

# Quranic Braille System

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**Abstract**—This article concerned with the translation of Quranic verses to Braille symbols, by using Visual basic program. The system has the ability to translate the special vibration for the Quran. This study limited for the (Noun + Scoon) vibrations. It builds on an existing translation system that combines a finite state machine with left and right context matching and a set of translation rules. This allows to translate the Arabic language from text to Braille symbols after detect the vibration for the Quran verses.

**Keywords**—Braille, Quran vibration, Finite State Machine.

## I. INTRODUCTION

HOW will blind people participate in a literate culture? How will they continue their education? What make them feel as the normal people? What about the Muslim blind people? Will they having the ability to read the Quran? What is the Braille system? And how this idea was created? From these questions the idea of Braille system arrives.

Braille is a system of writing that uses patterns of raised dots to inscribe characters on paper. Therefore, it allows visually-impaired people to read and write using touch instead of vision. Also It is a way for blind people to participate in a literate culture. The idea of Braille has been started by Louis Braille. He was a blind person, by accident when he was 3 years old; he needed a new way to learn. He stayed at his old school for more than two years, but he couldn't learn everything by listening, until 1821, a soldier named Charles Barbier's visited the school. Barbier share with his invention which is called "night writing," a code of 12 raised dots that let soldiers share top-secret information on the battlefield without having to speak. Louis trimmed Barbier's 12 dots into 6. Then he published the first Braille book in 1869.

Today, Computers, Internet, and information explosion provide an informational structure which has changed the way people interact with the outside world. These rapid changes in this area have the potential to reduce the differences between disabled and normal individuals. In the early days of computers, visually impaired users had little or no access to the information in the computer screen. Since then, software developers of screen readers have been able to cope with the text-based environment of early operating systems. However, most modern operating system environments are now GUI. Hence, the information on the screen is no longer accessible to users who rely on screen readers or Braille displays [1].

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Braille is the system of touch reading and writing which utilizes raised dots to represent the print alphabet letters for persons who are blind. The Braille system also includes symbols to represent punctuation, mathematic and scientific characters, music, computer notation, and foreign languages. By using of Braille symbols, the blind are able to review and study the written word. It provides a vehicle for literacy and gives a blind the ability to become familiar with spelling, punctuation, paragraphing, footnotes, bibliographies and other formatting considerations. Braille cell is consist of 6 dots, 2 across and 3 down, is considered the basic unit for all Braille symbols. For easier identification, these dots are numbered downward 1, 2, 3 on the left, and 4, 5, and 6 on the right (see Fig. 1).

1 ○ ○ 4  
2 ○ ○ 5  
3 ○ ○ 6

Fig. 1 The Dot that represents Braille symbols

Sixty-four probabilities are represented from these six dots, which include the space symbol. The sixty four patterns represent at the below equation:

$$P = 2^n$$

Where

P: number of Braille symbols,

n: number of the dot

The Arabic language is one of the languages that have been translated to Braille system and this system has been used by blind Muslim persons to read the Quran. However the current system [2] is not complete; it does not include special vibrations that are required in reciting Al-Quran which it different at the reciting for the Arabic language. These vibrations are: Noon + Scoon vibrations (اظهار) (Edhare), ادغام (Edgham), اقلاب (Eklabe), كلكلة (Kalkala) and اخفاء (Ekhfa'). Therefore there is a need to develop system for translating special vibration into Braille symbols for the Quran verses.

Through this study, the Decision table will use to controls the operation of the finite state machine (FSM) and provides more flexibility for it. Grad 2 to the Arabic Quran Braille creates, where it will cover the shortage of the vibration that not exists in the existing systems. Suitable FSM that handle the new grade of Braille within the same language will develop to allow a single set of rules to double as translation to Braille for a language, and a simple list of character translation rules that can be edited directly by non-technical users. Then proof the efficiency of this flexible technique at

the new Arabic Quran Braille generation.

This study concentrates on developing a prototype system for translating special vibrations of Quran recitation into Braille symbols. It uses FSM that allows the application of rules to be controlled by comparing left and right contexts. This system translates input text using a set of character rules, determining what characters are valid for the language and their attributes, FSM, decision table, and a set of translation rules containing wildcards for matching input text. These parts together constitute a complete language rules table. Contraction and different types of translation can all be supported within the same language rules table.

