing which is to take into consideration is, since all the Indian languages share the same Braille representation, it will be difficult to identify when a language switch is occurring in multilingual texts. This issue is still being examined and possibly one of the cells might be used to indicate a change of context. But for most persons, bilingual text would be adequate where one of the languages will be English and the context would be sensed from the text itself. If needed, text in different languages may always put on separate lines on a printed page of Braille [27].

2.3.2 Assignment of Cells to Aksharas of Indian Languages

The aksharas of Indian languages are divided into vowels and consonants. Across the many different languages of the country, one finds up to sixteen vowels and about forty consonants. The assignment of the cells is therefore applicable across all the languages though it must be stated that a few cells have to interpret based on the language. This is a consequence of the fact that we have only sixty three cells available to us and reserving ten cells for punctuation leaves us in a tight situation. Across the languages, fifteen vowels and thirty three consonants are common (with the exception of Tamil) and so the basic assignment in Bharati Braille corresponds to these.

Bharati Braille is thus a system for writing syllables using a basic set of 63 shapes, each corresponding to a cell. Here, the most basic approach to writing syllables using generic consonants has been used. A syllable in Indian languages can take any one of the following forms.

- A pure vowel V.
- A basic consonant and a vowel CV.
- A conjunct with two or more consonants and a vowel CC...V.

The cell assignment for a consonant assumes that the consonant has an implied vowel "a" as part of it. A pure consonant (also known as a generic consonant) has no vowel and so to distinguish a basic consonant from its generic equivalent a special symbol is used in the writing systems. This is known as the halanth and its shape is a language specific ligature added to the shape of the basic consonant. Bharati Braille has set apart one cell for this purpose and this cell placed before the cell for a basic consonant turns it into a generic consonant. The idea here is that one can use this principle to write syllables in the CC...V form simply by concatenating the cells for each generic consonant [27].

The cell assignments corresponding to the basic vowels and consonants are similar to the assignments of the English alphabet where the sounds match. But only about 25 can be matched this way. “Halanth” is represented through one cell having only one dot namely dot 4.

It is also observed that some of the aksharas have been assigned two cells. The first of the two cells will invariably be a cell with just one dot, typically dot 5. The understanding here is that a cell with dot 5 alone is a special cell implying that the following cell has to be interpreted differently. Such schemes where a special symbol is employed to provide specific interpretation of the following character are common with computer systems and the special character is known as the Escape character. It is remarkable, that Braille had employed this scheme long before computers came into the picture.

2.3.3 Basic Rules for Preparing Braille Text

These are the some basic rules for preparing the Braille text that how the cells are assigned to the vowels and consonants.

- Bharati Braille conforms to the syllabic writing system followed for all the Indian languages and syllables are just written using the cells assigned for the consonants and vowels.
- A pure vowel is always shown using the cell assigned for the vowel.
- A basic consonant is always shown using the cell assigned for the consonant.

2.3.4 List of Braille character for English /Indian languages

These lists are categorized in the seven parts on the basic of a particular dot presence or absence. This categorization is done to make it possible for us to do the assignment in such a way that we can easily relate the letter or symbol to the cell, learning Braille will be easier. So we now look at how the sixty three cells can be arranged geometrically into groups where cells in a group share a common property. The main idea is here is that hopefully, we will be able to associate groups of cells with groups of letters or special characters based on some criteria where groups share some common properties.

Category 1: The first category is in which the dot number 3 and 6 of the Braille cell are absent in each of its cell. The listing of such type of cells is shown in the table 2.1.

Table 2.1: Braille characters list for English/ Hindi having absence of dot 3 and 6 [7].

⠁	A	अ	அ	అ	ಅ	അ	ଅ	অ	અ	ਅ	अ
⠃	B	ब	–	బ	ಬ	ബ	ବ	ব	બ	ਬ	ब
⠉	C	च	ச	చ	ಚ	ച	ଚ	চ	ચ	ਚ	च
⠙	D	द	–	ద	ದ	ദ	ଦ	দ	દ	ਦ	द
⠑	E	ए	எ	ఎ	ಎ	എ	ଏ	এ	એ	ਏ	ए
⠋	F	–	–	–	–	–	–	–	–	–	–
⠛	G	ग	–	గ	ಗ	ഗ	ଗ	গ	ગ	ਗ	ग
⠓	H	ह	ஹ	హ	ಹ	ഹ	ହ	হ	હ	ਹ	ह
⠊	I	इ	இ	ఇ	ಇ	ഇ	ଇ	ই	ઇ	ਇ	इ
⠚	J	ज	ஜ	జ	ಜ	ജ	ଜ	জ	જ	ਜ	ज

Category 2: The second category is in which the dot number 3 is present and 6 is absent in each of its cell. The listing of such type of cells is shown in the table 2.2.

Table 2.2: Braille characters list for English/ Hindi having presence of dot 3 and absence of dot 6 [7].

⠅	K	क	க	క	ಕ	ക	କ	ক	ક	ਕ	क
⠇	L	ल	ல	ల	ಲ	ല	ଲ	ল	લ	ਲ	ल
⠍	M	म	ம	మ	ಮ	മ	ମ	ম	મ	ਮ	म
⠝	N	न	ந	న	ನ	ന	ନ	ন	ન	ਨ	न
⠕	O	ओ	ஓ	ఓ	ಓ	ഓ	ଓ	ও	ઓ	ਓ	ओ
⠏	P	प	ப	ప	ಪ	പ	ପ	প	પ	ਪ	प
⠟	Q	क्ष	க்ஷ	క్ష	ಕ್ಷ	ക്ഷ	କ୍ଷ	ক্ষ	ક્ષ	–	क्ष
⠗	R	र	ர	ర	ರ	ര	ର	র	ર	ਰ	र
⠎	S	स	ஸ	స	ಸ	സ	ସ	স	સ	ਸ	स
⠞	T	त	த	త	ತ	ത	ତ	ত	ત	ਤ	त

Category 3: The third category is in which both the dots means number 3 and 6 of the Braille cell are present in each of its cell. The listing of such type of cells is shown in the table 2.3.

Table 2.3: Braille characters list for English/ Hindi having both dots 3 and 6 [7].

