

## CHAPTER III

### METHOD

#### 3.0 Introduction

Methodology is the scientific procedure used in the research. The success of any research largely depends on the suitability of the method and the tools and techniques adopted. The method of the present study on “Effect of Tech Aided Grade2 Braille (TAG2B) Tutoring System for Students with Visual Impairment” is discussed in this chapter. The study had two stages.

**Stage I** : Developing ‘Tech Aided Grade2 Braille Tutoring system’

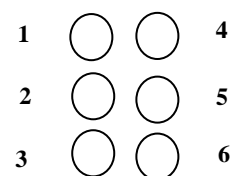
- Stage II** :
- a. Study the effect of newly developed ‘Tech Aided Grade2 Braille Tutoring System’ by introducing the system to the students with visual impairment.
  - b. Special Education Teacher Trainees and Special teachers were involved to offer their opinion and perceptions on the usability of the system. In order to develop TAG2B, the content to each module has been prepared.

The following tables from 3.3 to 3.14 describe each module and the corresponding computer keys for operation.

#### 3.1 Content Preparation for Development of TAG2B

##### a. Description of Grade1 and Grade2 Braille

Braille alphabets are represented using cells. There are totally 6 cells which will set forth in three rows and two columns. The combination of cells is different from one alphabet to another.



**Fig 3.1 Cell Number Identification**

Alphabet stands for English alphabet. They are 26 in numbers. Contractions is the shortest way of writing the Braille that helps the Braille user to read and write faster. They are called as Grade 2 Braille. In the present study they were categorized into 11 modules.

## b. Grade 2 Braille and its Configuration

Grade 2 Braille has the categories such as ‘Alphabet word signs, Strong word, Lower word, Dot 5 with initial letter, Dot 4-5with initial letter, Dot 4-5-6 with initial letter, Final letter, Short form words, Indicators, Punctuation and Grouping punctuation’. The newly developed ‘TAG2B’ tutoring system has 11 modules comprised of different configurations of Braille cells indicating 170 contracted English words in Braille besides 26 alphabets, Indicators (25) and Punctuation (25) as shown in the following table 3.1.

**Table 3.1: Braille Contraction in Grade 1 & Grade 2**



S.No	Grade 1 & 2 Braille Contractions	Number
1.	Alphabet	26
2.	Alphabet Whole word contractions	23
3.	Special word signs	06
4.	Simple upper group signs & Word signs	11
5.	Lower Group signs	10
6.	Punctuation	17
7.	Compound Signs-Initial Word signs With Dot 5	22
8.	Initial Word signs With Dot 4 -5	05
9.	Initial Word signs With Dot 4 -5- 6	06
10.	Final group signs	12
11.	Composite punctuation signs	08
12.	Short forms	75
13.	Indicators	25
<b>Total</b>		<b>246</b>

## c. Keys Used

The ‘QWERTY’ key of existing computer key board has been converted to Braille keys by downloading **Duxbury software**. As such, the keys of F-D-S and J-K-L are used for the six keys of the Braille. The below table explains the keys and the corresponding Braille cells. The following table 3.2 depicts the keys used for operations in ‘TAG2B’ tutoring system and Fig. 3.2 represents Duxbury keyboard. Duxbury Braille Translator (DBT) provides translation and formatting facilities to automate the process of conversion from regular print to braille (and vice versa), and also provides word-processing facilities for working directly in the braille as well as the

print. “Fonts” are used for displaying the Braille. Six-Key Entry allows the user to use six keys on regular PC Keyboard, plus the space bar, to input braille directly into DBT. Duxbury's default set of keys: FDS JKL and the corresponding Braille cells are F-1, D-2, S-, J-4, K-5, L-6.

**Table 3.2: Keys Used for Operation in ‘TAG2B’ Tutoring System**

S. No	Keys Used	Operation
1.	f	Selecting Cell 1
2.	d	Selecting Cell 2
3.	s	Selecting Cell 3
4.	j	Selecting Cell 4
5.	k	Selecting Cell 5
6.	l	Selecting Cell 6
 <p><b>Fig. 3.2: Duxbury Keyboard</b></p>		
7.	Upper Arrow	User to point the option
8.	Down Arrow	User to point the next option
 <p><b>Fig. 3.3: Qwerty Keys converted into Braille Keys using Duxbury Software</b></p>		
9.	Shift	Selecting the current pointed option. SHIFT key instead of ENTER key. SHIFT key is used for continuation to next move.
10.	Esc	Go Back to the previous window

Any user of this system must learn the operation of conventional keys into Braille Cell/ Keys used before getting into the tool.

The following tables from 3.3 represents the formation of Alphabet in Braille and the Corresponding Braille Dots and Duxbury keyboard (Appendix IV).

**Table 3.3 Duxbury Keys for Level 1: Alphabet**

Alphabet	a	b	c	d	e	f	g
Braille Code	● ○ ○ ○ ○ ○	● ○ ● ○ ○ ○	● ● ○ ○ ○ ○	● ● ○ ● ○ ○	● ○ ○ ● ○ ○	● ● ● ○ ○ ○	● ● ● ● ○ ○
Braille cell	1	1-2	1-4	1-4-5	1-5	124	1-2-4-5
Keys	F	F-D	F-J	F-J-K	F-K	F-D-J	F-D-J-

corresponding to Braille cell							K
Alphabet	<b>h</b>	<b>i</b>	<b>j</b>	<b>k</b>	<b>l</b>	<b>m</b>	<b>n</b>
Braille Code	● ○ ● ● ○ ○	○ ● ● ○ ○ ○	○ ● ● ● ○ ○	○ ● ● ● ○ ○	● ○ ● ○ ● ○	● ● ○ ○ ● ○	● ● ○ ● ● ○
Braille cell	1-2-5	2-4	2-4-5	1-3	1-2-3	1-3-4	1-3-4-5
<b>Keys corresponding to Braille cell</b>	F-D-K	D-J	D-J-K	F-S	F-D-S	F-S-J	F-S-K
Alphabet	<b>o</b>	<b>p</b>	<b>q</b>	<b>r</b>	<b>s</b>	<b>t</b>	<b>u</b>
Braille Code	● ○ ○ ● ● ○	● ● ● ○ ● ○	● ● ● ● ● ○	● ○ ● ● ● ○	○ ● ● ○ ● ○	○ ● ● ● ● ○	● ○ ○ ○ ● ●
Braille cell	1-3-5	1-2-3-4	1-2-3-4-5	1-2-3-5	2-3-4	2-3-4-5	1-3-6
<b>Keys corresponding to Braille cell</b>	F-S-K	F-D-S-J	F-D-S-J-K	F-D-S-K	D-S-J	D-S-J-K	F-S-L
Alphabet	<b>v</b>	<b>w</b>	<b>x</b>	<b>y</b>	<b>z</b>		
Braille Code	● ○ ● ○ ● ●	○ ● ● ● ○ ●	● ● ○ ○ ● ●	● ● ○ ● ● ●	● ○ ○ ● ● ●		
Braille cell	1-2-3-6	2-4-5-6	1-3-4-6	1-3-4-5-6	1-3-5-6		
<b>Keys corresponding to Braille cell</b>	F-D-S-L	D-J-K-L	F-S-J-L	F-S-J-K-L	F-S-K-L		

Mapping to cell 1(F) denotes letter ‘A’. Mapping to cell 1 (F) and 2 (D) denoted letter ‘B’. Similarly mapping to cell 1-2,-3 and 5 (F-D-Sand K) denotes ‘R’.

### Module Description for Grade 2 Braille

Grade 2 Braille has 11 modules which are described below

1. Alphabet word sign
2. Strong word
3. Lower word
4. Dot 5 initial letter
5. Dot 4-5 initial letter
6. Dot 4-5-6 initial letter
7. Final letter
8. Short form words

- 9. Indicators
- 10. Punctuation and
- 11. Grouping punctuation

Examples for content in each module are given below with visual orientation besides Braille cell details and corresponding ‘Duxbery’ Keys.

**Module 1: Alphabet Word Sign**

Table 3.4 shows the Braille codes for Module 1 which is Alphabet word sign.

**Table 3.4 Module 1- ‘Braille Codes for Alphabet Word Sign’**

	‘Abbreviation-Alphabet Word Sign’					
	but	can	not	people	quite	you
Braille code	● ○ ● ○ ○ ○	● ● ○ ○ ○ ○	● ● ○ ● ● ○	● ● ● ○ ● ○	● ● ● ● ● ○	● ● ○ ● ● ●
Alphabet word sign	b	c	n	p	q	y
Braille cell	1-2	1-4	1-3-4-5	1-2-3-4	1-2-3-4-5	1-3-4-5-6
Keys corresponding to Braille cell	F-D	F-J	F-S-J-K	F-D-S-J	F-D-S-J-K	F-S-J-K-L

**Module 2: Strong Word**

Table 3.5 shows the Braille codes for Module 2 which is Strong word.

**Table 3.5 Module 2 -‘Braille Codes for Strong Word’**

	‘Abbreviation-Strong Word’						
	and	the	with	wh / which	ch / child	ed	ing
Braille code	● ● ● ○ ● ●	○ ● ● ○ ● ●	○ ● ● ● ● ●	● ○ ○ ● ○ ●	● ○ ○ ○ ○ ●	● ○ ● ● ○ ●	○ ● ○ ○ ● ●
Braille Cell	1-2-3-4-6	2-3-4-6	2-3-4-5-6	1-5-6	1-6	1-2-4-6	3-4-6
Keys corresponding to Braille cell	F-D-S-J-L	D-S-J-L	D-S-J-K-L	F-K-L	F-L	F-D-J-L	S-J-L

**Module 3: Lower Word sign**

Table 3.6 shows the Braille codes for Module 3 which is Lower Word sign

**Table 3.6 Module 3 - ‘Braille Codes for Lower Signs’**

	‘Abbreviation-Lower Sign’						
	bb be	cc con	dis	enough	his	in	was
Braille code	○ ○ ● ○ ● ○	○ ○ ● ● ○ ○	○ ○ ● ● ○ ●	○ ○ ● ○ ○ ●	○ ○ ● ○ ● ●	○ ○ ○ ● ● ○	○ ● ● ● ○ ○
Braille Cell	2-3	2-5	2-5-6	2-6	2-3-6	3-5	2-4-5
Keys corresponding to Braille cell	D-S	D-K	D-K-L	D-L	D-S-L	S-K	D-J-K

**Module 4 : Dot 5 with Initial Letter**

Table 3.7 shows the braille codes for Module 4 which is Dot 5with Initial Letter.