## II. LITERATURE REVIEW

### A. Braille System in English Characters

1854 was the starting with adoption of Braille as the official communication method for the blind in France. By the end of the nineteenth century English language translate to in the United Kingdom, Australia and many other countries. In the United States, however, Braille was not adopted until 1932. Early in the nineteenth century there were five tactual systems in use throughout the United States, including American as well as British Braille, [3].

There are many researches of Braille system was done lately to the English symbols. The market-leader in commercial translation products is produced by the Duxbury Company in the USA (Holladay, 2001). They provide many functions, including translating word-processed documents and plain text, integration with other applications, bulk translation and graphical interfaces. There are versions for individual users, integrated with the Microsoft Windows and Apple Macintosh desktop operating systems, as well as large-scale volume translators. They are feature-rich, constantly updated but relatively expensive. Some fourteen languages are supported.

Another system designed for desktop computers is Win Braille. This is produced by the Index Braille company [4] which manufactures embossers and thus produces a free text-to-Braille product to encourage Braille use. This supports 18 languages in a WYSIWYG word-processor style, allowing Braille code to be edited directly. It is designed to produce output for the Index embosser. It uses a rule-based translation system, and the rules can be edited by users for local variations. It also supports grades of translation, straight character or abbreviation.

For special symbols of Danish, French, German, and Italian alphabets, the basic 6-dot pattern is chosen to be identical with its 6-dot representation in the Braille code of the respective language. However, in different languages the same Braille representation is used for different symbols, [5].

### B. Braille System in Arabic Characters

The Arabic language from the important language in the world, where it the main language for the Quran in the Islam religion, The Custodian of the Two Holy Mosques' Braille

Press for the production of the Holy Quran was initially known as the Regional Bureau Press and was established in 1973 under the purview of the Middle East Committee for the Affairs of the Blind. The print house initially started producing educational books using manual Braille equipment which however was considered to be primitive and thus incapable of printing the Quran. The period

Between "1985 – 1986" (1406 hijri) saw the first Quran being produced in Braille in Saudi Arabia by the special Education Press of the Ministry of Education following a fatawa given by the Grand Mufti of Saudi Arabia, Sheikh Abdulaziz Bin Baz. In [6], between "1986 – 1987", the Regional Bureau Press also produces its first copy of the Quran.

### C. The Existing Braille Systems

#### 1) Duxbury Braille Translation (DBT) Software

In [7], DBT is window-based software that automates the process of conversion from regular print to Braille (and vice versa.) It provides translation and formatting facilities. It also provides word-processing facilities directly in the Braille mode where the user can treat the keyboard as Perkins machine to enter Braille text as well as using the software for ordinary word processing tasks. Also, the software can translate Arabic text to Braille. With this supplement, one can create and edit natural Arabic text using Microsoft Word (Arabic version), and then import and translate the file into Arabic Braille using the DBT software. English text may also be intermixed, and both languages may be contracted, or no contracted, or any combination. Although Duxbury Translation software supports all of the above features, yet, there was a small bug; the translation of Arabic characters in DBT was not 100% equivalent to the Arabic character set supported by Windows 95/98/NT/2000. Perhaps this was due to the difference in character code page used by DBT and our Windows 95/98/NT/2000. Moreover, DBT does not support any type of sound that is essential for the blind to interact with computer.

#### 2) IBSAR

Al-Sharekh reported in [8], that a Braille translator, a window-based application that was developed by Aramedia, Jordan. The software is designed for the sighted users, it have the ability to translate Arabic and English text into Braille without contractions. It uses MS-Word as its platform.

#### 3) Printing System with Braille Software

The Kuwait institute for scientific research has developed software called Printing system with Braille. It is a window-based application that is oriented to sighted people to convert Arabic text to Braille (one way translation), []. The software supports multi-level contractions as well as the conversion of Holy Quran files into Braille.

#### D. Finite State Machine

FSM is a useful data structure to express actions with a given sequence of events. FSM concepts are used for pattern recognition, artificial intelligence studies, language and behavioral psychology. And yet, the basic concepts are easy to understand and immensely powerful. The idea behind the FSM is that a system such as a machine with electronic controls can only be in a limited (finite) number of states. Consider some simple systems that you encounter every day: a door may be open or closed; a light may be on or off; a light bulb may be on, off or broken; a cassette player may be playing, stopped, rewinding or fast forwarding.

