

The Akeffa Tutor Application: A New Arabic Writing System

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Abstract—This paper illustrates an application for a new Arabic writing system, named the Talah Arabic Writing System for people with visual impairments. The most well-known communication system for people with visual impairment around the world is Braille. However, those who use Arabic Braille face many problems especially with reading diacritical marks, which are written in the same way as letters. This problem inspired a lady named Talah Abo-Alnaja to invent a new Arabic writing system where letters and diacritic marks are written as geometrical shapes to make learning easier. This allows anyone to learn and practice the Talah Arabic writing system. However, because this system is still relatively new and unknown among people with visual impairments, it suffers from a lack of learning resources. Hence, the objective of this project is to develop an application to teach the Talah Arabic writing system using an external keyboard for students with visual impairment. The methodology involves analysis, design, implementation and testing. The result of this project is an education tool that helps students with visual impairment to read in Arabic effortlessly. Therefore, the result of this project has contributed to the educational for visual impairment students in Saudi Arabia; towards the development of knowledge society to achieving Saudi Arabia Vision 2030.

Keywords—Keyboard, Learner, Voiceover, Akeffa, Visually impairment, Educational system

1 Introduction

Everyone deserves an equal opportunity to gain a good education and acquiring knowledge is the main path to academic success. Thus, reading and writing are the major ways we gather and produce information that allows us to achieve a good level of education. Based on the journal of the American Medical Association, visually impaired individuals in the Saudi population require audio instructions to make navigating through applications easier. This also enables instructors to view learners' progress. In addition, this allows admins to change the application's content based on user reviews. Learning by practice and hearing audio is considered an effective teaching and learning approach. According to the Learning Pyramid approach, learning by practice and hearing audio could increase learners' retention rates by 75% for practice and 20% for audio, respectively [6].

Therefore, we propose the Akeffa tutoring application that uses an external keyboard and allows learners to practice the Talah Arabic writing system. This system is expected to support the 9.3% of the Saudi population who suffer from visual impairments to improve their learning [20]. People with visual impairments have a variety of skills and talents which, if applied, can add to Saudi's success and achievement because vision loss leads to educational, social, and employment difficulties.

The Braille writing system is currently used by those with visual impairments. However, people using Arabic Braille face some difficulties in learning it. Specifically, they often have problems with the diacritic marks (which are written as a separate character before the letter or directly after it) and this makes the text much longer to read. A lady named Talah Abo-Alnaja developed a new writing system to replace Arabic Braille: the Talah Arabic writing system. This new system is more flexible and easier to learn than Arabic Braille.

The aim of the proposed application is to create an educational application that will help users learn the new Talah writing system and allow it to reach a wider audience so that people with visual impairments can learn it faster and gain more knowledge about it so they can communicate with others and progress in their education easier.

The main objective of this application is to teach and provide practice with the Talah writing system for people with visual impairments. Specifically, this will enable learners the desired keys; we have programmed the keys based on the three patterns used in the Talah writing system. This will make it easier for the visually impaired to learn and memorize the letters.

The mobile application is connected to external keyboard designed with prominent shapes above the buttons. It is an educational application that is concerned about letters and diacritical marks. It will also help the users to examine themselves by taking some tests. An Anker-type keyboard can be connected to a smartphone via Bluetooth. This keyboard was chosen because people with visual impairments find it easy to carry and use. Prominent shapes above the buttons were designed to be placed on the keyboard to enable writing in the Talah writing system (letters and diacritic marks). Some popular keys (navigation keys, shift, delete and enter) are prominent so that users can touch, feel and then press on them; these prominent shapes were designed and optimized to enhance the end-user's tactile sensation. Also, these keys were designed to be easy to

install on any other keyboard using any strong double-sided tape. This increases its adaptability and will help the system to be more widely used overall. The keys were created using a 3D printer (Ultimaker 2) and were made polylactic acid (PLA) with a 3D-print resolution and a 0.06 mm layer height. This allows the original ink print on the key to be shown even after the installation of the prominent shape (if the keyboard is also to be used by other people). The height difference between the prominent shapes is 1.5 mm, and the width of the lines on the prominent shapes is 1 mm. The tactile feeling of the fingertips on the keys makes it easier for users to feel and distinguish among the different shapes.

2 Literature Review

Visual impairment is the functional limitation of the eye or both eyes or the vision system that leads to loss of visual acuity (Definition from CDC). According to recent studies of the World Health Organization (WHO), they estimated and found that there are 285 million people with visual impairment (fully vision loss or other visual impairments) worldwide. It was estimated that the Eastern Mediterranean Region accounts for 12.6% of the world's blindness [16].

The Braille writing system was developed to enable people with visual impairments to read, write and communicate with others. Braille system consists of combinations of prominent dots that make the letters and numbers. People usually use their sense of touch to feel those dots to read or write. Some people may consider Braille as a language, but it's a writing system, that is applied to many languages such as Arabic, English...etc. In King Abdul-Aziz University, there is a special need unit to help the visually impaired. It provides computers that have a screen reader to help them to use it. The special need unit also provides a document reader that reads the pages, and Braille conversion that converts text files to Braille [15].