**Table 3.7 Module 4-‘ Braille Codes for Dot 5 with Initial Letter’**

	‘Abbreviation-Dot 5 with Initial Letter’			
	Day	Ever	Father	Mother
Braille code	○ ○ ● ● ○ ● ○ ● ○ ○ ○ ○	○ ○ ● ○ ○ ● ○ ● ○ ○ ○ ○	○ ○ ● ● ○ ● ● ○ ○ ○ ○ ○	○ ○ ● ● ○ ● ○ ○ ○ ○ ● ○
Braille Cell	5, 1-4-5	5, 1-5	5, 1-2-4	5, 1-3-4
Keys corresponding to Braille cell	K,F-J-K	K,F-K	K,F-D-J	K,F-S-J
	‘Abbreviation-Dot 5 with Initial Letter’			
	Right	Work	Character	
Braille code	○ ○ ● ○ ○ ● ● ● ○ ○ ● ○	○ ○ ○ ● ○ ● ● ● ○ ○ ○ ●	○ ○ ● ○ ○ ● ○ ○ ○ ○ ○ ●	
Braille Cell	5, 1-2-3-5	5, 2-4-5-6	5, 1-6	
Keys corresponding to Braille cell	K,F-D-S-K	K,D-J-K-L	K,F-L	

**Module 5: dot 4-5 with Initial Letter**

Table 3.8 shows the Braille codes for Module 5 which is Dot 4-5 with Initial Letter.

**Table 3.8 Module 5 - ‘Braille Codes for dot 4-5 with Initial Letter’**

	‘Abbreviation -dot 4-5 + Initial Letter’				
	These	Those	Upon	Whose	Word
Braille Code	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠
Braille Cell	4-5, 2-3-4-6	4-5, 1-4-5-6	4-5, 1-3-6	4-5, 1-5-6	4-5, 2-4-5-6
Keys Corresponding to Braille Cell	J-K,D-S-J-L	J-K,F-J-K-L	J-K,F-S-L	J-K,F-S-L	J-K,D-J-K-L

**Module 6 : Dot 4-5-6 with Initial Letter**

Table 3.9 shows the Braille codes for module 6 which is Dot 4-5-6 with Initial Letter.

**Table 3.9 Module 6 - ‘Braille Codes for dot 4-5-6 with Initial Letter’**

	‘Abbreviation -dot 4-5-6 with Initial Letter’		
	Cannot	Had	Many
Braille Code	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠
Braille Cell	4-5-6, 1-4	4-5-6, 1-2-5	4-5-6, 1-3-4
Keys corresponding to Braille cell	J-K-L,F-J	J-K-L,F-D-K	J-K-L,F-S-J
	‘Abbreviation -dot 4-5-6 with Initial Letter’		
	Spirit	Their	World
Braille Code	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠	⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠
Braille Cell	4-5-6, 2-3-4	4-5-6, 2-3-4-6	4-5-6, 2-4-5-6
Keys corresponding to Braille Cell	J-K-L,D-S-J	J-K-L,D-S-J-L	J-K-L,D-J-K-L

**Module 7: Final Letter**

Table 3.10 shows the Braille codes for Module 7 which is Final Letter.

**Table 3.10 Module 7 - ‘Braille Codes for Final Letter’**

	‘Abbreviation- Final Letter’			
	-ance	-less	-sion	-ful
Braille code	⠠⠠⠠⠠	⠠⠠⠠⠠	⠠⠠⠠⠠	⠠⠠⠠⠠
Braille Cell	4-6, 1-5	4-6, 2-3-4	4-6, 1-3-4-5	5-6, 1-2-3
Keys corresponding to Braille cell	J-L,F-K	J-L,D-S-J	J-L,F-S-J-K	J-L,F-D-S
	-tion	-ment	-ity	
Braille code	⠠⠠⠠⠠	⠠⠠⠠⠠	⠠⠠⠠⠠	
Braille Cell	5-6, 1-3-4-5	5-6, 2-3-4-5	5-6, 1-3-4-5-6	
Keys corresponding to Braille cell	J-L,F-S-J-K	J-L,D-S-J-K	J-L,F-S-J-K-L	

**Module 8: Short Form Words**

Table 3.11 shows the Braille codes for Module 8 which is Short Form Words.

**Table 3.11 Module 8 - ‘Braille Codes for Short Form Words’**

	‘Abbreviation- Short Form Words’		
	about	above	afternoon
Braille code	⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠
Braille Cell	1, 1-2	1, 1-2, 1-2-3-6	1, 1-2-4, 1-3-4-5
Keys corresponding to Braille cell	F,F-D	F,F-D,F-D-S-L	F,F-D-J,F-S-J-K
	‘Abbreviation -Short Form Words’		
	blind	braille	conceiving
Braille code	⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠
Braille Cell	1-2, 1-2-3	1-2, 1-2-3-5, 1-2-3	2-5, 1-4, 1-2-3-6, 1-2-4-5
Keys corresponding to Braille cell	F-D,F-D-S	F-D,F-D-S-K,F-D-S	D-K,F-J,F-D-S-L,F-D-J-K

**Module 9: Indicators**

Table 3.12 shows the Braille codes for Module 9 which is Indicators.

**Table 3.12 Module 9 - ‘Braille Codes for Indicators’**

	Indicators		
	numeric	cap-letter	cap-word
Braille code	○ ● ○ ● ● ●	○ ○ ○ ○ ○ ●	○ ○ ○ ○ ○ ○ ○ ○ ○ ● ○ ●
Braille Cell	3-4-5-6	6	6,6
Keys corresponding to Braille cell	S-J-K-L	L	L,L
	Indicators		
	gr.1 symbol	gr.1 word	gr.1 passage
Braille code	○ ○ ○ ○ ○ ● ○ ○ ○ ○ ○ ●	○ ○ ○ ○ ○ ● ○ ● ○ ● ○ ●	○ ○ ○ ○ ○ ○ ○ ● ○ ● ○ ● ○ ● ○ ● ○ ●
Braille Cell	5-6	5-6,5-6	5-6,5-6,5-6
Keys corresponding to Braille cell	K-L	K-L,K-L	K-L,K-L,K-L

**Module 10: Punctuation**

Table 3.13 shows the Braille codes for module 10 which is punctuation.

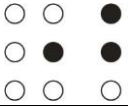
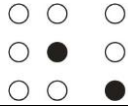
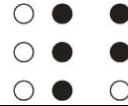
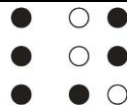
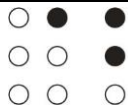
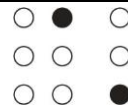
**Table 3.13 Module 10 - ‘Braille Codes for Punctuation’**

	Punctuation					
	Comma ,	Apostr. '	Question ?	Semi ;	Open quot. “	Close quot. “
Braille Cell	2	3	2-3-6	2-3	2-3-6	3-5-6
Keys corresponding to Braille cell	D	S	D-S-L	D-S	D-S-L	S-K-L

**Module 11 : Grouping Punctuation**

Table 3.14 shows the Braille codes for Module 11 which is Grouping Punctuation.

**Table 3.14 Module 11 - ‘Braille Codes for Grouping Punctuation’**

	Punctuation		
	(	)	{
Braille Code			
Braille Cell	5, 1-2-6	5, 3-4-5	4-5-6, 1-2-6
Keys corresponding to Braille cell	K,F-D-L	K,S-J-K	J-K-L,F-D-L
	Punctuation		
	}	<	>
Braille Code			
Braille Cell	4-5-6, 3-4-5	4, 1-2-6	4, 3-4-5
Keys corresponding to Braille cell	K-J-L,S-J-K	J,F-D-L	J,S-J-K

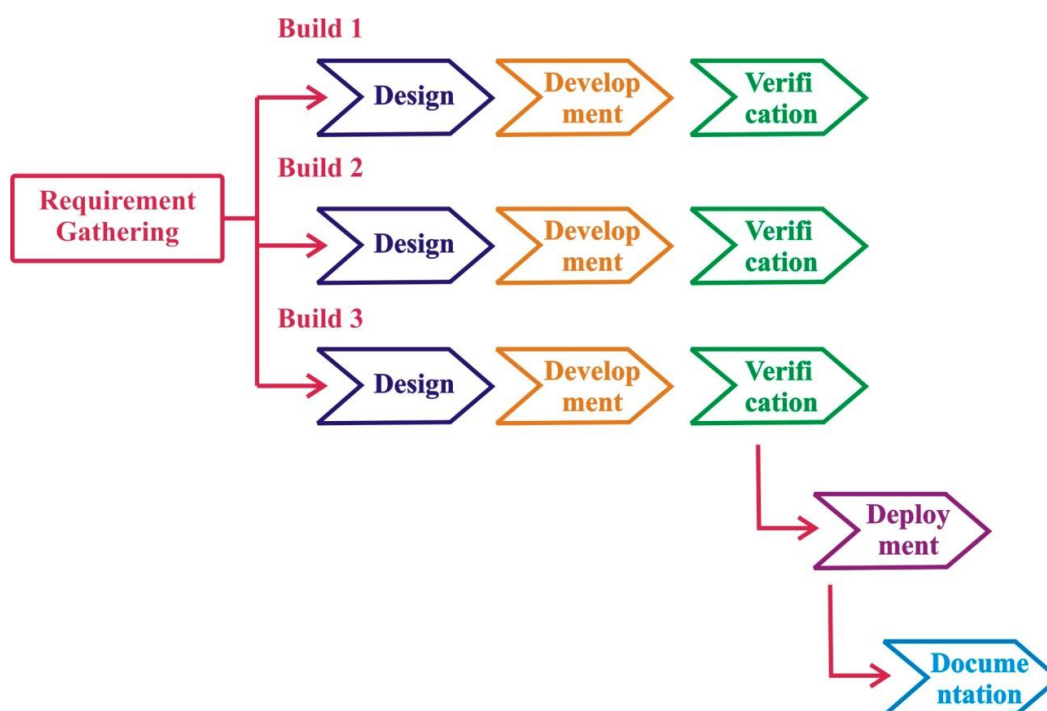
The content prepared has been converted into Digital content for development of Tech Aided Graded 2 Braille Tutoring system

### 3.2 Stage I: Developing ‘Tech Aided Grade2 Braille Tutoring system’

The process of development of ‘Tech Aided Grade2 Braille Tutoring system’ involves the following:

#### 3.2.1 Life Cycle of ‘Tech Aided Grade2 Braille (TAG2B) Development

Lifecycle of ‘TAG2B’ works in an iterative process. Iterative process breaks down the development of software into smaller units from the larger one. Here, the feature code is designed, implemented and verified in repeated process. For each iteration, new features are added to design, implement and tested. Once the entire software is ready with the entire functionality, the software is ready to release in the user environment. The ‘TAG2B’ tutoring system works in three builds and each build has the following phases. They include requirement gathering, design, development, verification, and finally deployment.