The first step in any FSM design is to identify the significant states of the system; you need to include all the important states but avoid including unnecessary states. Hence, the door may be "Opening" or "Closing", but "3/4 open" or "1/4 closed" would most likely be overkill, [9].

Alasdair King is concerned with the translation of text to and from Braille, by using the matching of left and right contexts of the translation windows, with FSM to handle grades of Braille within the same language and to allow a single set of rule to duple as translation to and from Braille for a language, decision table controls the operation of the finite state machine, and simple list of character translation rules that can be edited directly by non-technical users, [10].

The UMIST translation system [11], is one of the few published of work on text and Braille translation in recent years. Where the engine state controlled by FSM, using the contents of the decision table, and regulates which subset of the language translation rules can be used. The translation engine can use any language rules table, so any language can be translated to or from Braille code if the language rules table is constructed.

### III. METHODOLOGY

The prototype developments are divided into four phases. The flows of phases are problem identification, theory building, system development and experimentation. Fig. 2 illustrates the methodology approach Adopted from [12] for this project.

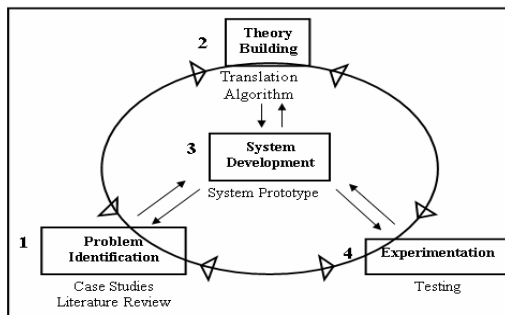


Fig. 2 Multi-Methodological Approaches

#### A. Problem Identification

Problem identification is the first step involved in the research methodology in this project there is a need to prototype system that cover the recital requirement that needed for translate the Quran characters to Braille symbols, where the vibration for Quran recitation is different than the Arabic language reading, the Quran has special vibration that must taken in considered, where any change in the reading way maybe give another meaning, Allah said: "ورنل القرآن ترتيلا", verses number (4), Surah (Al-mozammel).

#### B. Theory Building

Theory building is a process of developing methods or models. And the translation algorithm is used to develop Quranic Braille system, see the Fig. 3:

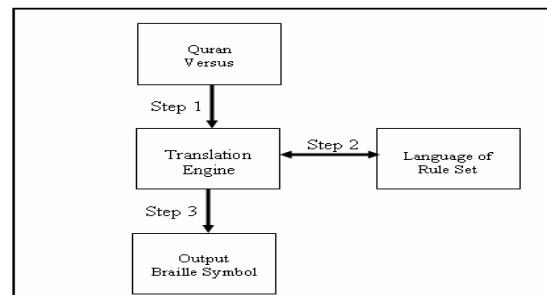


Fig. 3 Methodology approach for translation algorithm

#### Step 1:

During translation the engine works along the input text, character by character. It attempts to match a window of input text starting with the current character with one of the translation rules in the language rules table.

#### Step 2:

FSM, involve the complications of state, control tables and many rules. An alternative approach using only the matching of left and right contexts of the translation window was developed. The former contains the translation algorithms and functions, and the latter all of the translation information for translation of one language in one direction. The translation engine can use any language rules table, so any language can be translated to or from Braille code if the language rules table is constructed. The language rules table consists of a set of translation rules and a decision table.

#### Step 3:

A successful match with a translation rule must match a segment of text, the context - the text to the left and right of the window - and the state of the engine. The engine state is controlled by the FSM, using the contents of the decision table, and regulates which subset of the language translation rules can be used. The translation rule then provides the translation for that window of input text, which is appended

to the growing output text, and the engine moves along the input text to the next unmatched character.

C. System Development (Prototype)

1) Develop the Rule set

i. Create New Vibration

As a mention in section (III.A), the recitation for the Quran verses, is not similar to the Arabic language reading, where the Quran verses have special vibration that help the Quran reader to get the right meaning for the verses. In this study we create 5 new vibrations that were not exist in the previous systems.

The standard world Braille that founded is represented the English character, so that the developers, who develop the Arabic Braille systems, used the English characters to represent the Arabic character then translate it to Braille symbols.