The Vision of Saudi Arabia 2030 was guided by directives Custodian of the Two Holy Mosques King Salman bin Abdul-Aziz and with full supporting from crown prince Mohammed bin Salman bin Abdul-Aziz Al Saud. This vision includes developing teaching methods, developing curricula and providing a stimulating educational environment. The Ministry focuses on the development of education based on the Vision 2030 on building a school environment. One of the Ministry tasks to achieve the vision of 2030, is through attention and supporting for people with special needs (deaf and blind disabilities as well as those with learning disabilities). They Integrate them with their peers of healthy students, which considered a useful educational vision. This paves the way for positive social interaction with colleagues [22].

People who are using Arabic Braille still face many problems especially with the diacritical marks, which are written as same as the letters. Additionally, diacritical marks located before or after the letter makes texts longer. A girl named Talah AboAl-naja was facing some problems when she wanted to communicate with her visually impaired friend. Due to the difficulties of the Arabic Braille, she invented a new writing system where letters and diacritical marks are written as geometrical shapes. This new

writing system (Talah's writing system) makes communicating easier because its simple and fast to learn. This writing system helps visually impaired to read, write and communicate with others easier and faster than the Braille writing system. The idea is based on the use of geometrical shapes. The alphabet in the Arabic language is 28 letters therefore, Talah divided them into three groups, each group has nine basic shapes used recurrently for each group. The main difference between the groups is the number of dots in each group. The first set starts with the letter (alif) and ends with the letter (dhal), there are no dots in this group. The second set starts with the letter (ra) and ends with the letter (ayn), this group has one dot in its shapes. The last set starts with (ghayn) and ends with (waw), this group has two dots in its shapes. The letter (ya) does not belong to any set and its shape has three dots. The diacritical marks have distinct geometrical shapes that are easier to memorize and are written in small forms above the letters which is the opposite from Braille, where its diacritical marks are written as separate characters before or after the letters.

2.1 Educational mobile application

Education is critical since it is essential for economic prosperity and workforce development. However, since the appearance of ipads and other smart mobile devices, the current practice of education has been transformed rapidly [1] [12]. This is because these smart mobiles devices are claimed as easy to use, increase students' interest and improve students' learning [7]. In addition, smart mobile devices are extensively used for dealing with information on education and provide entertainment at home and school [19]. A mobile application or app is software optimized for use with smart mobile devices. The vast majority of adult users and teachers positively evaluate the devices and its potential educational benefits of thousands of apps [8] [11] [13]. Moreover, mobile applications are getting important in education as early as preschool education [18]. [17].

In these days, there are many educational mobile applications are developed to target students who are visually impaired to give them free sense in education.

Visually impaired have many abilities and skills, even with their loss of vision. Hence, many people nowadays move toward developing applications either on portable devices or on computers, to help and allow people with visual impairments to engage more in society. Since the new writing system is still unfamiliar among people, there are no similar projects that teach this system. On the other side, there are a huge number of applications that teach the Braille writing system.

2.2 Related work

This section reviews previous related research on teaching the visually impaired a writing system using a mobile application.

Taptilo educational application (Find reference): First, Taptilo is an educational application available on the Apple iOS store for free. This application targets children to help them learn the Braille writing system with an interactive wireless keyboard and voice commands. The advantages of this application are that it has the ability to read

out every key a user types, provides full control of the application using the keyboard and includes a basic set of lessons and tests [22] [6].

Table 1. Taptilo educational application Features

Functionality	Teaching and learning Braille language using special keyboard.
Target Users	Young children with visual impairments.
Technology	Interactive keyboard, voice command a wireless Braille device using Bluetooth along with a partnered application.
Advantages	Readout every key a user types. Control the Application using the keyboard. Includes a basic set of games and activities.
Disadvantages	Very expensive 1,195.00 \$.
Relation with Our Project	Both are educational programs. Both are depending on screen reading and interactive keyboard. Both are using exercise and tests to improve the user skills.

Exploring Braille with Madilyn and Ruff (Find reference): Exploring Braille with the Madilyn and Ruff Application was created to introduce children with visual impairments to the alphabet with Braille dot configurations. Through a fun interactive, multi-sensory approach, the application includes a basic set of games and activities and can connect to any braille keyboard device [10].

Table 2. Exploring Braille with Madilyn and Ruff Features

Functionality	Teaching the alphabet letter for Braille Dot Configurations.
Target Users	Young children with visual impairments.
Technology	Interactive keyboard, Screen reader.
Advantages	Readout every digit key a user types. Control the Application using the keyboard. Includes a basic set of games and activities.
Disadvantages	NOT free.
Relation with Our Project	Both are educational programs. Both depend on screen reading and interactive keyboard. Both use exercises and tests to improve user skills.