**Fig. 3.4 Lifecycle of ‘TAG2B’**

#### a. Requirement Gathering Phase

Requirement gathering was the planning phase of ‘TAG2B’ tutoring system development. In other words, the core requirements of the ‘TAG2B’ tutoring system were established. The development team arranged a meeting with the experts and end user to gather the requirement about the functionality of the software. This helped to

frame the functional and nonfunctional requirements of the software. The team prepared a checklist which contains

- TAG2B's scope and objective
- Functional and non-functional requirements of 'TAG2B'
- Estimated time involved to complete 'TAG2B'
- Estimated cost involved in 'TAG2B'
- Estimated manpower involved for developing 'TAG2B'
- Estimated bugs and defect occur based on similar projects of 'TAG2B'
- Tools required

Spending more time in requirement gathering lead to minimize the development time period and testing time period. Fig. 3.3 represents the entire requirement gathering of 'TAG2B' in the beginning indicating that the time taken for requirement gathering was 4 months.

### **b. Design Phase**

Design stands for blueprint of prototype of 'TAG2B' tutoring system. Based on the requirement of 'TAG2B', various diagrams like end product of tool, object-oriented diagram, static and behaviour diagrams of UML were created. Attributes, methods and their relationships were identified. Based on this, the development team developed the software. Hence the output, the former phase was the input of the later phase. Design phase reduced the complexity of developing the 'TAG2B' tutoring system.

As mentioned above, there were three builds in developing 'TAG2B'. From the table 3.1, design of developing Alphabet of Braille comes in build 1. This happened in the 4<sup>th</sup> month of lifecycle of 'TAG2B' development. Design of developing first 5 Grade2 Braille were done in build 2 which happened in the 7<sup>th</sup> month of 'TAG2B' lifecycle. Last 6 Grade2 Braille were designed in the 11<sup>th</sup> month of the 'TAG2B' lifecycle.

- Prototype
- UML diagrams
- Module design
- Attributes, methods, and its relationships

### **c. Development Phase**

From the name, it could be understood that the development means implementation of 'TAG2B' tutoring system. The entire 'TAG2B' project was divided into smaller units. Each unit was developed in separate build-ups. Based on the framework of design, Alphabet of Braille was implemented in build 1 which took 4<sup>th</sup> month of the 'TAG2B' lifecycle. In 8<sup>th</sup> and 9<sup>th</sup> month of 'TAG2B' lifecycle, first 5 Grade2Braille were developed in build 2. From 12<sup>th</sup> to 14<sup>th</sup> month of TAG2B lifecycle, last 6 Grade2 Braille were developed in build 3. These details are mentioned in Gantt Chart table 3.15.

- Implementing build 1, 2 and 3 using Visual Basic 6.0

### **d. Verification Phase**

Verification implies 'Am I developing the 'TAG2B'tutoring system right?'. Validation means 'Am I developing the right 'TAG2B'tutoring system?'. It was nothing but testing the software during each build-ups. Once the smaller unit of the software was developed, it was necessary to verify the software whether it worked perfectly or not.

Analysing the table 3.1, 6-month duration was taken for verifying the piece of software of build, 10<sup>th</sup> month for software in build 2. Finally, the entire unit of 'TAG2B' tutoring system was tested in 15<sup>th</sup> month of lifecycle of 'TAG2B' development.

- Verification and Validation

### **e. Deployment phase**

Deployment meant that the research team was ready with the 'TAG2B'tutoring system. The team would release the software in the user environment and receive the acknowledgement from the end user. Here the acknowledgement for some was positive and for some negative. Based on the acknowledgement the 'TAG2B'tutoring system was modified. From the table 3.15 it was clear that deployment was taken on 16<sup>th</sup> month of lifecycle of 'TAG2B' development.

- Usage of 'TAG2B' tutoring system

- Customer Satisfactory
- Maintenance

**f. Documentation**

Documentation meant converting the entire ‘TAG2B’ tutoring system software into words and pictures. It was a user manual to guide the user how to operate the ‘TAG2B’ tutoring system. It described the step by step working process of the tutoring system. This could help even for the layman to understand the ‘TAG2B’ tool and to use it. Table 3.15 shows that the 17 month duration was taken for documentation in lifecycle of ‘TAG2B’ development.

- *User manual*

**Table 3.15 Gantt Chart for ‘TAG2B’**

<b>Build 1</b>							
<b>Components/Duration in months</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	
Requirement gathering							
Design							
Development							
Verification							
<b>Build 2</b>							
<b>Components/Duration in months</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>			
Design							
Development							
Verification							
<b>Build 3</b>							
<b>Components /Duration in months</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>
Design							
Development							
Verification							
Deployment							
Documentation							

### 3.1.2 Description of ‘Tech Aided Grade1 and Grade2 Braille’

Tech Aided Grade2 tutoring system is divided into two levels namely Alphabet and Grade2 Braille. Each of these levels has three modes. These modes are developed in three build-ups such as Learning, Practice and Evaluation and combined together at the end. This helped the software to be a single entity.

#### Alphabet - Mode of Operation

To begin the user has to open the program ‘TAG2B’ and click the shift key. The Main screen appears. The following figures from 3.5(a) to 3.5(i) depict the step-by-step screenshots on the computer screen.

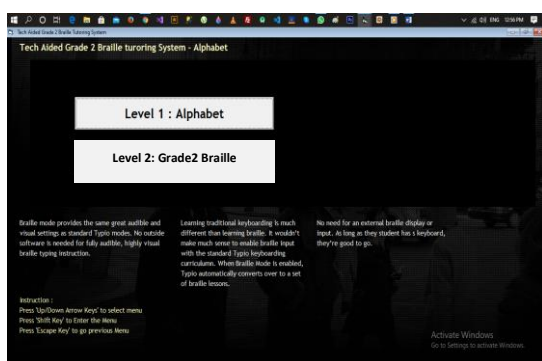


Fig. 3.5(a) Main Screen

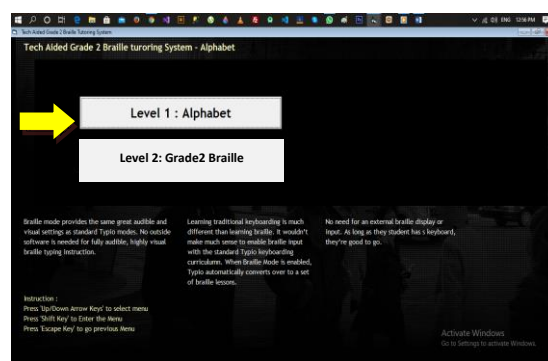


Fig. 3.5(b) Alphabet

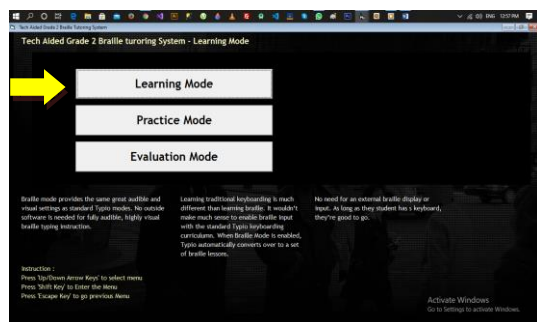


Fig. 3.5(c) Learning Mode - Alphabet

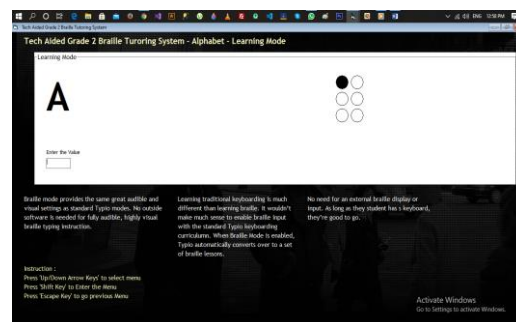


Fig. 3.5(d) Learning the Alphabet ‘A’

Figure 3.5(a) shows the main screen of ‘TAG2B’ tutoring system. Two options have been displayed: level 1 Alphabet and level 2 Grade2 Braille. Figure 3.5(b) shows that the user is selecting the option level 1: Alphabet. As soon as a click is made, it enters into the learning mode of level 1 Alphabet as shown in fig 3.5(c). Three options are displayed for the user whether he/she wants to Learn or Practice or Evaluate.

## 1. Learning Mode

Once the user selects the option of learning mode, the window will migrate to another window to learn the keys for each and every alphabet. The corresponding key value will voice out and the user has to select the key. A simple example of learning the key used for the Alphabet ‘A’ is shown in fig 3.5(d).

## 2. Practice Mode

Moving on to practice mode option by selecting it from fig 3.4(c), the window will migrate to another window as shown in fig 3.5(e). Here the user can practice whatever he/she has learned from learning mode. ‘TAG2B’ tutoring system voiceout the Alphabet, and the user has to select the appropriate key from Duxbury keyboard. A voiceout will be sent whether the user has entered the key right or not. Fig 3.5(e) represents the practice mode window where the user is practicing for Alphabet ‘A’. The user interface of both 3.5(d) and (e) will be same but the difference is there will be voice out of both Alphabet and key(s) in 3.5(d) whereas a voice out of only Alphabet is there in practice mode, i.e., fig 3.5(f).