Therefore, when the process began to create the new vibration that used in our Quranic Braille system (اظهار) (Edhare), ادغام (Edgham), اقلاب (Eklabe), قفلة (Kalkala) and اخفاء (Ekhfa'), it was by found all the possible probability symbols that not duplicate with the other existing Arabic symbols, then put it for the new 5 vibrations, as shown in Table I.

TABLE I  
 NEW QURAN VIBRATION SYMBOLS

|   |   |      |        |      |       |   |
|---|---|------|--------|------|-------|---|
| ⠠ | 0 | 356  | 001011 | 356  | اظهار | ⠠ |
| ⠠ | 4 | 256  | 010011 | 256  | ادغام | ⠠ |
| ⠠ | 6 | 236  | 011010 | 236  | اقلاب | ⠠ |
| ⠠ | 7 | 2356 | 011011 | 2356 | لغفاء | ⠠ |
| ⠠ | p | 1234 | 000100 | 1234 | قفلة  | ⠠ |

ii. Character Rules

- 1) Arabic character that need to translate.
- 2) Identify all the Arabic character that needs to translate.
- 3) Identify all the symbols that don't matter to translate it.
- 4) English character that meet the Arabic characters.
- 5) Identify the new created symbols.
- 6) The world standard for Braille symbols for the English characters

iii. Vibration Rules

This vibration occur, if the below character in each vibration coming after (تتولين) (Tanween) or (نون ساكنة) (Noun + Scoon)).

TABLE II  
 اظهار . (EDHARE)

|   |   |   |   |    |   |   |   |   |   |
|---|---|---|---|----|---|---|---|---|---|
| خ | ع | ح | ع | هـ | ء | أ | إ | ؤ | ئ |
| X | > | : | ) | H  | ^ | / | . |   | Y |
| ⠠ | ⠠ | ⠠ | ⠠ | ⠠  | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ |

TABLE III  
 ادغام (EDGAM)

|   |   |   |   |   |
|---|---|---|---|---|
| ن | ل | م | ر | ي |
| N | L | M | R | I |
| ⠠ | ⠠ | ⠠ | ⠠ | ⠠ |

TABLE IV  
 اقلاب (EKLABE)

|   |
|---|
| ب |
| B |
| ⠠ |

Table V

اخفاء (EKHFA')

|   |    |   |   |   |   |   |   |   |   |   |   |   |   |
|---|----|---|---|---|---|---|---|---|---|---|---|---|---|
| ظ | ض  | ص | ث | ك | ج | ق | س | د | ط | ز | ف | ت | ص |
| = | \$ | T | F | Z | ( | D | S | Q | % | J | K | ? | ! |
| ⠠ | ⠠  | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ | ⠠ |

Table VI represents the characters that whom if followed by Scoon it will accrue the (Kalkala).

TABLE VI  
 قفلة (KALKALA)

|   |   |   |   |   |
|---|---|---|---|---|
| د | ج | ب | ط | ق |
| d | j | b | ( | q |
| ⠠ | ⠠ | ⠠ | ⠠ | ⠠ |

2) Develop the Finite State Machine

For each pair of state and input symbol there is one and only one transition to a next state, or each input symbol it will then transition to a state given by following a transition function.

FSM, these are also known as Turing machines, named after Alan Turing, the father of computing. The computer Artificial Intelligence (AI) will progress between various states that generate actions. A state might be "Expand", "Defend", "Attack", "Build up resources", etc. and each state will generate appropriate actions. Each state has a number of inputs, and methods of moving from state to state. In this way an AI is created, [13].

The first step was to developed the FSM is by determine the states that needed to do the translation process where it was four states in the system, then determine the transition function that was needed to transition from state to state.

The Fig. 4, represent the diagram for the FSM method that used in the system to make monitoring at the translating processes.