Talking Typer (Find reference): Talking Typer is a self-voicing application for typing and computer keyboard training. It is used to help improve skills using drills, practice lessons, and games by typing lessons using a sound card. It was made specifically for blind and visually impaired people and allows users to learn about any key on the computer keyboard [2].

Table 3. Talking Typer Features

Functionality	Teaching and learning keys on the keyboard.
Target Users	People with visual impairments and people who learn through listening.
Technology	Screen reader, interactive keyboard, sound card.
Advantages	Screen reading. Read out every key a user types and presses. Control the program using the keyboard. Digitized human speech feedback.
Disadvantages	If you do not have a password for your account, anyone is able to login with your account information on the same device. There are no records kept for Open Typing.
Relation with Our Project	Both are educational programs. Both depend on screen reading and interactive keyboard. Both are using drills and tests to improve user skills.

Braille Tutor (Find reference): Braille Tutor provides an interactive learning experience for sighted or blind Braille learners. The app uses sounds and text-to-speech to support vision-impaired learners. By using a Bluetooth keyboard, it provides users with feedback via the keys [6].

Table 4. Braille Tutor Application Features

Functionality	Provides lessons to learning and typing Braille.
Target Users	Sighted people or blind Braille learners.
Technology	Interactive keyboard and Voice-over for navigation within the app.
Advantages	- It is a free application on iPad and can be connected to a keyboard. - Uses voice command to interact with visual impairments users.
Disadvantages	Only available on iPad.
Relation with Our Project	Both use keyboards. Both depend on interactive keyboard.

Math Flash (Find reference): Math Flash is software for basic math training. It uses drills and tests to improve the user’s mathematical skills by using a sound card. It is made for people with visual impairment and has the ability to read user-generated equations and every digit key the user presses. Math Flash offers a variety of programmable configurations. For example, you can tell Math Flash to generate a drill and test materials by specifying a set of criteria, or you can type in specific problems to generate drills and tests [14].

Table 5. Math Flash Features

Functionality	Teaching and learning mathematical basics.
Target Users	People with visual impairments.
Technology	A screen reader, interactive keyboard, sound card.
Advantages	Screen reading. Readout every digit key a user types. Control the program using the keyboard. Digitized human speech feedback.
Disadvantages	Downloaded on windows PCs only
Relation with Our Project	Both are educational programs. Both depend on screen reading and interactive keyboard. Both use drills and tests to improve user skills.

Learn Keys (Find reference): Learn Keys software helps users explore the keyboard through digitized human speech feedback that tells the user about each key they type on the screen. Learn Keys works in two modes: full-screen & background

In the full-screen mode, the program vocalizes every single key the user types and displays them on the screen, without activating any keys with special functions (similar to the Windows menu key or the backspace key functions). In the background mode, the program will keep working while you open any other programs, by vocalizing each key the user types and activating the special keys functions [3].

Table 6. Learn Keys Features

Functionality	Exploring the keyboard keys
Target users	People with visual impairments and people who learn through listening
Technology	interactive keyboard, sound card
Advantages	-Read out every key a user press -control the program using the keyboard -work on the background
Disadvantages	Downloaded on windows only
Relation with Our Project	-Both are using keyboard. -Both are depending on interactive keyboard.

Braille Easy (Find reference): Braille Easy was developed for users with visual impairments and supports two languages, Arabic and English. This application use gestures to allow users to navigate and typing is made easier; requiring one hand only. Braille Easy provides a main screen where users can choose whether to take a tutorial or to go directly to the lessons. In the tutorial section, the user will learn how to use specific gestures to type or navigate through the application. In the lessons section, the user will be able to choose a lesson from a variety of different lessons (alphabets, numbers, diacritic marks, punctuation, and so on) [21].

Table 7. Braille Easy Features

Functionality	Teaching and learning Braille writing system.
Target users	Users with visual impairments
Technology	Virtual keyboard, screen reader and speech feedback
Advantages	Include an audio tutorial. It supports Arabic and English language.
Disadvantages	-Only available on IOS - Can't use the gesture unless the application stop speaking.
Relation with Our Project	-Both are educational application. -Both are having Tutorial and lessons.

3 Methodology

The methodology for this project is designed purposely to achieve the project objective, so the phases involve are analysis, design, and implementation and testing.

3.1 Analysis

In this phase, we conducted the data collection, requirements analysis using Unified Modeling Language.

Data collection: Data collection is the process of collecting information from relevant resources to help in the search process. We used two methods to collect the data for our project.

In the first method, we interviewed visually impaired teachers and students at King Abdul-Aziz University, two were teachers and seven were students. We asked them some questions, in order to know what education approach they use, what features they wanted for the keyboard and what are the difficulties they were facing with Arabic Braille writing system. The second method used, was a web-based questionnaire by designed using Google Form that was directed and distributed only to people with visual impairment. The purpose of collecting information from them is to know their requirements and design a system that is suitable for them.

Requirements analysis: In the requirements analysis, the functional and non-functional requirements are identified and Unified Modelling Language (UML) is used to visualize the functional requirements.