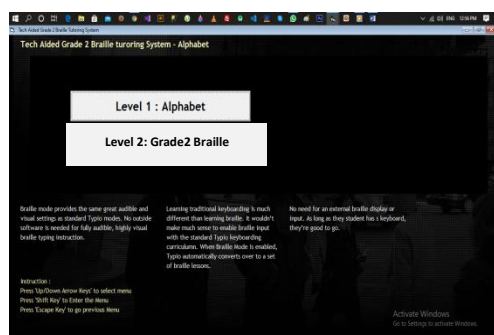


Fig. 3.5(a) Main Screen

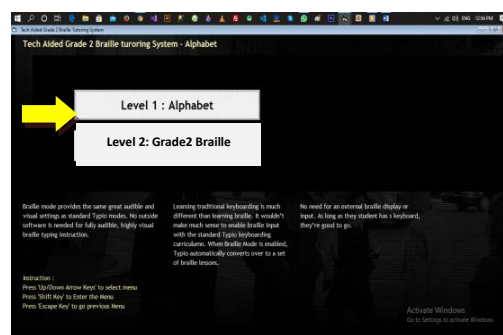


Fig. 3.5(b) Alphabet

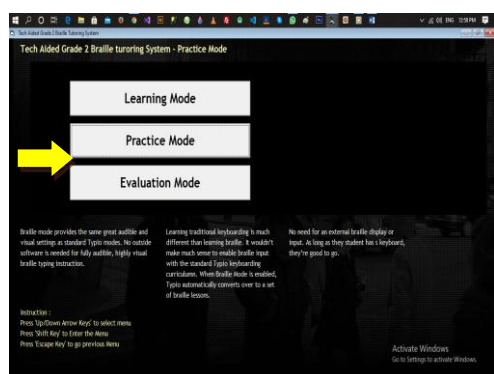


Fig. 3.5(e) Practice Mode - Alphabet

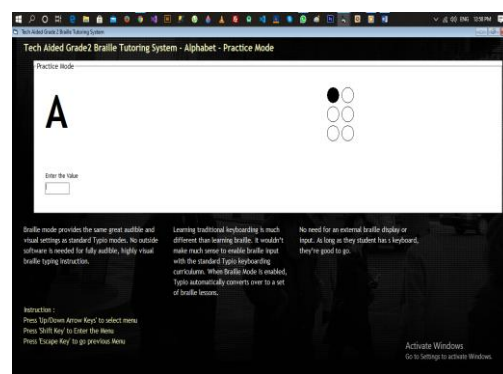


Fig. 3.5(f) Practicing the Alphabet ‘A’

For better understanding fig 3.5(a) and fig 3.5(b) get repeated. In fig 3.5(e), the second option, i.e., practice mode is selected. After a click is made, the window will move on to practicing window as shown in fig 3.5(f).

### 3. Evaluation Mode

For better understanding, fig. 3.5(a) and fig. 3.5(b) get repeated. Selecting level 1: Alphabet option in fig. 3.5(b) also selecting evaluation mode as shown in fig 3.5(g), evaluation window also called as assessment window will be opened to the user. This is shown in fig. 3.5(h) the student can take assessment for the score of 26.

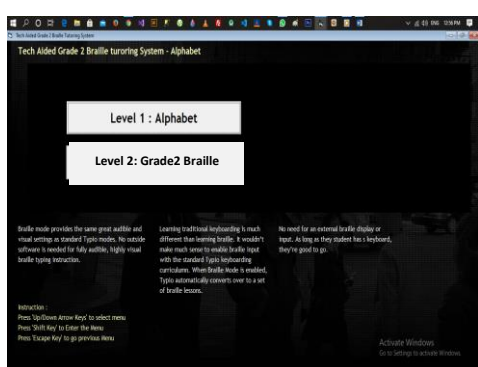


Fig. 3.5(a) Main Screen

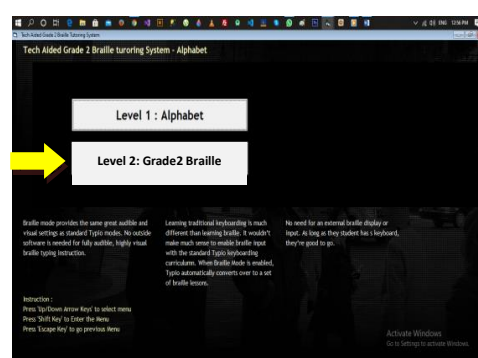


Fig. 3.5(b) Alphabet

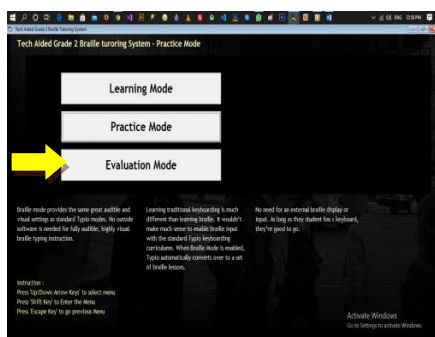


Fig. 3.5(g) Evaluation Mode - Alphabet

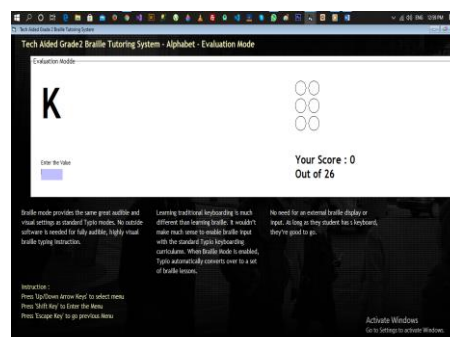
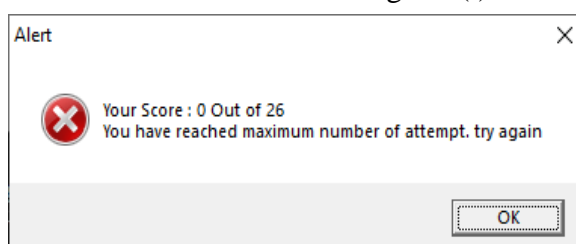


Fig. 3.5(h) Evaluation / Assessment

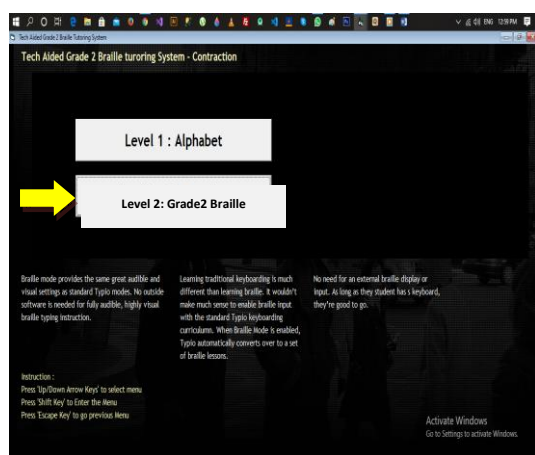
The maximum number of errors that are allowed in the Evaluation/Assessment mode is 2. Performing more than two errors, evaluation window will exit. Total marks scored will be displayed in the alert window. Refer fig. 3.5(i) for score board.



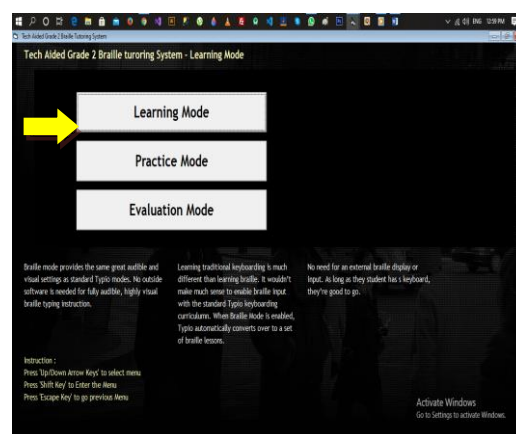
**Fig. 3.5(i) Score Board for Assessment in Level 1: Alphabet Grade2 Braille- Mode of Operation**

**1. Learning Mode**

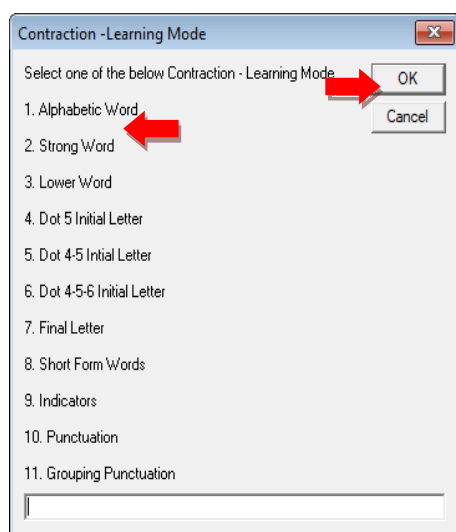
Figure 3.6(a) describes the selection of level 2: Grade2 Braille option from the main screen of ‘TAG2B’ software. Like level 1 : Alphabet, level 2 : Grade2 Braille also has three modes namely learning, practice and evaluation which has been shown in fig. 3.6(b). selecting the option of learning mode from the screen, will move on to the next window which lists the types of Grade2 Braille and ‘TAG2B’ software allows the user to select any one Grade2 Braille mode, say 1 for Alphabet Word, for learning process, as it is displayed in fig. 3.6(c). Alphabet Word Aided Learning Mode window, say fig. 3.6(d), will be opened to the user and the user can start learning using Duxbury keyboard. The same process is repeated for the rest of the Grade2 Braille mode.



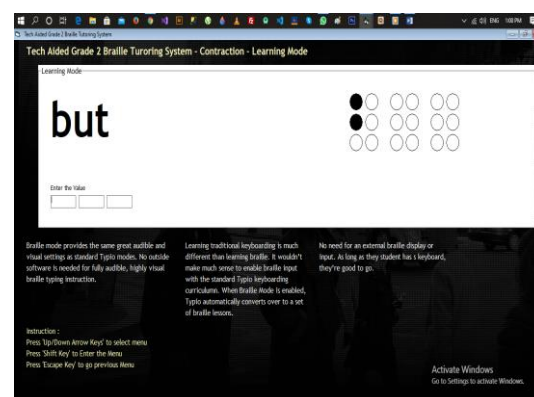
**Fig. 3.6(a) Grade2 Braille**



**Fig. 3.6(b) Learning Mode**



**Fig. 3.6(c): Select Option for**



**Fig. 3.6(d) Learning for ‘but’**

## Grade2 Braille

### 2. Grade2 Braille - Practice Mode

For better understanding, the main window, fig 3.6(a), of ‘TAG2B’ tutoring system is shown here. Fig. 3.6(e) describes the selection of practice mode in level 2: Grade2 Braille. Fig. 3.6(f) represents the selection of Grade2 Braille type for practicing. Once the option is selected, practicing mode window for the particular Grade2 Braille, as shown in fig. 3.6(g), will be opened and user can start answering it using ‘Duxbury keyboard’.