⠥	U	उ	உ	ఉ	ಉ	ഉ	ଉ	উ	ઉ	ਉ	उ
⠧	V	व	வ	వ	ವ	വ	ଵ	ব	વ	ਵ	व
⠭	X	ऑ	ஒ	ఒ	ಒ	ഒ	–	–	–	ઑ	ऑ
⠽	Y	य	ய	య	ಯ	യ	ଯ	য	ય	ਯ	य
⠵	Z	ज़	-	-	-	-	ଜ଼	জ়	-	ਜ਼	ज़
⠯	and	प	ஷ	ప	ಪ	പ	ପ	প	પ	-	प
⠿	For	ह	-	హ	ಹ	ഹ	ହ	হ	હ	ਹ	ह
⠷	Of	-	ழ	-	-	ഴ	–	–	-	-	-
⠮	the	ध	-	ధ	ಧ	ധ	ଧ	ধ	ધ	ਧ	ध
⠾	with	ट	ட	ట	ಟ	ട	ଟ	ট	ટ	ਟ	ट

Category 4: The fourth category is in which bottom right dot means dot 6 of the Braille cell is present in each of its cell. The listing of such type of cells is shown in the table 2.4.

Table 2.4: Braille characters list for English/ Hindi having dot 6 [7].

⠡	ch	छ	–	ఛ	ಛ	ഛ	ଛ	ছ	છ	ਛ	छ
⠣	gh	घ	–	ఘ	ಘ	ഘ	ଘ	ঘ	ઘ	ਘ	घ
⠩	sh	श	ஶ	శ	ಶ	ശ	ଶ	শ	શ	ਸ਼	श
⠹	th	थ	–	థ	ಥ	ഥ	ଥ	থ	થ	ਥ	थ
⠱	wh	ज्ञ	–	జ్ఞ	-	ജ്ഞ	ଜ୍ଞ	জ্ঞ	જ્ઞ	–	ज्ञ
⠫	ed	ढ	–	ఢ	ಢ	ഢ	ଢ	ঢ	ઢ	ਢ	ढ
⠻	er	ढ़	ழ	ఱ	ಱ	റ	ଢ଼	ঢ়	ઢ઼	ੜ	ढ़
⠳	ou	ऊ	ஊ	ఊ	ಊ	ഊ	ଊ	ঊ	ઊ	ਊ	ऊ
⠪	ow	औ	ஔ	ఔ	ಔ	ഔ	ଔ	ঔ	ઔ	ਔ	औ
⠺	w	ठ	–	ఠ	ಠ	ഠ	ଠ	ঠ	ઠ	ਠ	ठ

Category 5: The fifth category is in which top two dots (dot 1 and 4) of the Braille cell are absent in each of its cell. The category consists code for punctuation marks and some contraction for two letters combination. The listing of such type of cells is shown in the table 2.5.

Table 2.5: Braille characters list for English/ Hindi having absence of dot 1 and 4 [7].

⠂	' ea	ऽ	–	ఽ	ಽ	ഽ	ଽ	ঽ	ઽ	–	ऽ
⠆	; be bb	;	;	;	;	;	;	;	;	;	;
⠒	: con cc	ञ	ஞ	ఞ	ಞ	ഞ	ଞ	ঞ	ઞ	ਞ	ञ
⠲	. dis dd	।	.	.	.	.	.	.	.	.	।
⠢	en	ऍ	எ	ఎ	ಎ	എ	ଏ	য়	ઍ	–	ऍ
⠖	! ff	! फ	–	! ఫ	! ಫ	! ഫ	! ଫ	! ফ	ફ઼	! ढ	! फ
⠶	(or) gg	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
⠦	" ?	?	?	?	?	?	?	?	?	?	?
⠔	in	*	?	*	*	*	*	*	*	*	*
⠴	"	झ	–	ఝ	ಝ	ഝ	ଝ	ঝ	ઝ	ਝ	झ

Category 6: The sixth category is in which two dots (dot 1 and 2) of the Braille cell are absent in each of its cell. The listing of such type of cells is shown in the table 2.6.

Table 2.6: Braille characters list for English/ Hindi having absence of dot 1 and 2 [7].

⠌	st	ऐ	ஐ	ఐ	ಐ	ഐ	ঐ	ଐ	ઐ	ਐ	ऐ
⠬	ing	ङ	ங	ఙ	ಙ	ങ	ঙ	ଙ	ઙ	ਙ	ङ
⠼	(n. sign) ble										
⠜	ar	आ	ஆ	ఆ	ಆ	ആ	আ	ଆ	આ	ਆ	आ
⠄	(ap ostr)	अँ	-	-	-	-	অঁ	ଅଁ	અઁ	ਅਁ	अँ
⠤	hyp h co m	-	-	-	-	-	-	-	-	-	-

Category 7: The seventh category has seven codes which are identified by the absence of dots in the left column of each cell. The first four codes are used for denoting special attribute to the following letter and remaining are used for forming contractions. The listing of such type of cells is shown in the table 2.7.

Table 2.7: Braille characters list for English/ Hindi having absence of dots in left column [7].

⠈	Accen t sign	`	·	[illegible]	[illegible]	ˇ	`	`	`	`	`
⠨	Italic Sign	ख	–	ఖ	ಖ	ഖ	ଖ	খ	ખ	ਖ	ख
⠰	Letter Sign	अं	ஔ	అం	ಅಂ	അം	ଅଂ	অং	અં	ਅਂ	अं
⠠	Capit al Sign	अः	ஃ	అః	ಅಃ	അഃ	ଅଃ	অঃ	અઃ	–	अः
⠐	Sign for contra ction										
⠘	Sign for contra ction	भ	–	భ	ಭ	ഭ	ଭ	ভ	ભ	ਭ	भ
⠸	Sign for contra ction	ळ	ள	ళ	ಳ	ള	ଳ	–	ળ	ਲ਼	ळ

2.4 Issues in Reading and writing of Braille

Reading and writing of Braille is the process in which there are several steps. Mainly we can divide these steps in four parts. The steps can be divided as follows.