Functional Requirements

Learner's functional requirements:

- The learner shall be able to view brief description of the application.
- The learner shall be able to choose between two options (lessons, tests).
- The learner shall be able to learn the keyboards keys, letters and diacritical marks.
- The learner shall be able to perform exercises.

- The learner shall be able to perform tests.
- The learner shall be able to view the scores.
- The learner shall be able to view the wrong answers.

Admin's functional requirements:

- The admin shall be able to sign in.
- The admin shall be able to sign out.
- The admin shall be able to change password.
- The admin shall be able to reset password.
- The admin shall be view lessons.
- The admin shall be able to delete lessons.
- The admin shall be able to edit lessons.
- The admin shall be able to view learner statistics.

Instructor's functional requirements:

- The instructor shall be able to sign up.
- The instructor shall be able to sign in.
- The instructor shall be able to reset password.
- The instructor shall be able to sign out.
- The instructor shall be able to view a brief description about the application.
- The instructor shall be able to add learner.
- The instructor shall be able to delete learner.
- The instructor shall be able to edit learner.
- The instructor shall be able to view the information's of the learner.
- The instructor shall be able to contact to admin.
- The instructor shall be able to update profile.

Non-Functional Requirements

Usability: Usability means how easy the product's use is, such as software or mobile applications can be used to achieve a specific goal effectively and efficiently. In our application [23], we will apply two type of methods in the usability testing:

- **Expert review:** It is to ask an expert to use their knowledge and experience to evaluate the usability of the system, to spot problems and to give recommendations to improve the usability of the system.
- **Questionnaire:** Used to ask the users questions regarding the system and then collect their feedbacks [5].

Authentication: Authentication is the process of recognizing a user's identity by comparing the email and password on a file in the firebase database of the authorized user's information within the application. In our application, admins and instructors must have a password and email to access the application [4].

3.2 Design

The design phase, which helps in understanding requirements delivered by analysis, phase and transfers these requirements into an architecture chart. This architecture chart determines the components, their interfaces, and behaviors. Also, it helps to answers the question about how to build the best solution. In this phase, we will also develop the prototypes [26]. The purpose of the design phase to construe the interface to enable the user to run the system and its functions [27].

Prototype Design involve a prototype is an original model, form or an instance that serves as a basis for other processes. In software technology, the term prototype is a working example through which a new model or a new version of an existing product can be derived. A prototype has many benefits, such as the developer and the implementer getting valuable feedback from the user even before the actual project is started [28].

Designing Low Fidelity Prototype known as low-tech, is a simple and easy translation of the product and design concepts. It's used to turn the design ideas into testable and tangible artifacts, collecting and analyzing the user demands at the early stage [29]. It involves :

- Main Screens: The main screen contains the application's name. See Figure 2.
- Learners interfaces: See Figure 3.



Fig. 1. Main Screen of Application



Fig. 2. Learners interface

Designing high fidelity prototype: To help users to look and feel how the application interface will be. Prototypes help in examining design problems and evaluating solutions [29].

Database design: Can be defined as related collection of data. We mean by data is known facts that have implicit meaning and can be recorded. Database has several properties; database sometimes called the universe of discourse (UoD) because it represents some aspects of the real world, logically database is a collection of data, and for specific purpose the database is designed, built, and populated with data [30]. Thus, we conducted logical database design and physical database design.

3.3 Keyboard design

An Anker type keyboard can be connected to a mobile via Bluetooth. This keyboard was chosen because it is easy to carry and use by visually impaired people. prominent shape above buttons was designed to be placed on the keyboard to enable writing in the Talah writing system (letters and diacritical Marks). Some famous keys like (navigation keys, shift, delete and enter) are prominent so that the visually impaired can touch, feel and then press on the desired key. The prominent shape will be designed by a 3D printer. Also, we will program the keys based on the three known patterns for the Talah writing system. This will make it easier for the visually impaired to learn.



Fig. 3. Keyboard

User interface design: Helps the user to implement what he/she wants to build applications that meet their needs and that are easy to use. [31]. The user interface design for this application is based on the following principles [32]:

- **The structure principle:** The design should be organized the user interface purposefully, based on clear and consistent models which are recognizable to users.
- **The simplicity principle:** The design must make simple to do the common tasks, providing the good shortcuts, which are meaningfully, and commenting clearly in the user's own language.
- **The visibility principle:** The design must keep all necessary materials and options visible without distracting the users by inessential and redundant information. Good designs don't require many alternatives or confuse them with unnecessary information.
- **The feedback principle:** The design must keep users informed through clear and brief language familiar to users about all actions, changes of state, and errors or exceptions that are related to the users.
- **The reuse principle:** The design must reuse the internal and external behaviors and components, so that will be reducing the need to the user to rethink or remember.