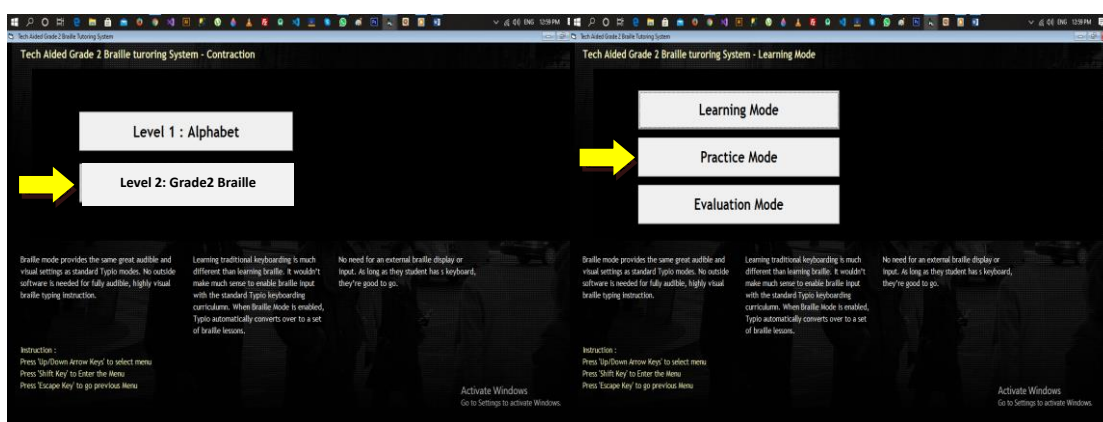


Fig. 3.6(a) Grade2 Braille

Fig. 3.6(e) Practice Mode

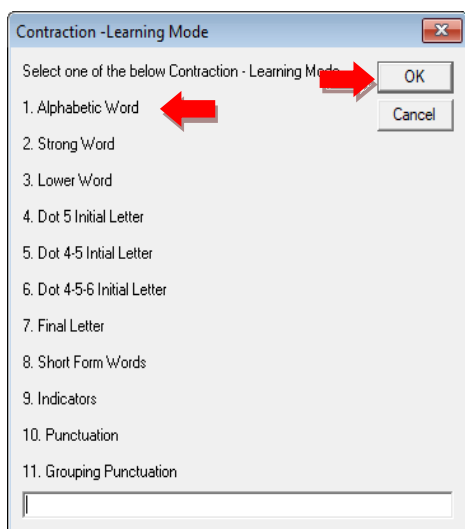


Fig. 3.6(f) Select Option for Grade2 Braille

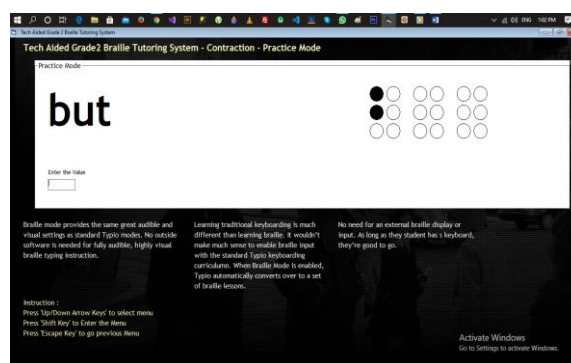
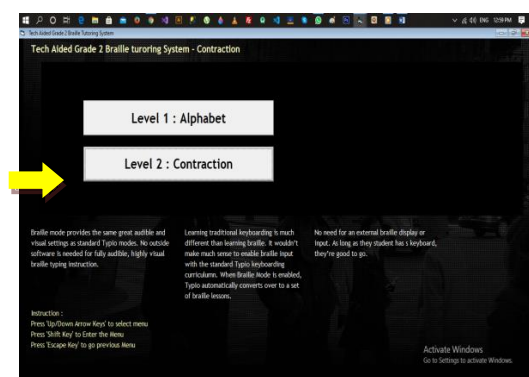


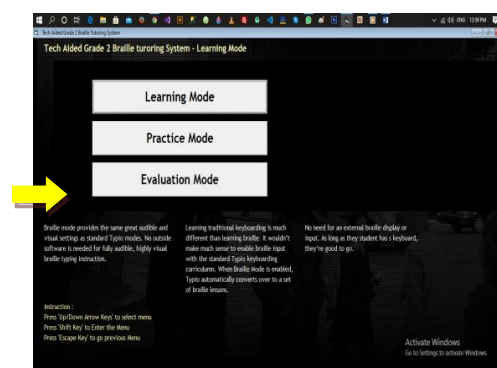
Fig. 3.6(g) Practicing for ‘but’

### 3. Grade2 Braille - Evaluation Mode

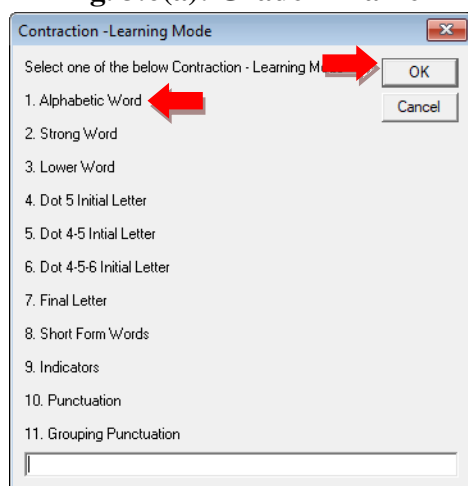
For better understanding, fig. 3.6(a) is repeated. In fig. 3.6(h), selection of evaluation mode is shown. Then the widow is migrated to Grade2 Braille evaluation mode in which the user is allowed to select any one Grade2 Braille from 11 Grade2 Braille modules for evaluation purpose, as represented in fig 3.6(i). Finally, the Assessment window or Evaluation window will be opened to the user, refer fig. 3.6(j), where the user can take part the test. The score board will be displayed once the test gets completed or the user does two wrong answers. The score board for Grade2 Braille is shown in fig. 3.6(k).



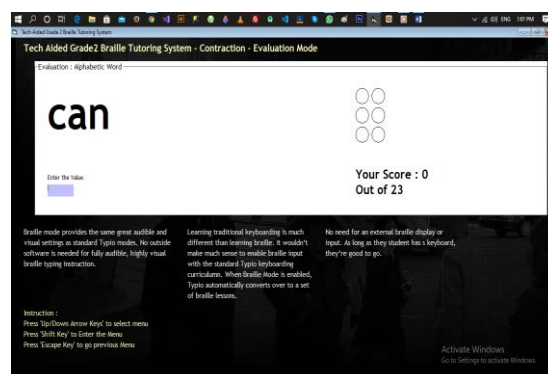
**Fig. 3.6(a): Grade2 Braille**



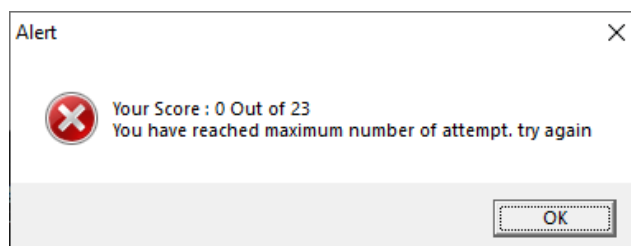
**Fig. 3.6(h) Evaluation Mode**



**Fig. 3.6(i) Select Option for Grade2 Braille**



**Fig. 3.6(j) Evaluation / Assessment**



**Fig. 3.6(k): Score Board for Level 2 : Grade2 Braille**

### 3.1.3 Usage of Shift Key in 'TAG2B' Operation

To map or select any Alphabet say 'a' the key 'f' or in other words dot '1' is pressed. The user has to enter the key 'F', then to press SHIFT key. Thus, the dot '1' is selected. Mapping to dot '1' indicates the Alphabet 'a'. To map Alphabet 'd' the student with visual Impairment has to press the input as dots 1-4-5 simultaneously. After this key operation Alphabet 'd' is displayed both in audio & visual format. Here the operation of 'SHIFT' key is essential before mapping the Alphabet and also after completion of typing any Alphabet for continuation of further move.

For example, if the user wants to type 'f' and then 'g' the following procedure should be followed.

1. Press shift key
2. Press dots 1 - 2 - 4 simultaneously for 'f'
3. Press shift key
4. Alphabet 'f' is displayed
5. Press shift key for continuation for next move.
6. Press dots 1 - 2 - 4 - 5 simultaneously for the alphabet 'g'
7. Press shift key
8. Alphabet 'g' is displayed

When the user has to go to the next Alphabet from one operation to other, 'SHIFT' key must be used so that the user can continue. For eg.: After typing the Alphabet 'f' if the user continues to map 'g' he/she has to use 'SHIFT' key on completion of typing dots for 'f'. The same procedure is repeated for all the Alphabet with their corresponding cell values.

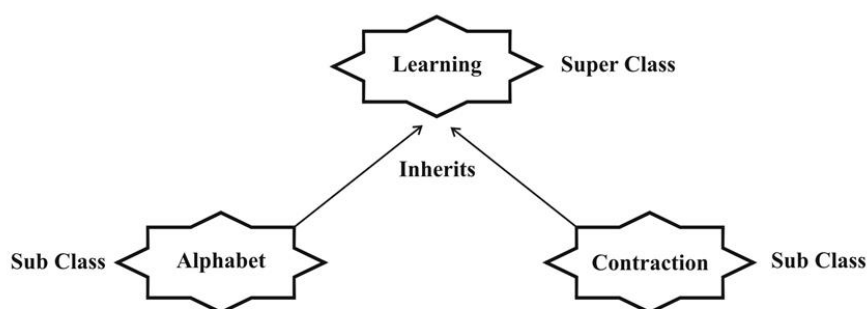
This procedure is followed for typing any Alphabet /any Grade2 Braille or any other usage.

### 3.1.4 Sample Coding for Alphabet and Grade2 Braille

#### LEVEL 1: ALPHABET

##### 1. Learning Mode: Alphabet

Learning Mode has two Modules. They are Alphabet and Grade2 Braille. Fig. 3.7 represents object modelling for learning mode using Booch notation, where, learning is a parent class / super class and, Alphabet and Grade2 Braille are child classes.