- Pre –Braille training
- Reading Readiness test
- Reading Braille
- Writing Braille

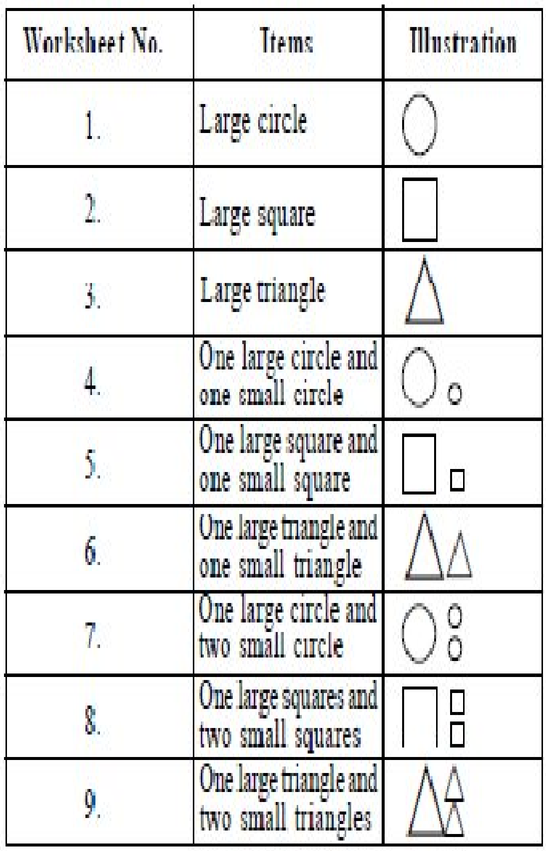
2.4.1 Pre –Braille training

Before teaching Braille reading and writing skills, the important thing is that the child develops good tactual ability to make difference and finger agility. A child should be encouraged to perform various activities to develop hand coordination, finger movement, and tactual discrimination and fine muscle coordination. It is advisable to develop a variety of Pre-Braille worksheets using different combinations of six dots. These worksheets train the child to move fingers from left to right identify location of dots and identify differences among Braille dots [12]. For example a worksheet can be prepared as follows in which we follow the Braille lines.

- Develop a worksheet with Braille lines using dots 3 and 6.
- Make four lines of different lengths.
- Identify shortest and longest lines.

2.4.2 Reading Readiness Test

As a training that blind may recognize sense of touch, Reading Readiness Test, should be managed. The test can be developed using cardboard, scissor, glue and paper. Three shapes round, triangle and square should be cut into larger and smaller sizes. The shapes should be pasted on paper in the following sequence as shown below in the figure 2.7 [13, 14].



Worksheet No.	Items	Illustration
1.	Large circle	
2.	Large square	
3.	Large triangle	
4.	One large circle and one small circle	
5.	One large square and one small square	
6.	One large triangle and one small triangle	
7.	One large circle and two small circle	
8.	One large squares and two small squares	
9.	One large triangle and two small triangles	

Figure 2.11: Basic symbols [13]

Increase the small circle, square and triangle one each in the subsequent worksheets till their number reaches six. The last three worksheets should have six small circles, six small squares and six small triangles each. Direct the test to the blind child who has been exposed to pre-Braille activities. Once the child is able to recognize these worksheets clearly, he is ready for training in reading of Braille.

2.4.3 Reading of Braille

The Pre-Braille Training and Reading Readiness Test should terminate into reading of Braille. Learning of Braille may consist following steps.

- Reading of Braille should be the first step.
- Beginning should be made with recognition of dots.

- Writing of Braille should be the last stage.
- Use both forefingers for reading Braille.
- Read Braille with the tips of the fingers.
- Fingers should be slightly bent and wrist should be slightly elevated.
- Fingers should be slightly curved and resting lightly on the reading material.
- Dots should be touched lightly and not pressed hard.
- Read from left to right.
- Most people read Braille with the right index finger, using the left index. finger to read part of the Braille line or as a marker at the left margin to help find the next line [15].

2.4.4 Braille Writing

In this we may discuss the method how Braille is written and what are the necessary skills for this.

1) Method

Braille is written with a Braille slate, Inter Point Braille Frame, or a four line pocket frame and a stylus or with a Brailler.

a) To write Braille with a slate or Interpoint Braille Frame

- Paper is inserted between the top and bottom layers of the guide of the slate or the pocket frame.
- Paper is held firmly using locking mechanism in case of the slate or corner pins in case of a pocket frame.
- Braille dots are punched using the stylus downward into the paper through the cells of the slate or frame.
- Braille is written from right to left so that when the paper is turned over for reading; characters can be read from left to right.

b) To write Braille with a Brailler.

- Paper is inserted through a slot.
- Paper is rolled on a drum by rotating the knobs.

- Braille can be written on the top of the paper by pressing the necessary keys.
- On Brailler, the operator will write from left to right as dots are appearing on the upper part of paper.

2) Necessary skills

a. Child must understand the meaning of each cell.

b. Child should possess the following:

- Child must possess Finger manipulation skills.
- Fine motor coordination and control of muscles.
- Competency to read familiar Braille words.

2.5 Computerization of Braille

As today day by day computers are being introduced in all fields and they are becoming very beneficial and recent spread of personal computers has brought new benefits to Braille users also that have access them. Computerized Braille translation is one of these benefits, but it is not a straightforward process because of the complexities of Braille contraction.

2.5.1 Difficulties in Computer Braille Translation

Contraction makes Braille translation difficult. Without it, Braille translation would be a relatively text characters to Braille cells. Each language (English, Hindi) or code (chess, math's) would need its own unique mapping dictionary, but the operation would be trivial. Contraction greatly increases complexity, so computer translation is generally difficult. For simple task, mapping example, in English, there are many words that are formed from the concatenation of other words, similar to the English "uphill". Many potential Braille contractions will arise from the new juxtaposition [19, 20].

2.5.2 Braille versus Audio, Visual technique

Braille has come under attack in recent years ,with studies showing decreasing usage due to changing patterns of education. Alternative technologies ,like speech synthesis ,now exist for many of its application . It can be safely assumed that sighted people will use ink printed,and visually impaired , partially sighted or blind people will used embossed pattern .There are fundamental reasons for continunig with Braille. Reading and writing Braille code is a form of literacy , literacy is a vital component of modern knowledge and society , the braille code permits literacy for blind people. Using audio only technology denies electricity to braille users.

- Braille code is silent alternative technolgy to braille may not be usable in all circumstances. A speech synthiszer and speech interpretor forbid complete privacy and impose on the local environment. This would not be appropriate in, for example, an office environment [21].