3.4 Implementation

The Arabic writing system (incorporated into Talah's writing system) makes communicating easier because it is simple and fast to learn. This writing system helps the visually impaired to read, write, and communicate with others easier and faster compared to the Braille writing system. The concept is based on the use of geometrical shapes. The alphabet in the Arabic language is made up of 28 letters. Therefore, in

Talah, we divided them into three groups; each group has nine basic shapes used recurrently for each group. The main difference between the groups is the number of dots in each group. The first set starts with the letter (alif) and ends with the letter (dhal), there are no dots in this group. The second set starts with the letter (ra) and ends with the letter (ayn), this group has one dot inside its shapes. The last set starts with (ghayn) and ends with (waw), this group has two dots inside its shapes. The letter (ya) does not belong to any set and its shape has three dots inside it. The diacritic marks have distinct geometrical shapes that are easier to memorize and are written in small forms above the letters, which are the opposite from Braille, where diacritic marks are written as separate characters before or after the letters.

The Akeffa Tutor Application was designed and developed to help people with visual impairments learn the new writing system (the Talah writing system). The design of the application focuses on simplicity and clarity in its design to facilitate use by the visually impaired by providing a seamless UI; it is simple to navigate and interact with a user by using sounds and voiceovers. The application is connected to an external keyboard connected to a mobile via Bluetooth. Prominent shapes were designed to be placed on the keyboard to facilitate practising the new writing system (the Talah writing System). The application was developed with Swift by using the XCode program and Firebase for the database and authentication. We used authentication through email and password for instructors and admin, and an anonymous ID for the learner. Also, we used Cloud-Firestore, Real-Time, and Storage for storing data.

The application has three primary types of users; each type has a primary section.

- **Learner:** In the first, learners can listen to a brief description of the application and the Talah writing system. Then, they can listen to lessons and perform exercises. After that, learners can perform tests and check their test results.
- **Instructor:** Instructors can add any learners to see their progress in the Talah writing system. The instructor may be the teacher or the parents of the learners. Instructors have three primary sections. They can read a brief description of the application and the Talah writing system. Also, they have a My Students section in which they can add students and view information about them, such as ID, name, age, gender, and view tests results. When instructors view student's tests results, they can see their progress. Moreover, instructors can contact Admin by email to tell them about any suggestions or changes required to the application.
- **Admin:** The Admin (administrator) is responsible for the Talah writing system and does not have any programming background. They have two primary sections. First, they can view the lessons and make changes to them by editing or deleting them. Also, they can view users' statistics and display how many users are using the Akeffa application for each learner and instructors and learner's average test grades. The system architecture design describes the structure, behaviour, and provides more visualizations of the application from these three users' perspective. An illustration of the system architecture is presented in Figure 1

The first user (Learner): The learner will interact with the system via an external keyboard. The learner must be connected to the Internet to retrieve the required information from the database. For example, when the learner presses a ‘brief description’ button, the audio is recovered from the database. In addition, the system will evaluate learner’s input by comparing it with the true value in the database. Moreover, when a learner completes a test, the information will be stored on the database and can be retrieved if required.

The second user (Instructor): Instructor interacts with the system by adding a student and then the database will store the student information that can be retrieved from the database if required. Also, when an instructor wishes to send an email to the admin, the system will open the main email application on the instructor’s device.

The third user (Admin): Admin interacts with the system by deleting or editing an existing lesson(s) on the application. Then, the database will be modified according to the event that can be either a deletion or an edit. Moreover, admin can access users’ statistics and the average of learners’ grades.

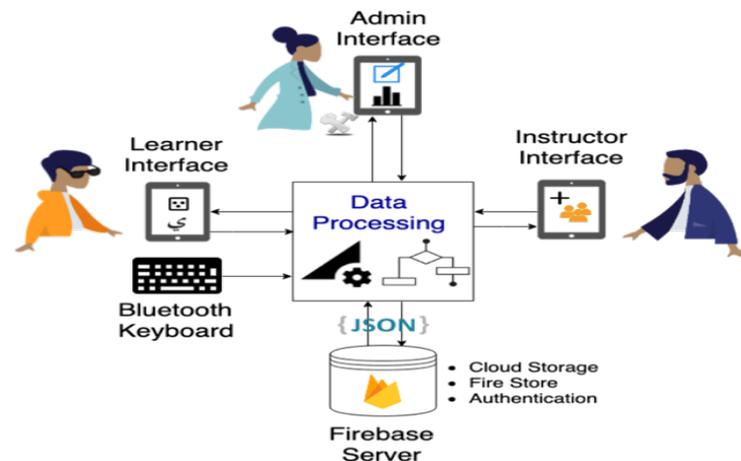


Fig. 4. System Architecture

3.5 Testing

In testing phase, we conducted two type of testing. The first testing is known as black box testing which is focusing on testing software from the user perspective to test the functional requirements [33]. Secondly, we conducted a usability testing for non-functional requirements.

Black box testing Method In the black box testing, we choose the functional testing to test the functional requirements. Thus, the following steps are carried out [33] :

- The functional requirements and specifications of the system are examined.