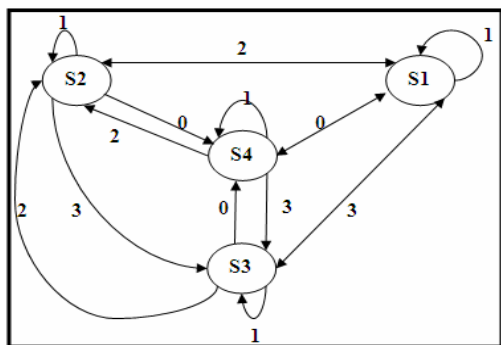


Fig. 4 Finite state Machine Diagram

As example to declare the FSM work, the verses (قَمَن يَعْجَل) took to apply it at the technique. The initial state is S1, the cursor will read the first character in the versus and because it haven't any vibration, the transaction function will be (0) which will translate the character to Braille symbol, then the current state for the algorithm will be S4, then the cursor will move to the second character, and it will find it also haven't vibration so that, the transaction function will be (0) also, and the current state S1, the cursor will move to the third character, so it will find ( Noon followed by Scoon), and then apply the transaction function (3), that will check the character after it, to determine what the special vibration that detected, and then translate the characters and put the symbol of the special vibration before the word verses then the current state will become S3. And so on.

The Table VII below represents the truth table for the finite stat machine status, for each state and each possible input from the user.

TABLE VII  
 TRUTH TABLE

| Sates | Transition Function |    |    |    |
|-------|---------------------|----|----|----|
|       | 0                   | 1  | 2  | 3  |
| S1    | S4                  | S1 | S2 | S3 |
| S2    | S4                  | S2 | S1 | S3 |
| S3    | S4                  | S3 | S2 | S1 |
| S4    | S1                  | S4 | S2 | S3 |

The transition function which determines the next state based on the current inputs and state, in this study. The Table VIII below is description transition for each state.

TABLE VIII  
 TRANSITION FUNCTION DESCRIPTION

| Transition Function | Description                      |
|---------------------|----------------------------------|
| 0                   | No character Found               |
| 1                   | Character                        |
| 2                   | التنوين Tanween Found            |
| 3                   | "نون ساكنه" (Noon + Scoon )Found |

### 3) Design and Developing the Translation Engine

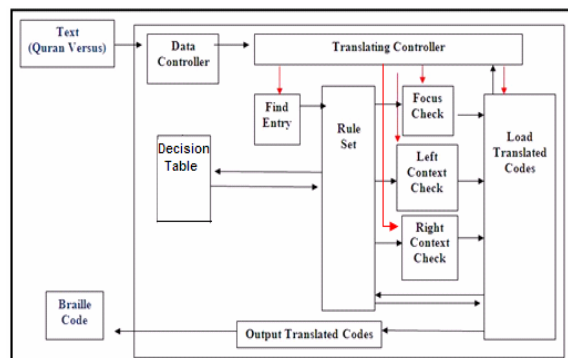


Fig. 5 Translation Block

In Fig. 5, the find-entry block receives one entry character from the translating-controller block and outputs a particular address to the output-rule block. Two operations keep running in the output-rule block. One is reading rules from the Decision table block, and the other is sending every single rule to focus-check, right-context-check, left context-check, and load-translated-codes blocks. The output-rule block receives signals from the find-entry block obtaining addresses, and signals from the load-translated-codes block that indicate if the output rule can be used. The output-rule block sends an address to the Decision table to read one rule at a time and sends it separately to focus-check, right context-check and left-context-check blocks. If the rule does not find a match, then a signal is generated and the output-rule block gets the next rule and sends it. This process continues until a match is found and the focus is successfully translated. The focus-check and right-context-check blocks receive not only the rule from output-rule block, but also the whole group of words to be translated from the translating controller because more than one letter of focus and right context might need to be checked. Each block generates signals for the load-translated-codes block indicating if the focus, the right context or the left context were successfully matched. If one of the three fails, then a signal is sent back to the output-rule block requesting the next rule. If the focus, right context and left context match one of the rules, then the load translated-codes block sends the translated codes to the output translated- codes block, and informs to the translating-controller block how many characters were translated. After one group of characters has been translated, the output-translated-codes block transmits the corresponding Braille ASCII characters one by one. Then the translation of a new set of characters begins.

#### D. The Experimentation

This the final task in the research methodology, represent the test task for the environment that the system will apply at it and test for the system to make it more efficient.

- *Experimental Procedure*

In this process the translation engine translate the Quran verses and that include the vibrations. See Fig. 6.