- Braille code is accurate in reading. Speech synthesis, an alternative to Braille, may establish indecipherable meanings, Problem will arise from words not known to synthesizer, mis- spelt words (for example "The fihs swam" is clearly a typographical error when read , but "the fizz swam" is not so clearly identified and corrected when heard), or with words prononced differently according to contexts. (for example "the book was not read because I wanted to read it later".) . Reading straight from the text remove the potential source of error.

- Braille code allows the interpretation of the text by the reader, not by another. Any reader who wishes to interpret the text themselves. An actor or a reader for pleasure.-may want to form their own interpretation of a text, not be forced into that of a disinterested computer program or particular actor. Inaccuracies in interpretation will be possible.
- Braille code is cheaper than computer technology. This is a simplification. The mechanism to print and reproduce braille is expensive and the volume produce are text and braille computer translation.

2.5.3 Braille printer

Braille printers receive data from computer devices and emboss that information in Braille onto paper through the use of solenoids that control embossing pins. Braille printers typically print on heavyweight paper and use up more pages for the same amount of information than pages printed on a regular printer. They are also slower and noisier. Interpoint printers are braille printers that emboss braille on both sides of a page. The price of a braille printer is directly related to the volume of braille it produces. Small-volume braille printers cost between $1,800 and $5,000 and large-volume ones may cost between $10,000 and $80,000. This braille printer can be used for taking printout from Braille translator output.

2.6 Existing System

In this we will discuss that what work has been done in the Braille translation field . The American Printing House for the Blind in Louisville [1,2] had installed an IBM 709 computer, which receives input from a team of sighted typists. This system produces Grade 2 Braille on punched cards, which are then used to drive stereotyping machines. While the Braille that is produced is of highest quality, the cost of the process justifies it only for large-volume runs.

A second project was that of the development of Brailletran by Boyer [5]. The system of software that utilized the line printer technique had as constituents literary and technical Braille, and was intended to accept a variety of inputs. Glazer, in cooperation with the Center for Sensory Aids Evaluation and Development at MIT. [4], developed a Grade 1.8 Braille translator on a PDP-8 computer. This 97 program drove a high-speed embosser (16 characters per second) [5] designed and built by the Department of Mechanical Engineering, MIT A number of follow-up systems have utilized this embosser such as that of the Phase I reading-machine system at the Research Laboratory of Electronics, MIT In conjunction with the embosser, which is now in the production and development stage, a flexible software package has been written by A. and J. ISchack and Thornhill. This package, called "DOTSYS" [5], generates Grade 2 Braille from a variety of inputs, including teletype and monotype tape.

Anderson and Rogers, at the Lawrence Radiation Laboratory of the University of California [3], have succeeded in producing Braille by a modified Model 33 teletype. They accomplish this by replacing the type on the type wheel by the seven possible dot combinations for one half of the Braille cell. Also, the platen is softened by rubber backing and the ribbon is removed. Such a technique, while very attractive require two or more typing or embossing operations to produce the Braille characters. At least two line printers, the IBM 1403N-2 and the Analex, have been modified to produce near-standard Braille. Both techniques involve the modification of the printer mechanism with reasonably expensive kits. While such a technique provides a good embosser, the cost of the equipment (line printer, kit, and computer), together with the necessary high input rate, make the system too expensive for most applications. At the other extreme Morrison of the Telephone Company Pioneers has produced a modified teleprinter that embosses Braille on a paper tape. Still others, such as Gill [5], Blanco, Bellows, Dangel, and Blackman at MIT, have built strip or belt Braille displays. Grunwald and his associates at Argonne National Laboratory are developing a promising line brailler whose display relies on a plastic belt. His Braille is formed by raising selected dimples on the belt, which may easily be replaced when worn out. None of these has yet gone into production, and it is probable that this type of display would not meet with widespread acceptance, owing to the single-line format. Such devices could be used, however, as displays for tape-recorded Braille.

Chapter 3
Problem Statement

3.1 Problem Statement

Nearly 161 million persons live with a disabling visual impairment, of whom 37 million are blind. About 90% of them live in developing countries of Africa, Asia, Latin America and the Pacific Regions. Development of Braille for teaching the Blind was a very big achievement and this helped a lot for giving a chance of participating the blind person in this fast moving world and they can have some knowledge which a person should have for a normal life. 9 out of 10 blind children in developing countries have no access to education. This low literacy rate is partly due to the lack of trained teachers and the challenges associated with learning to write Braille on a traditional slate and stylus. These challenges include writing from right to left, writing mirrored images of letters and cost associated with Braille translation. Every 5 seconds someone becomes blind, every minute somewhere a child goes blind. [24]

The other problem with creating documents in Braille is that it takes a lot of space as the cell required for a single letter is very large in physical dimension in comparison of the alphabet for which it is used, due to this paper cost increases. Also we people and government do not take such steps so that the blind may be benefitted because it is very tedious job to teach blinds. Due these reason a very little text is available for blinds and they do not have enough literature for them, by which literacy rate can be increased. So, such a tool was needed which can translate normal languages text to Braille, so that by this fast conversion we may be able to provide them all that text which they deserve. The main aim was to greatly increase the cost effectiveness of the Braille manufacturing process and provide the kinds of Braille material that the blind person needs. The blind person requires in Braille highly specialized material with as short a delay as possible. So this inspires us for the development of this software. We develop it for English which is very useful for the Global communication and as in India a lot of people don't know

English and they can understand only Hindi so for benefiting them we get inspiration for the development of this system.

4.1 Objectives

The main objectives which we aim to achieve in the development of this system are as stated below.

- The first objective is of Understanding the Braille.
- The second aim is understanding the computerization of Braille. Means how Braille can be computerized.
- The third objective is Development of Braille for English.
- The fourth objective is Development of Braille for Hindi.
- The last objective is testing of the system.

Chapter 4

Implementation and Flowchart of the Developed System

4.1 Architecture of the system

The block diagram of the architecture of the developed system is shown in figure 4.1. It is divided into four parts. The first part is input processor which will process the input text (input text will be the text of English or Hindi text). The second part is alphabet tokenizer that will token the words of input text into characters. The third part is text matcher that will match the tokenized characters with the look-up table characters and the 4th part is Braille processor that will process the final output in the Braille language which is the equivalent character of the tokenized character.