- Tester chooses valid inputs (positive test scenario) to check whether the application can process them correctly. Also, some invalid inputs (negative test scenario) are chosen to verify that the application is able to detect them.
- Tester determines expected outputs for all those inputs.
- Software tester constructs test cases with the selected inputs.
- The test cases are executed.
- Software tester compares the actual outputs with the expected outputs.
- Defects if any are fixed and re-tested.

The Nielsen criteria as shown in Table 9 were adopted to evaluate the usability of the Akeffa Tutor Application’s functions [15]. Usability testing refers to how useful the product was to use (or not) by testing it from users’ perspectives to ensure that users understand everything on the system and measure how easy they find using it. A questionnaire based on the Nielsen criteria was designed to collect users’ perspectives after using the Akeffa Tutor Application. 20 participants from Al-Noor Institution in Jeddah participated in the experiment and filled in the questionnaire after trying out the application with an external keyboard.

Table 8. Criteria to Measure Usability [16]

Measurement	Excellence	Acceptable	Unacceptable
Learnability: is Akeffa Tutor easy to use when using it for the first time to accomplish any task			
Efficiency: When you learn how to use the Akeffa Tutor application, did it help you to perform the task quickly?			
Memorability: If you returned to the application after a period of time, would it be easy to remember how to accomplish the tasks in the Akeffa Tutor Application			
Errors: When you are performing a task, does the Akeffa Tutor application help you avoid errors?			
Satisfaction: When you are using the Akeffa Tutor Application, are you happy and satisfied with its performance?			

4 Result and Discussion

4.1 Data analysis

Figure 1.1 shows a survey that was distributed among 100 visually impaired people. The same survey was distributed to other 15 people without visually impairment, but that will not affect the final results. Talah's material will not make any difference between people with visually impaired and those who are not, those it will not affect the final results. Her scale in the experiment between both are as the following:

- The people with visually impaired uses the most powerful sense which is the touch.
- The normal people in order depend on other sense which is a vision which they are using every day.

Her goal is to measure how fast both of them can learn the same subject or material.

The survey included some questions such as:

- How well they mastered the Arabic Braille.
- The difficulties they faced during the process.
- A question to understand their acceptance regarding a new writing system other than Arabic Braille.
- Their opinions on the new writing system.
- What they think should be improved.
- Braille system was easy to learn
- How much time took you to learn Braille?
- Do you face any challenges in using Braille? (especially in Arabic)
- Do you believe in the idea of creating a innovative writing system other than Braille?
- Do you agree that crating an innovative system can solve communication problems?

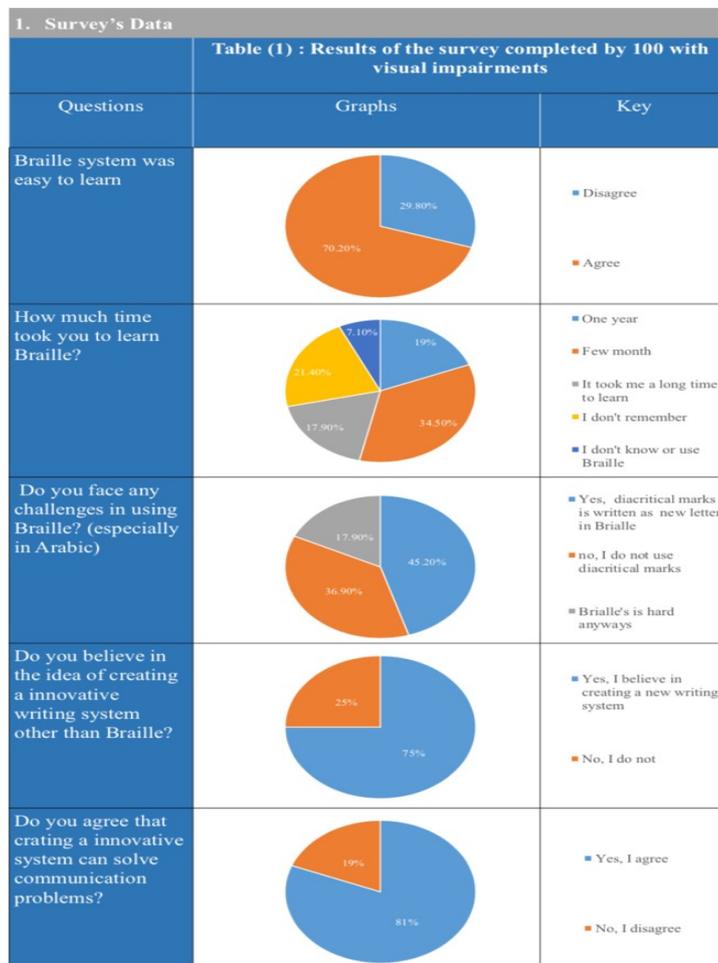


Fig. 5. Survey

The time taken for the two groups to fill the survey was compared. Figure 1.2 shows the time taken to learn the Arabic Braille compared to the time taken to learn the new system. Figure 1.3 shows the comparison between the time taken to read a three word sentence in the Arabic Braille and the new writing system. Finally, Talah rated the participants during the experiment from one to ten based on their communication skills and from the statistic, she found that the new writing system was easier than the Arabic Braille writing system.