**Fig.3.7 Object Modeling using Booch Notation for Learning Module**

##### Learning Mode: Alphabet

##### Sample coding for learning alphabet 'A'

```

Case 1 'A 1
LCase(brailleValue) = "f" || "F"
playingAudioApp.Path& "\\1A.mp3"
    If checkAlphabet(clsAlphabet, strUserInput) = True Then
        lblDisplay.Caption = "A": Text1(0) = "":
        BraileDisplay ("F") || BraileDisplay("f"):
        playingAudioApp.Path& "\\Great.mp3":
        clsAlphabet = clsAlphabet + 1
    Else

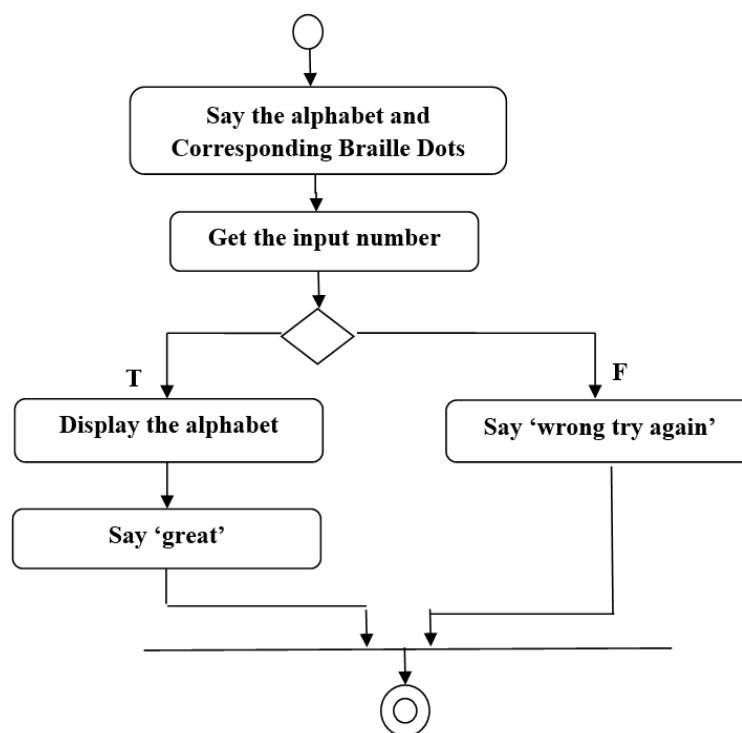
```

```

    playingAudioApp.Path& "\\WrongTryAgain.mp3"
End If

```

The above sample coding instructs the user to type 'f' or 'F' to point Braille cell 1 for the Alphabet 'a'. Cell '1' represents the selection of cell 1 for the Alphabet 'a'. The *If* statement checks whether the user input is true. If true, it displays the letter 'A' on the screen and gives a voice output as 'Great'. Then the next letter 'b' is selected by incrementing the `clsAlphabet` value (initially points to 0, indicates 'a'). If the user given input *if* false in the *If* statement, the control moves on the *Else* part and voices out 'Wrong Try Gain'. The following fig. 3.8 shows the activity diagram for learning Alphabet.

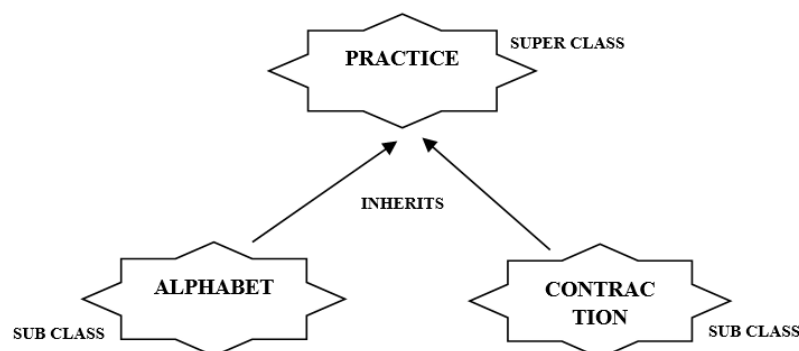


**Fig. 3.8 Activity Diagram for Alphabet in Learning Mode**

## 2. Practice Mode: Alphabet

Like to the learning mode, the 'TAG2B' tutoring system says a question to the user and the user has to identify the correct Braille codes. No information about the cell number(s) are given to the user as it voices out in the Learning Mode. Once the input is given, the system checks the number(s) is right or wrong. For both positive and negative acknowledgement, a voice output will be sounded. Here no marks will be provided. Hence, any number of mistakes is allowed in Practice Mode.

The practice Mode is further divided into two levels. They are Alphabet and Grade2 Braille. Figure 3.9 depicts the object modeling for Practice Mode using Booch notation. Practice is the super class / parent class. Alphabet and Grade2 Braille inherit the properties and functions of super class, as Alphabet and Grade2 Braille are the child classes to Practice class.



**Fig. 3.9 Object Modeling using Booch Notation for Practice Module**

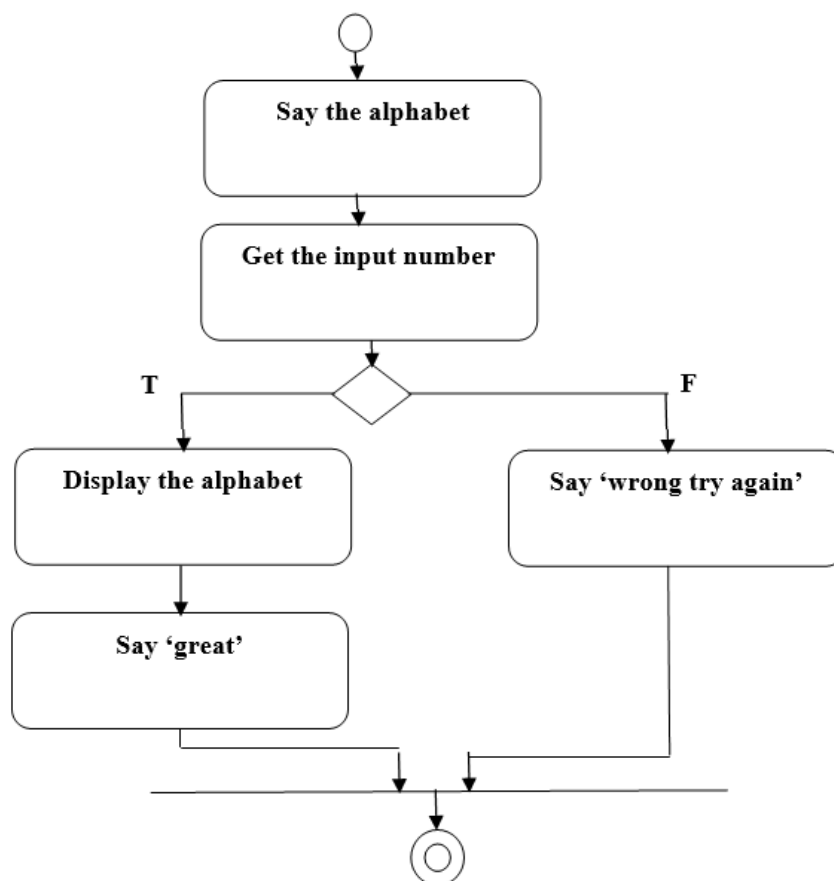
### Sample Coding for Practicing the Alphabet ‘A’

Case “1”

```

If Text1(0).Text = “f || F” Then
    If checkAlphabet(1, strUserInput) = True Then
        lblDisplay.Caption = “A”: Text1(0).Text = “”:
        BrailleDisplay(“f”) || BrailleDisplay(“F”):
        playingAudioApp.Path & “\great.mp3”:
    Else
        playingAudioApp.Path & “\WrongTryAgain.mp3”
    End If
End If
  
```

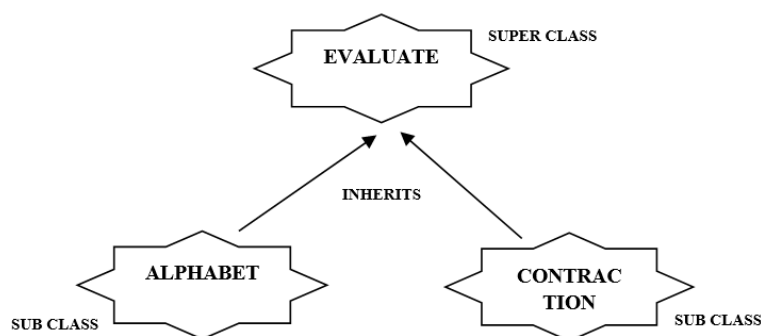
The above sample coding checks whether the user gives the input for ‘A’ is ‘f’ or ‘F’. If true, it displays the letter ‘A’ on the monitor and voices out as ‘Great’. If the user given input is wrong, then it sounds ‘Wrong Try Again’. Fig. 3.9 shows the activity diagram for Alphabet in Practice mode.



**Fig. 3.10 Activity Diagram for Alphabet in Practice Mode**

### 3. Evaluation Mode: Alphabet

Whatever is learnt and practiced in Level 1 and 2, are evaluated in Level3 Mode i.e Evaluation Mode. A set of randomly generated questions are asked to the user to evaluate his/er progress. Totally 26 questions are incorporated for each module: Alphabet and Grade2 Braille, the user has to answer the questions by selecting the right Braille cells/keys for cell mapping. Maximum of two wrong choices are allowed. For the next wrong choice, the questionnaire session will be closed and will come out of the window. Based on the performance, 'Good' or 'Not Bad' comment will be displayed and voiced out. Figure 3.11 shows the object modelling for Evaluation Mode using Booch notation. Like the former Levels, this level also has two modules namely Alphabet and Grade2 Braille. Evaluation is considered to be a super class / parent class. Alphabet and Grade2 Braille are considered to be the child classes which inherit the properties of super class.



**Fig. 3.11 Object Modeling using Booch Notation for Evaluation Module**

### **Alphabet in Evaluation Mode**

#### **Sample coding for evaluating the Alphabet ‘K’**

Case 11 'K

```

      'If brailleValue = "13" Then result = True Else
result = False
      If (LCase(brailleValue) = "fs" Or
LCase(brailleValue) = "sf") Then
          result = True
          playingAudioApp.Path& "\\great.mp3": Call
textBoxReset(1):
          userMark = userMark + 1:
BrailleDisplay("13")
      Else
          result = False
          playingAudioApp.Path& "\\WrongTryAgain.mp3":
Call textBoxReset(2):
          userWrong = userWrong + 1
      End If
  
```

The above sample coding checks whether the given input for ‘K’ is ‘fs’ or ‘sf’ for selecting Braille Cell 13. Either ‘fs’ or ‘sf’, then it gives a positive comment as ‘great’. The mark scored is incremented to 1 (initially it is 0). If the user has given some other value for ‘K’, then it sounds ‘Wrong Try Again’. The negative mark is

calculated. If more than two errors made by the user, then the ‘TAGB2’ tool exits from the current window and goes back to the main window. Figure 3.12 shows the activity diagram for Alphabet in Evaluation module.

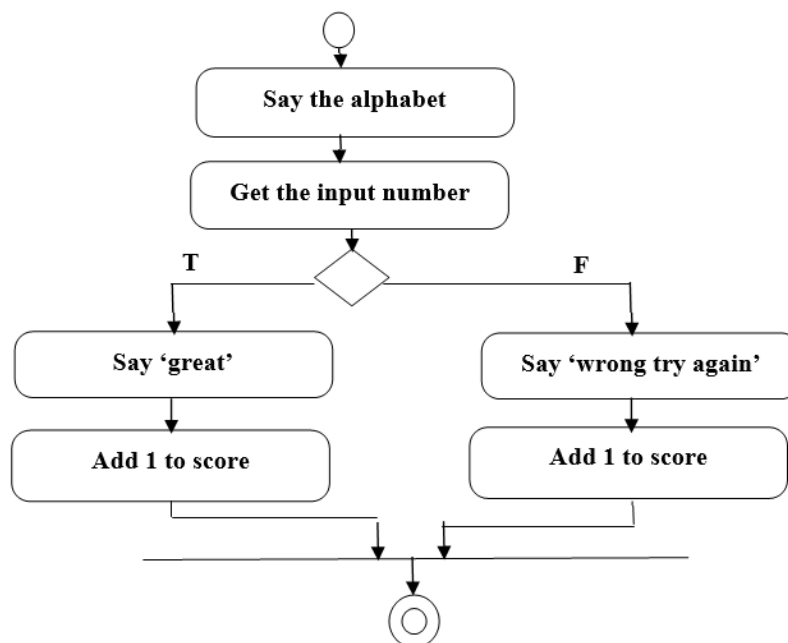


Fig. 3.12 Activity Diagram for Alphabet in Evaluation Mode

## LEVEL 2: GRADE2 BRAILLE

The Level 2Grade2 Braille has 11 modules. The user has the freedom to select any module of his/her choice using the numeric keys. e.g To choose module ‘3’ the numeric of key ‘3’ has to be pressed/typed. Thus, the perspective numeric values indicate the corresponding modules.