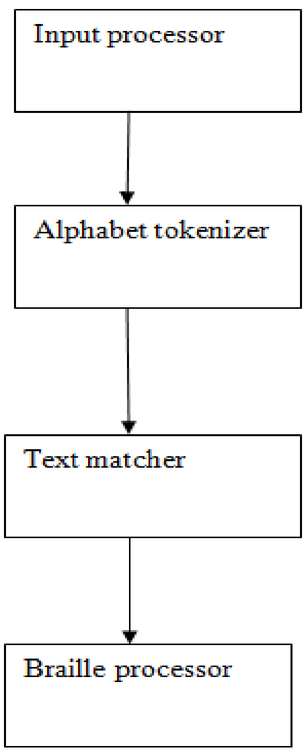


Figure 4.1: Architecture of the System

4.2 Flowchart of the System

The flowchart which shows that how text to Braille translation is achieved is shown in the figure 4.2.

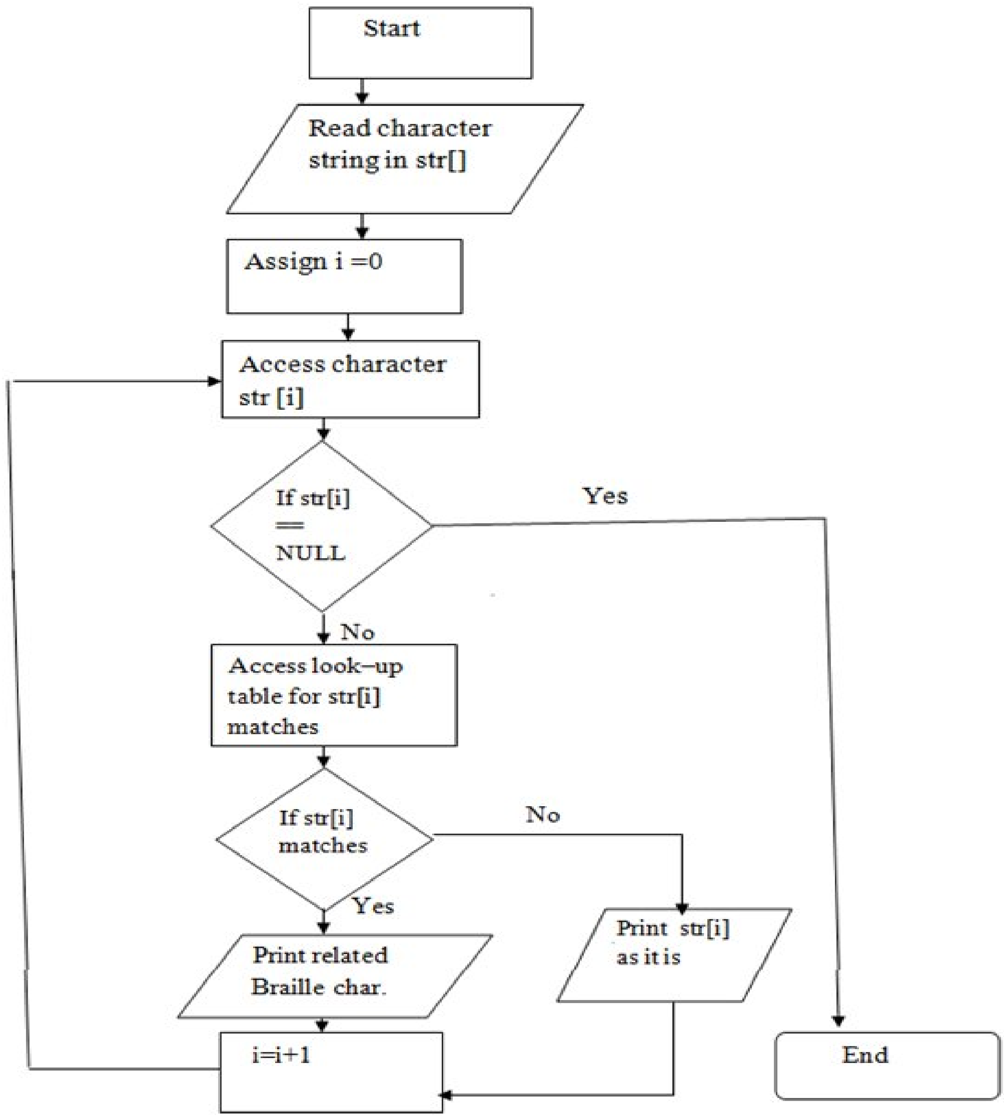


Figure 4.2: Flowchart of the System

In the form of algorithm the steps that are followed for the translation of input text to Braille are as follows.

1. Read a character string.

2. Separate the words on the basis of blank space.

3. Break the corresponding word into corresponding letters

4. Match the letters of the input text with the look-up table characters.

5. If characters match, then print corresponding Braille character as it is.

6. Repeat steps 4 and 5 until all the characters of input string are matched with look –up table characters.

4.3 Working of the System

When we input any language text then firstly for grade 1 Braille it will be divided into its constituents characters.

Example 1: I am reading a book from morning.

Book was written in English.

Writer of the book was William shakes pear.

now when we entered this text then all the words will be tokenized into its constitute characters i, a, m, r, e, a, d, i, n, g, a, b, o, o, k, f, r, o, m, m, o, r , n, i, n, g, b, o, o, k, w, a, s, w, r, i, t , t, e, n, i, n, e, n, g, l, i, s, h, w, r, i, t, e, r, o, f, b, o, o, k, w, a, s, w, i, l, l, l, a, m, s, h, a, k, e, s, p, e, a, r.

Now for Grade 1 Braille all these characters will be matched with the following look-up tables.

4.3.1 Look-up tables

Look-up tables are special tables in which there are three columns. The first column is for English alphabets, second column is for Hindi alphabets and the last and (third) column is for corresponding Braille representation. The look-up tables can be shown as in the tables 4.1 and 4.2.

Table 4.1: Look-up table

A	अ	⠁
B	ब	⠃
C	च	⠉
D	द	⠙
E	ए	⠑
F	-	⠋
G	ग	⠛
H	ह	⠓
I	इ	⠊
J	ज	⠚
K	क	⠅
L	ल	⠇
M	म	⠍
N	न	⠝
O	ओ	⠕
P	प	⠏
Q	क्ष	⠟
R	र	⠗
S	स	⠎
T	त	⠞
U	उ	⠥
V	व	⠧
X	ऑ	⠭
Y	य	⠽
Z	ज़	⠵

Table 4.2: look-up table

=	ढ	⠝
!	घ	⠕
*	छ	⠏
?	थ	⠟
$	ड	⠗
W	ठ	⠎
1	ऽ	⠞
2	;	⠥
3	ञ	⠧
4	।	⠭
5	ऍ	⠽
6	फ़	⠵

Now, for grade 1 Braille the tokenized text will be matched with the look-up table if any match exist then the corresponding Braille character will be displayed. The input and output window for grade 1 Braille will look like as shown in the figure 4.3 and figure 4.4.