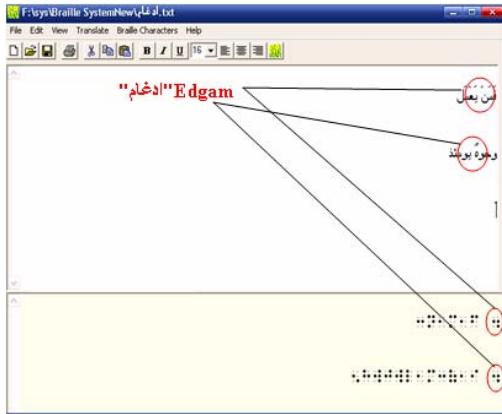


Fig. 6 Edgham (ادغام)

IV. FINDING / RESULT

In this study, results were obtained from the Quranic Braille System experimentation with many different verses. Initially, the purpose of the experiment is to find the system's performance and capability with different samples from the holy Quran (verses). In addition, the experiment is carrying out to examine the effects to the results obtained in respect to different kinds of vibration situation.

The result analysis from the experimental data, based on Table IX below, is sample shows that the technique is successfully performed well.

TABLE IX  
SAMPLE OF TEST VERSES

| Braille Translation | Quran Verses                       | Vibration |        |
|---------------------|------------------------------------|-----------|--------|
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠     | وَيُكَلِّمُ هَٰؤُلَاءِ             | Edhare    | اطهارة |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠     | مِنْ رَّبِّكَ                      | Edgam     | لدغام  |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠     | مِنْ بَيْنِكَ                      | Eklabe    | اكتلب  |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠     | مِنْ قِبَلِكِ                      | Ekhfa'    | اخذاء  |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠     | إِنْتِزَابًا لِلنَّاسِ حَسَابِهِمْ | Kalkala   | كلكه   |

V. SIGNIFICANCE / CONTRIBUTION

The study about translate the Quran verses to Braille symbol, the Quran as main book to the Islam religion from Allah, have some special vibrations, and the existing Braille systems that done before don't involve this property to recite the verses of the Quran, so that, this study come out with new generation from Braille system cover some miss compatible that found in the existing systems. It's for the blind Muslim people to uncover the way forward them to have the ability to be more understanding for the Quran with his entire

requirement.

VI. CONCLUSION AND FUTURE DIRECTIONS

This project has been success fully adhere their objectives:

- To translate Arabic Symbols to Braille symbols.
- To create appropriate Braille symbols for Noon vibrations.

It given the Quran word input, the system is able to translate it into Braille symbols. This is ready to be printed on the special equipment, such as Braille printer.

To reach the quality of outstanding systems, contributions from many institutes and research centers nationwide are required. Also, there is the need to standardize the Braille system to the Quran, because it have own contractions rules.

The Quran vibration is divided for 4 part (Noon + Scoon and Tanween), (Meem + Scoon), (Lam +Scoon) and (Mud). Through this study, this system currently handles only (Noon + Scoon and Tanween) vibrations, and the rest of the vibrations didn't have Braille symbols that cover it.

The Jawi language has similarity with the Arabic character where it has 28 similar characters and the rest characters need to be handled.

APPENDIX A

TABLE AI  
ARABIC CHARACTER & BRAILLE SYMBOLS

| Braille | Arabic | Braille. Dots | Dot    | English | Braille |
|---------|--------|---------------|--------|---------|---------|
| ⠠       | ا      | 1             | 100000 | a       | ⠠       |
| ⠡       | ب      | 12            | 110000 | b       | ⠡       |
| ⠣       | ت      | 2345          | 011110 | t       | ⠣       |
| ⠤       | ث      | 1456          | 100111 | ?       | ⠤       |
| ⠥       | ج      | 245           | 010110 | j       | ⠥       |
| ⠦       | ح      | 156           | 100011 | :       | ⠦       |
| ⠧       | خ      | 1346          | 101101 | x       | ⠧       |
| ⠨       | د      | 145           | 100110 | d       | ⠨       |
| ⠩       | ذ      | 2346          | 011101 | !       | ⠩       |
| ⠪       | ر      | 1235          | 111010 | r       | ⠪       |
| ⠬       | ز      | 1356          | 101011 | z       | ⠬       |
| ⠭       | س      | 234           | 011100 | s       | ⠭       |
| ⠮       | ش      | 146           | 100101 | %       | ⠮       |
| ⠯       | ص      | 12346         | 111101 | &       | ⠯       |
| ⠰       | ض      | 1246          | 110101 | \$      | ⠰       |
| ⠱       | ط      | 23456         | 011111 | )       | ⠱       |