### 1. Learning Mode: Grade2 Braille

#### Sample coding for learning the word ‘but’

Case 1

```

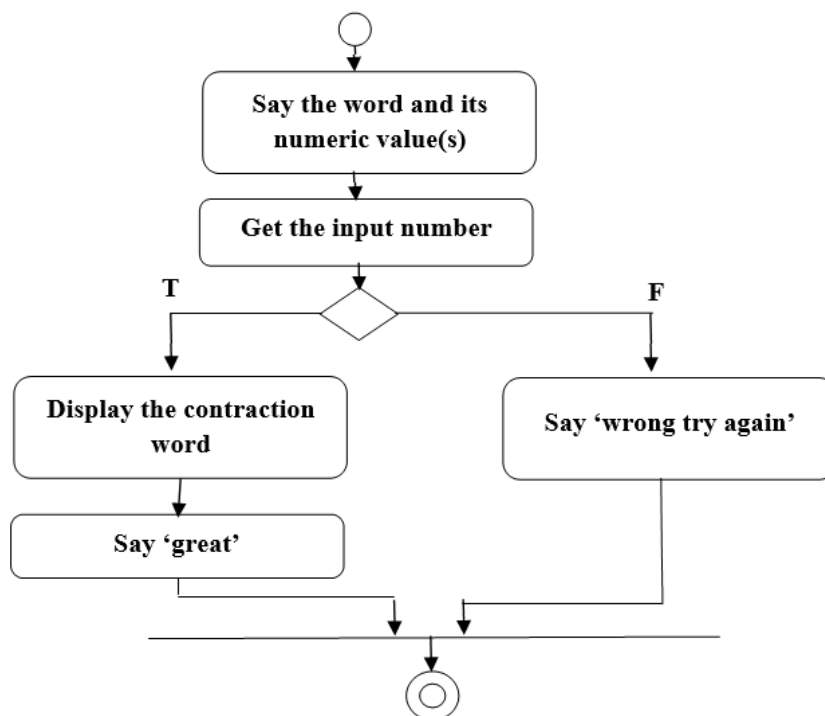
If Len(Trim(Text1(0).Text)) = 0 Then
    playingAudio App.Path & "\but.mp3"
Else
    If checkAlphabet(clsContraction, Text1(0).Text) =
True Then
        lblDisplay.Caption = "but": Text1(0).Text = "":
        BrailleDisplay (strFixingSeparator("12")):
  
```

```

        playingAudio App.Path & "\\Great.mp3":
        clsContraction = clsContraction + 1: Call
textBoxReset(1)
Else
        playingAudio App.Path & "\\WrongTryAgain.mp3":
        Text1(0).Text = "": Text1(0).SetFocus
End If
End If

```

In ‘TAG2B’ software, ‘Case 1’ represents learning braille values for ‘but’. Tech Aided Grade2 Braille directs the user to press Braille Value of ‘fd’. The input can be either ‘fd’ or ‘df’. For both the input, ‘TAG2B’ tutoring system has to be executed right. Giving input other than these two can give the negative acknowledgement. In the sample coding, the ‘If’ statement checks whether the user input is true. If true, it displays the word ‘but’ on the screen and gives a voice output as ‘Great’. Then the remaining set of words will be selected by incrementing the clsContraction value by ‘1’. If the user given input is false in the ‘If’ statement, the control moves to the Else part and voices out as ‘Wrong Try Gain’. The following fig. 3.13 represents the activity diagram for learning Grade2 Braille in Learning Mode.



**Fig. 3.13 Activity Diagram for Grade2 Braille in Learning Module**

## 2. Practice Mode: Grade2 Braille

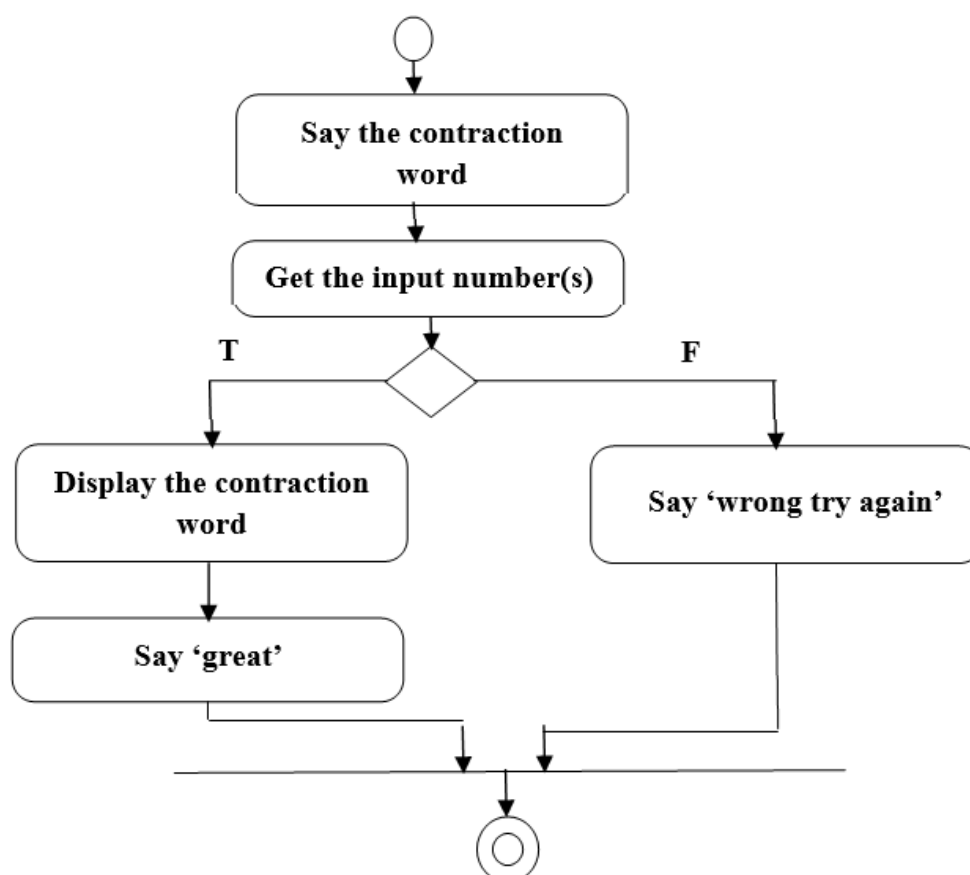
Similar to the Learning Mode for Grade2 Braille, the ‘TAG2B’ system says a question to the user and the user has to identify the correct Braille codes. No information about the cell number(s) are given to the user. Once the input is given, the system checks the Braille Code(s) is right or wrong. For both positive and negative acknowledgement, a voice output will be sounded to the user. Here no marks will be provided. Hence, any number of mistakes will be allowed to practice.

### Sample coding for practicing the word ‘but’

```

If checkAlphabet(1, strInput) = True Then
    lblDisplay.Caption      =      "but":      BrailleDisplay
(strFixingSeparator("12")):
    playingAudio App.Path & "/great.mp3": Call textBoxReset(1)
Else playingAudioApp.Path& "\\WrongTryAgain.mp3"
End If
End If

```



---

### Figure 3.14 Activity Diagram for Alphabet in Practice Module

The above sample coding checks whether the user given input for ‘but’ is ‘fd’ or ‘df’. If true, it displays the word ‘but’ on the monitor and voices out as ‘Great’. If the user given input is wrong, then it sounds ‘Wrong Try Again’. Fig. 3.14 describes the activity diagram for Grade2 Braille in practice mode.

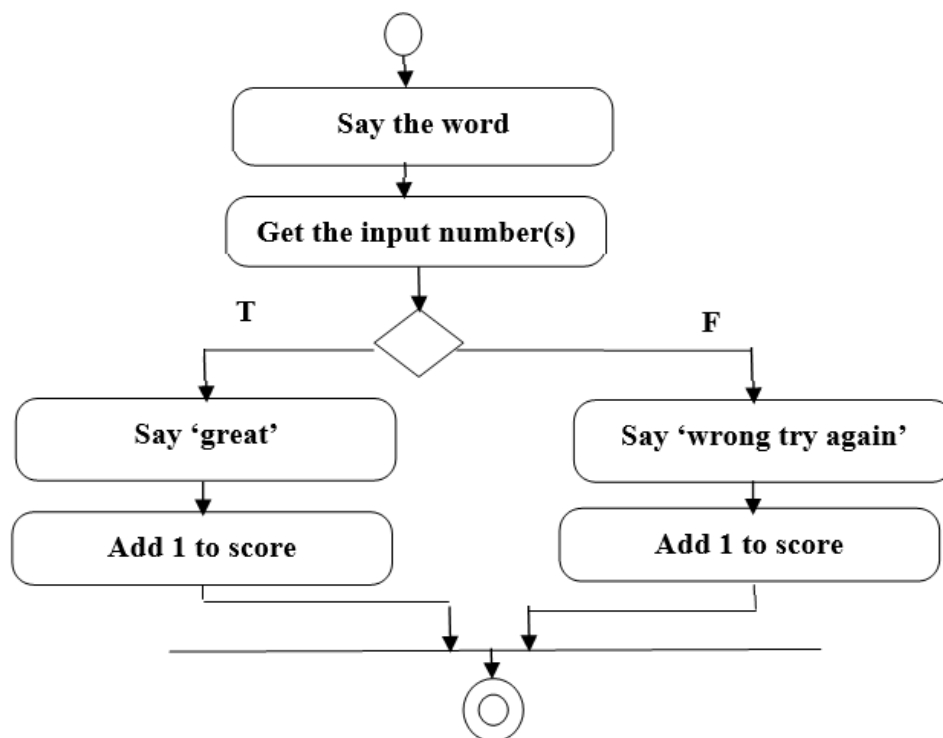
### 3. Evaluation Mode :Grade2 Braille

#### Grade2 Braille in Evaluation Mode

##### Sample coding for evaluating the word ‘day’

```
Case "can":
If checkAlphabet (2, strInput) = True Then
    playingAudioApp.Path& "\great.mp3":
    BrailleDisplay (strFixingSeparator (Text2(0).Text)):
textBoxReset(1):
    userMark = userMark + 1
Else
    playingAudioApp.Path&"\WrongTryAgain.mp3":
textBoxReset(2):
    userWrong = userWrong + 1
End If
```

By default, the dot ‘5’ plus Alphabet ‘d’ is for the word ‘day’. It evaluates the user given input is correct or not for the question ‘day’. If true, then it voices out with the positive acknowledgement as ‘Great’. Otherwise, it counts the user error value and increments it. It voices out with the negative acknowledgement as ‘Wrong Try Again’. For every wrong input the user Wrong value is incremented by ‘1’. If more than the 2 error, ‘TAGB2’ system exits from the current window and goes to the main menu. Fig. 3.15 represents the activity diagram for Grade2 Braille in Evaluation Mode.