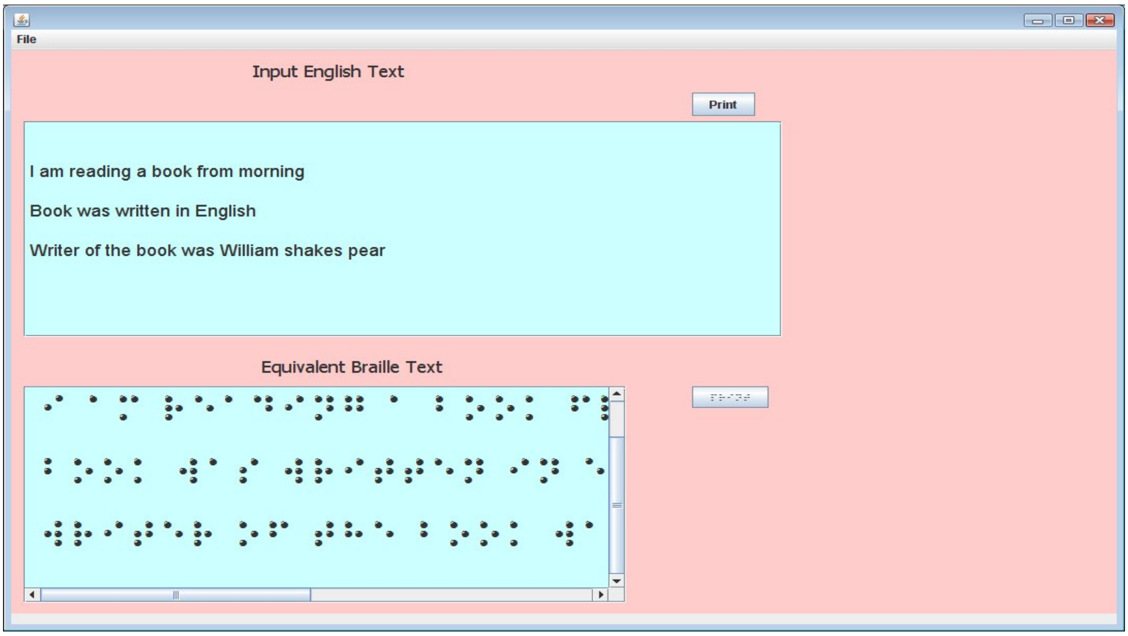


Figure 4.3: Input and output window for English to Braille translation

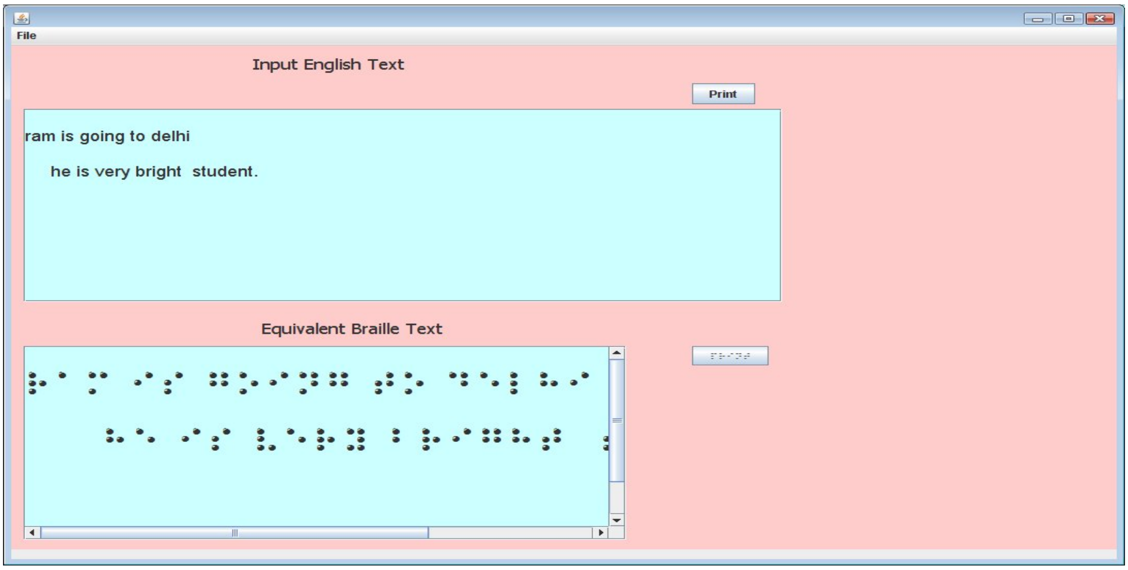


Figure 4.4: Input and output window for English to Braille translation

If we translate Hindi text to Braille then in this also firstly tokenization will take place. Then matching of characters will take place as we have done for English. The steps followed are such as shown for the below examples.

Example 1

राम खाना खाता है ।

नीरज गाना गाता है ।

मै पढता था ।

Now this text will be tokenized into its constituent letters

र, आ ,म, ख, आ ,न, आ, ख , आ ,त, आ, ह, ऐ, न, ई, र, ज, ग, आ ,न, आ, ग, आ ,त, आ, ह, ऐ,
म, ऐ, प, ढ, त, आ, थ, आ

Now these letters will be mapped on the look-up table. If match exist then the corresponding Braille representation is displayed. The input and output window snapshots are shown in figure 4.5 and 4.6 when Hindi text is translated to Braille.