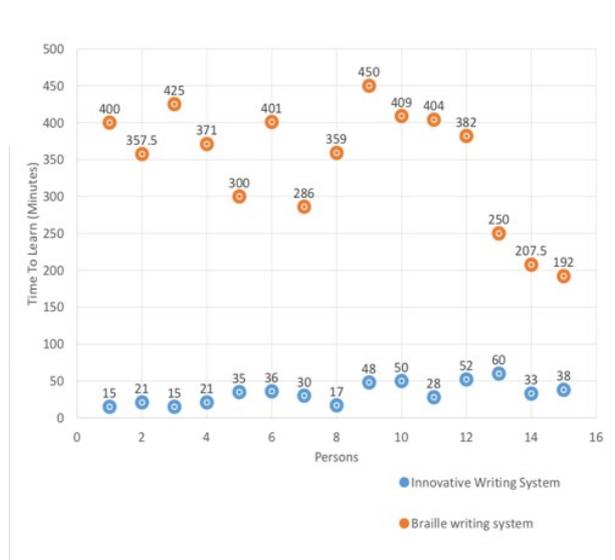


Fig. 6. Compared time between learning Arabic Braille and the new system

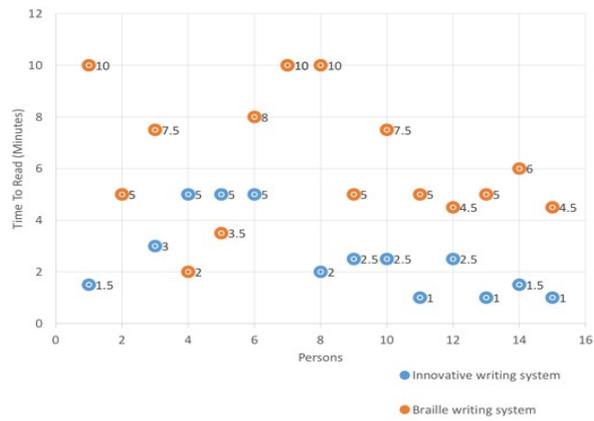


Fig. 7. Time taken to read a three-word sentence in Arabic Braille and the new writing system

5 Result

The result of this project is an educational application will be developed to teach people with visual impairments this new writing system, where statistics prove that it is easier than Braille. This application will allow those individuals to know more about this writing system and give them the opportunity to practice it through an external keyboard as shown in figure 4.

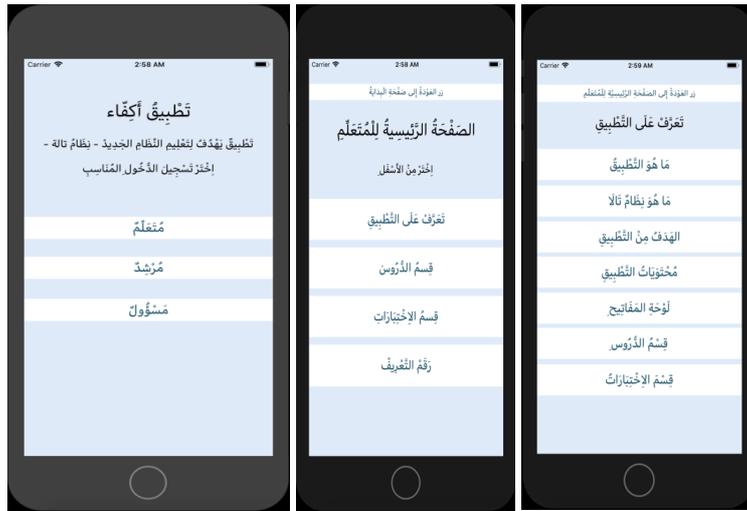


Fig. 8. Sequence of interfaces

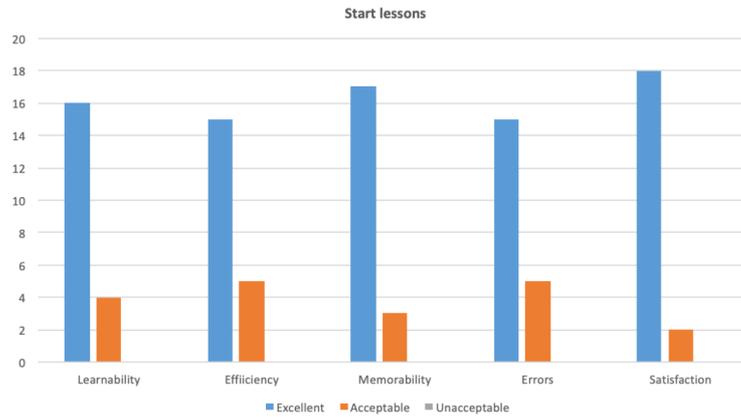


Fig. 9. Results of the Nielsen Measurement - Initial Lesson Task-

The results show that most of the students found the tasks had high levels of learnability, efficiency and memorability, few errors, and they were satisfied overall. Finally,

they filled in a post-use questionnaire after using the application and the external keyboard. The results show that 70% of participants rated as ‘excellent’ that learning through repeated listening to the explanations of the letters and performing exercises helped them to memorize the letters while 90% rated as ‘excellent’ the application’s rapid response during the training stimulated them to learn. As shown in Figure 1, most students reported that the initial lesson task had high learnability, efficiency, and memorability, had minimal errors, and they were satisfied with its performance.