**Fig 3.15 Activity Diagram for Grade2 Braille in Evaluation Mode**

Table 3.16 describes the comparison of learning, practice and evaluation module based on its operations.

**Table 3.16 Comparison of Learning, Practice and Evaluation**

S.No	Operations	Learning	Practice	Evaluation
1.	Information about numeric values of Braille code	Yes	Only negative acknowledgment as “wrong, try again”	No
2.	Total number of questions	Many	Many	26
3.	Number of errors allowed	Any	Any	Only 2
4.	Allocation of marks	No	No	Yes
5.	Grade	No	No	‘Good’ if score is 26 ‘Not bad’ if score is 24 or 25

### 3.3 Pilot Study

When the Tech Aided Grade2 Braille tool was ready to use, Pilot study was conducted among 10 students with visual impairment studying at Inclusive Schools in Coimbatore District. Pretesting and post testing were conducted in a sequence. The reliability of the items of the module were analyzed using test retest method with three weeks of gap between the first administration of the module and the second intervention. The reliability of the items of the module was assessed using Cronbach Alpha. It was found that the test retest Reliability of the eight modules of the intervention was found to be satisfactory. The Cronbach Alpha Coefficient was found to be 0.88 which indicates that the items of the modules intend to measure the respective modules. Hence no changes with regard to the items of the test were made in the main study.

### **3.4 Stage II: Study the Effect of ‘Tech Aided Grade2 Braille Tutoring System’**

After development of the Tech Aided Grade2 Braille tutoring system its efficacy was analyzed with the introduction of the software. For this purpose, samples were selected and the procedure for finding out the effectiveness of the tutoring system is detailed below.

#### **a. Site Selected**

The study was conducted in Inclusive schools in Coimbatore district of Tamil Nadu. The students with visual impairment from Grade VIII to XII were selected.

#### **b. Selection of the Sample**

The sample comprised of 42 students with visual impairment with 22 Boys and 20 Girls. Stratified random sampling technique was adopted to select the sample. In the selection of the sample, Inclusion and Exclusion criteria were kept in mind.

#### **Inclusion criteria**

- a. Inclusion includes students with visual impairment
- b. visual acuity not exceeding 6/60
- c. students with visual impairment studying in urban schools as specified in District Educational Office

- d. Students with visual impairment studying in Inclusive schools from Grade IX to XII

Exclusion criteria

- a. Students with visual impairment with associated disability
- b. Students studying in Private schools
- c. Visual acuity exceeding 6/60
- d. Students whose parents were not willing to permit their ward to participate in the study

The total number of the sample selected was 76 and out of this, 42 students with visual impairment were finally selected.

**c. Design of the Study**

The design adopted in the study is Quasi Experimental design. Stratified random sampling technique was adopted to select the sample. It is a single group design. Here Pre observation and post observation were made besides treatment. The layout of the design is:  $O_1 \times O_2$ .

Here  $O_1$  is Pre observation

$O_2$  is post observation and

$\times$  is the treatment in the Experimental study.

The students with visual impairment population are very limited. Hence this research adopted a quasi-experimental design without a control group. Here in this quasi-experimental research, the independent variable was manipulated, participants are not randomly assigned to conditions or orders of condition.

**d. Variables**

**Table 3.17 : Variables Used in the Study**

<b>Variables</b>	<b>Level</b>
<b>Independent Variable</b>	
Designing of TAG2B Braille Tutoring system	11 Modules 1. Alphabet 2. Grade2 Braille
Gender	i) Boys ii) Girls
Grade	G1(VIII, IX and X) G2(XI and XII)
<b>Dependent Variable</b>	
Rating of the Device by Special Teachers and Special Education Student Teachers	i) Existing knowledge on Grade2 Braille ii) Application iii) Self-learning tool iv) Advantages v) Usability vi) Challenges of the system
Assessment of Performance on TAG2B Braille Tutoring System	i) Alphabet ii) Grade2 Braille

**e. Construction of the Tool**

**1. Personal Data Bank**

To collect general information regarding Gender, Grade and Name of the School, Personal data bank was developed (Appendix I).

**2. Tool to assess the level of Acquisition of Braille Concepts**

This involves 26 items in Manual Braille related to Braille Alphabet to know the acquisition of Braille skills. Knowing the Braille Alphabet is a pre-requisite to move on to Grade2 Braille and a test was administered .1 score was given for each correct response.

### **3. Assessment of Performance of Grade2 Braille**

The test was aimed to measure the performance of students with visual impairment on Grade2 Braille. Two hundred and twenty Grade2 Braille were included from the new edition of the Braille Primer (1955) which offers a complete course in Grade2 standard English Braille which includes the following:

- a. Alphabet Whole word contractions/standing alone contractions(23),
- b. “Special word signs” (and, for, of, the, with)(5),
- c. “Simple upper group signs (word signs for “ch” , “sh” “th”, “wh”)-(6)& Word signs for ed, er, ou, ow(6),
- d. “Lower Group signs at the Beginning of a Word, Lower Group signs in the Middle of a Words”, “Lower Group signs in Any Part of a Word “en” and “in” , Lower Group signs in the Middle of a Words”, “Lower Group signs in Any Part of a Word “en” and “in” (10).
- e. “Initial Word signs With Dot 5”(22),
- f. “Initial Word signs With Dot 4- 5”(5),
- g. “Initial Word signs With Dot 4 -5 -6”(6),
- h. “Final group signs”(12),
- i. “Short forms”(75)
- j. Indicators(25)
- k. Punctuation (17)and
- l. Grouping punctuation (8)

**Scoring:** For each correct response one score and zero score for incorrect response.

### **4. Rating Scale to appraise the Impact of ‘TAG2B’ tutoring system among Special Education Student teachers and Special Teachers**

A rating scale to know the impact of ‘Tech Aided Grade2 Braille tutoring system’ was developed. It was in the form of 4 point rating scale viz Strongly Agree, Agree, Disagree and Strongly Disagree. The tool was administered among special education student teachers and special teachers (Appendix II).

## 5. Intervention Strategies

### *Learning, Practice and Evaluation*

Tech Aided Tutoring System has three modes viz., Learning Mode, Practice Mode and Evaluation Mode. While Learning Alphabet or Grade2 Braille in particular module, there is provision of Learning, Practice and Evaluation of what is learnt. Hence learning, Practicing and Evaluating go hand in hand. Apart from this, the students can select any mode for learning or practice or evaluation. In addition, 'TAG2B' tutoring system has option of selecting any module among these eleven as per student's choice.

After conduct of pretest using the Manual Braille developed, training regarding the Braille Alphabet and Grade2 Braille were given in sessions. A demonstration was given on 'Tech Aided Grade2 Braille Tutoring System' which has voice over with minimal Computer key usage. Then the students with visual impairment were given intervention and training on the application of 'Tech Aided Tutoring System' with the help of three applications viz., Learning Mode, Practice Mode and Evaluation Mode - (Refer 3.5(a) to 3.6(k) which depict the step-by-step screen shots on the computer screen).



**Fig 3.16 : Student working on Tech Aided Grade2 Braille**

The students were then oriented through 'Tech aided Grade2 Braille Tutoring System'. The students with visual impairment were taught and familiarized with Grade1 & Grade2 Braille. The Computer Program was set up as an individualized Unit for each student participant. The Braille Alphabet were introduced one by one in a sequence with the possibility of listening to the instructions for typing the letter cell corresponding to the required Alphabet followed by the Grade2 Braille. The Braille cell will be automatically displayed on the screen. This option is available in all the three modes Learning Mode, Practice Mode and Evaluation Mode. The students were

exposed to this phase for a duration of two months to get a better practice regarding Grade2 Braille.

Finally, the students with visual impairment were evaluated to know the performance level of students regarding Alphabet and Grade2 Braille. The Computer Program was set up as an individualized unit for each student participant. In this phase the computer is programmed to display the word Grade2 Braille and the student types the dots required. Once the dots are typed the student with visual impairment can self-evaluate their performance.

The intervention phase consumed duration of three months and the evaluation phase consumed a period of one month.

### **3.5. Data Collection Procedure**

#### **Phase I**

An assessment was made on Grade 1& Grade2 Braille using Manual Braille.

This test was considered as pretest using Manual Braille sheet. The time duration taken for assessment of performance was one month (Appendix III).

#### **Phase II**

The eight modules of Grade2 Braille have been introduced in a graded manner from simple to complex. During Learning and Practice sessions, the progress of the students was monitored by administering tests for learning of Grade2 Braille. During this phase, four tests were conducted to monitor the progress and this is termed as “Progress Monitoring Test”. The time duration for the phase was 4 months.

Post test was administered using the same tool adopted in pretesting. Posttest was administered by making the students perform the test individually. The score collected in this phase was considered as Post test score.

### **3.6. Data Analysis**

The following statistical techniques were used for analyzing the data

1. Analysis of Software Component of the 'Tech Aided Grade 2 Braille'
2. Percentage analysis to know the impact of 'Tech Aided Grade2 Braille Tutoring system'.
3. 'T test' was used for Comparison of Acquisition of Grade2 Braille concepts of students with visual impairment.
4. The Repeated Measures 'ANOVA' was employed to determine the Performance Score in Alphabet Word Sign, Strong words/group signs, Lower signs, Dot-5 Initial Letter, Dot 4 and 5 Initial Letters, Dot 4-5-6 Initial Letters, Final letter Grade2 Brailles and Short forms.
5. 'ANCOVA' test was employed to find out the influence of Gender, Grade and Locality on learning Grade2 Braille.