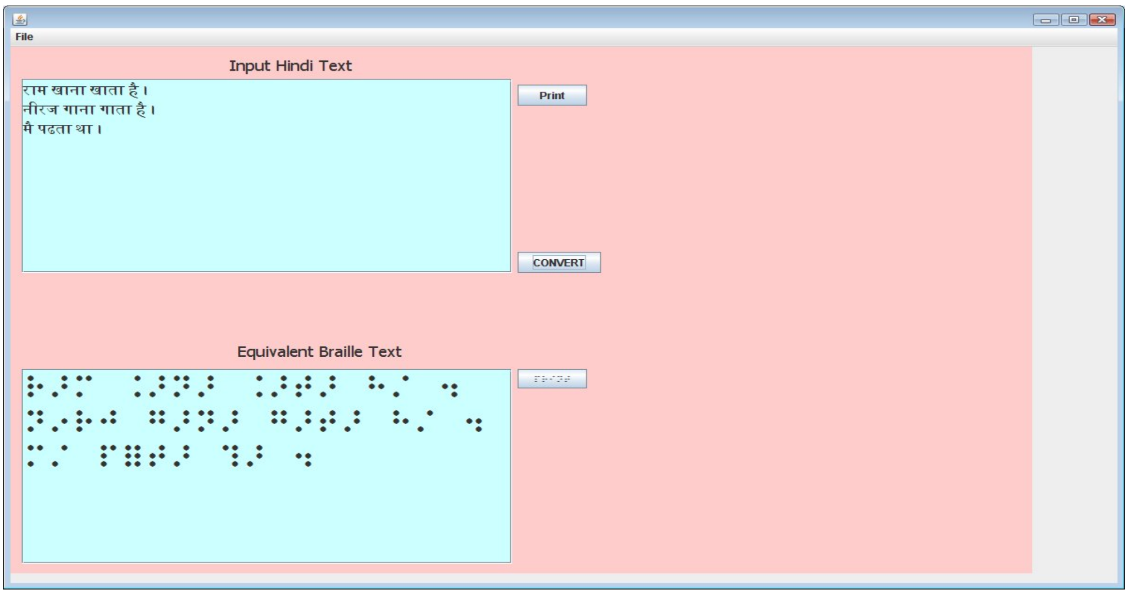


Figure 4.5: Input and output window for Hindi to Braille translation

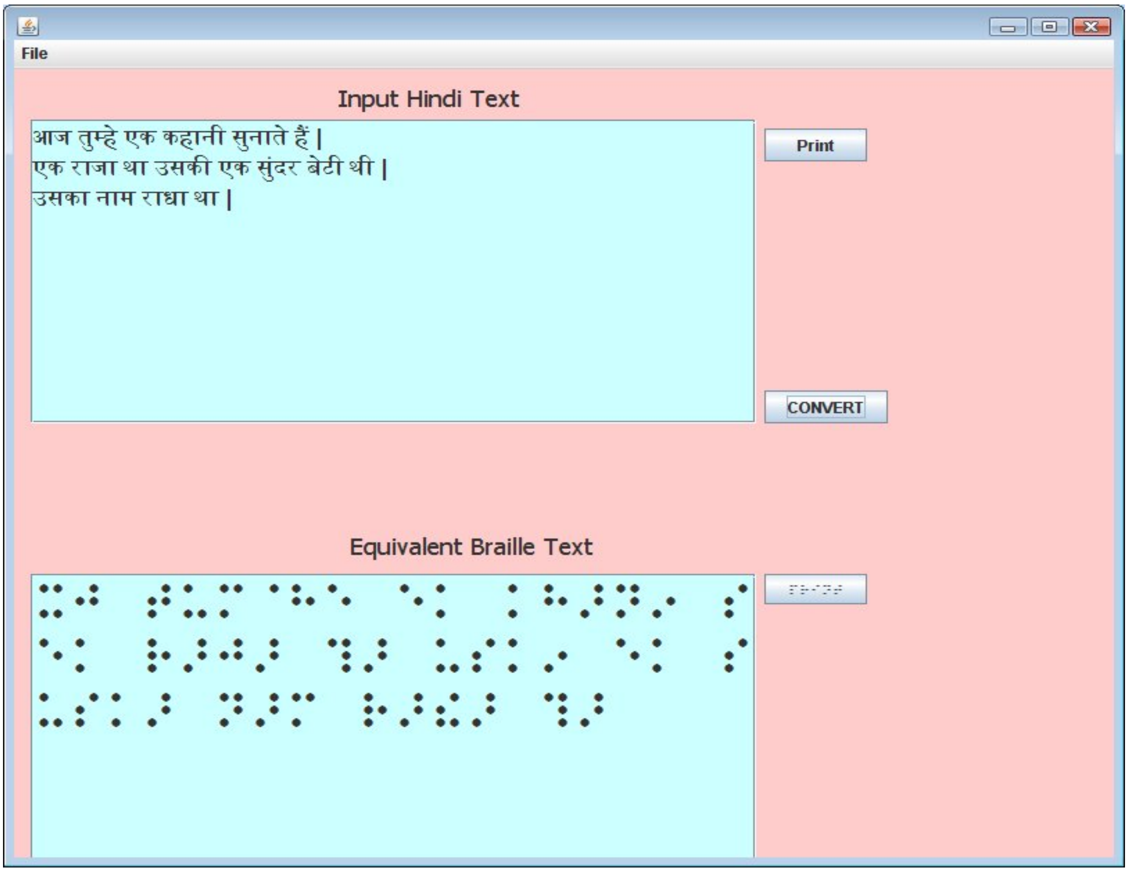


Figure 4.6: Input and output window for Hindi to Braille translation

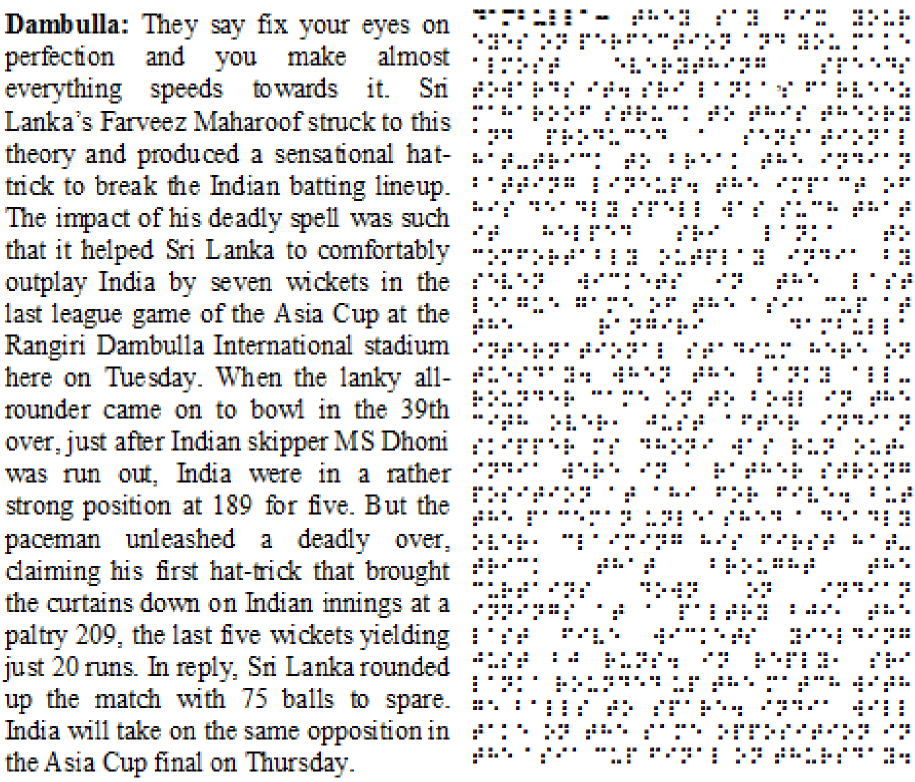
Now with the help of printer we can take printout and by taking printout we will be able to provide enough literature to Blinds.

Chapter 5

Testing of the System

5.1 Testing of the system

The system is working for Grade 1 Braille in English and Hindi. For the testing purpose we have taken some newspapers text for the translation by the system. We have taken 100 lines of text of English newspaper and translate it into Braille. Some of the translation of text to Braille is shown in the figure 5.1.



Dambulla: They say fix your eyes on perfection and you make almost everything speeds towards it. Sri Lanka's Farveez Maharoof struck to this theory and produced a sensational hat-trick to break the Indian batting lineup. The impact of his deadly spell was such that it helped Sri Lanka to comfortably outplay India by seven wickets in the last league game of the Asia Cup at the Rangiri Dambulla International stadium here on Tuesday. When the lanky all-rounder came on to bowl in the 39th over, just after Indian skipper MS Dhoni was run out, India were in a rather strong position at 189 for five. But the paceman unleashed a deadly over, claiming his first hat-trick that brought the curtains down on Indian innings at a paltry 209, the last five wickets yielding just 20 runs. In reply, Sri Lanka rounded up the match with 75 balls to spare. India will take on the same opposition in the Asia Cup final on Thursday.

Figure 5.1: English to Braille translation

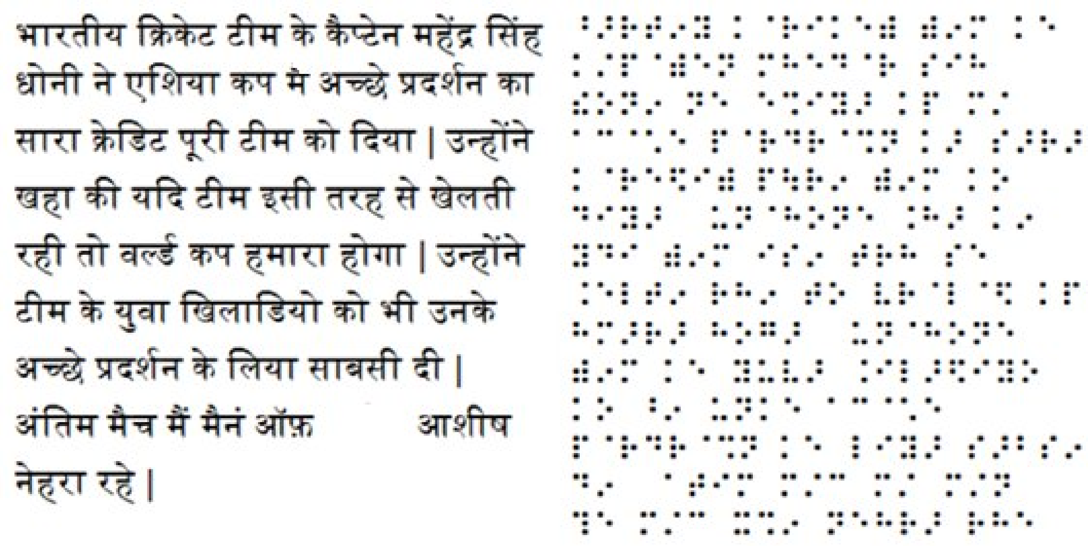


Figure 5.2: Hindi to Braille translation

Now for the testing purpose we have visited a blind school there we show this text to blind's teacher and they found that we have translated English text to grade 1 Braille with 100% accuracy and Hindi text to grade 1 Braille with 98% accuracy. Which is satisfactory result?