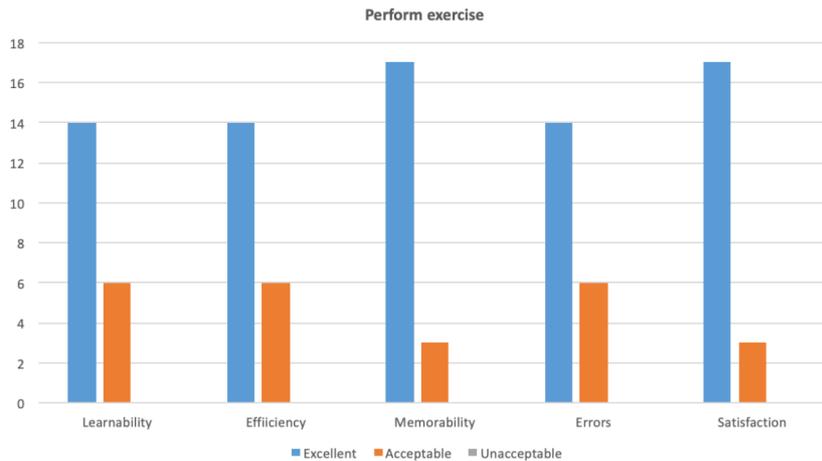


Fig. 10.Result of Nielsen measurement – ‘Perform Exercise’ Task

As shown in Figure 2, most students reported that the ‘perform exercise’ task had high learnability, efficiency, memorability had few errors, and they were satisfied.

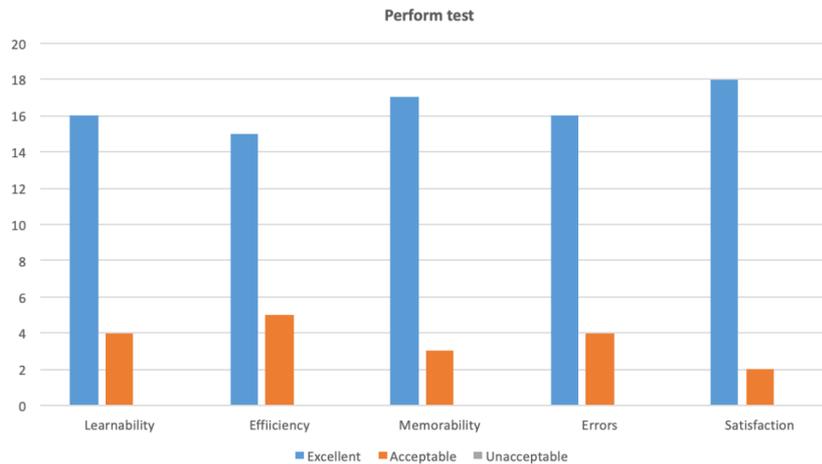


Fig. 11.Result of Nielsen measurement – ‘Perform Test’ Task

As shown in Figure 4, most students doing the ‘perform test’ task reported that it had high learnability, efficiency, memorability, had few errors, and they were satisfied.

6 Conclusion

The Akeffa Tutor Application was developed to help people with visual impairments to get the opportunity to learn how to use a new Arabic writing system where letters and diacritic marks are written as geometrical shapes to make learning easier. In this paper, we presented a novel application that teaches people with visual impairments and helps them practice the Talah writing system. This will enable visually impaired learners to make use of audio instructions that will make navigating through the application much easier. It also enables instructors to view learner's progress. In addition, the application is flexible as it allows admins to change content based on user reviews.

The limitation of this project is the appropriateness of this application as an education application is not yet discover and as a result in the future, we are targeted to facilitate the rubrics developed by [17] in our application in order to developmentally appropriate education application.

The future work on the Akeffa Tutor Application involves adding *gamification* as a new feature to help add a feeling of pleasure for users. In addition, we also intend to enable learners to communicate with each other and learn together online. Moreover, we intend to allow the application operates in the Android environment to encourage more users to become involved because currently, it is only available on IOS, which a key limitation is given the popularity of Android devices.

This work has been contributed to the education research area by helping the students with visual impairment, as well as to the growth of education applications purposely for visual impairments. This application has shown that it provides assistance for visual impairment students in reading that them more sense to their life. Therefore, with this application we hope to educate more people and contribute to the development of knowledge society in order to achieve Saudi Arabia Vision 2030.

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