5.2 Error Analysis

The error found in the translation of Hindi text to Braille was due to not inclusion of ॅ, ॆ, ॢ, ॣ, ॆ, य़, फ़, ज़, ड़, ग़, ख़, क़, ढ़, लॄ types of letters in the look-up table conversion. For the normal letters the translation is with 100% accuracy for both the languages but on inclusion of these letters the accuracy remains nearly 98% for Hindi.

Chapter 6

6.1. Conclusion

We have developed a system that can translate English and Hindi text to grade 1 Braille. We have tested our system for the translation of the newspaper text to grade 1 Braille. We found that we have translated the text to grade 1 Braille with 98% accuracy for Hindi and 100% accuracy for English , which are satisfactory results. This translation of text to Braille will help us to provide enough literature to the Blinds. For this translation we have used some look-up tables which consists three columns one for English, one for Hindi and one for Braille characters. When any input text is entered then firstly the input text words are tokenized into letters and then the tokenized letters are matched with the look-up table characters if match exist then the corresponding Braille is displayed.

6.2 Future Scope

In future we can enhance this system for the Grade 1 and ½ and Grade 2 Braille which is the contracted form of the Braille. This contracted form of Braille helps us for saving the space requirement. This helps us minimizing the cost associated with the translation. This system can also be enhanced for the other Languages of India (Punjabi, Malayalam, Telgu *etc.*). This enhancement for other regional languages can be done easily because Indian languages are phonetic in nature and the cell assignment for them is nearly same. In future we can also work on the efficiency of this system. So, that text can be translated fastly to Braille.

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