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Assistive Technology for Deaf People Based on Android Platform

Emad E. Abdallah[a,*] Ebaa Fayyoumi [b]

[a,b]*Faculty of Information Technology, Hashemite University, Zarqa 13115, Jordan*

Abstract

Social communication is one of the most important pillars that our society based on. It is well-known that the language is the only way to communicate and interact with each other verbally or non-verbal way. People with special needs are members of this society and have the right to enjoy the communication with the external environment in an easy and professional manner. This paper aims to provide an interesting application that guarantees ultimate communication with the disabled users and vice versa. The key feature of this application is employing the Arabic language as a medium of communication to learn all the sign language terms.

The power of this application appears in two aspects: first of all, the ability of normal people to communicate with the targeted people without having any previous knowledge on signs language. This can be either achieved by voice recognition of words or by typing the words in the Arabic language. The application is then displays the appropriate image(s) in the sign language. Secondly, and more importantly, people with special needs communicate with normal people by choosing the signs images on their phones from the numerous categories stored in the databases which express their ideas and thoughts. Consequently, the set of images is transformed into a text paragraph. We evaluated our application by testing it on real deaf and dumb users. We carefully created scenarios on realistic situations. The early results are promising as all deaf found the proposed technology useful and 90% of them wanted to use it on daily basis.

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Keywords: Disabled people; deaf; assistive technology; sign language; mobile application.

* Corresponding author. Tel.: +0096-795673231; fax: +00962(05) 3826625.
E-mail address: emad@hu.edu.jo

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1. Introduction

Deafness and hearing loss is the condition of incapability to hear things, either totally or partially. According to the World Health Organization, 360 million people worldwide (Over 5% of the world's population) have disabling hearing loss where 32 million are children ("World Health Organization," 2015). It is the second largest proportion in the distribution of people with disabilities according to the General Census of Population and Housing. Deafness has a deep impact on the quality of life for the deaf individuals and their community. Some people think that intelligence of deaf and dumb people are less than normal people, but what we would like to express that this idea is not true! Deaf and dumb people have sharp intelligence that makes them equal with normal people.

Hearing disabilities differ from other disabilities, due to the presence of another language that compensates for verbal or oral language and it is known as a sign language. We can define the sign language that it is the language which used by deaf and dumb people to communicate with each other and with other people. Despite the existence of another language that compensates the verbal language. The communication between the disabled people and the normal people is still difficult even with the existence of the sign language. This is because of the misconception which is common among people. As human we would like to contribute by developing an android application to connect people with special needs and other people.

Assistive technologies cover a wide range of assistive, adaptive, and rehabilitative devices for people with special needs. In the past 20 years, there has been a huge development in the sector of deafness and hearing loss assistive technologies. Assistive technologies are classified into hardware based, software based, and prosthetic implants [1]. For many years, people with hearing loss have used text telephone or telecommunications devices to communicate by phone. Assistive technologies allows people who are deaf, hard of hearing, or speech impaired to communicate through a communications assistant (CA) with people who use a standard telephone. A CA relays the TTY (text telephone or telecommunications device for deaf and hard of hearing people) [2,3] input to the telephone user and types that person's response back to the TTY user.

A game for deaf children is proposed in [4] to develop the children language skills. The game uses camera and sensors to detect and collect signal data for the American Sign Language (ASL) recognition system. The user will wear gloves and any sign made will be captured by the camera. The system then shows a video with a signer demonstrating the correct ASL phrase. The user can then mimic these gestures. The possibility for deaf educational technology is increased by allowing signing children to interact with the computer using their gesture-based language.

A computerized scheme to assist the deaf people is THETOS, it translate a spoken language to Polish sign language. The system uses natural language processing techniques[5]. They used a scripting notation for signing signals and a web browser plug-in to interpret this notation into gesture data. They achieve a very good delivery of signing. Moreover, they escape the inflexibility of video or motion capture. Tests with deaf community have shown that the method can deliver suitable quality of signing.

Interactive computer identification and correction of language errors is proposed in[6]. The main objective is to employ natural language processing to train deaf people on written English. A deaf person send his writing and the system will then execute a syntactic analysis, defines the errors and deliver feedback. The feedback will help the deaf to be aware of the nature of the errors he/she commit. The writing could be resubmitted for a second check and the cycle is repeated.

Application for deaf people is presented in[7], the idea is to help dumb or deaf people to express their feelings to normal people with the help of sign language. The application provides deaf people with an approach to become

more close to advanced technology by using speech to image conversion. An avatar based translation system from Arabic speech to Arabic sign language for deaf people is presented in[8] which define the significance of web to search multimedia content such as image or video. The technique is composed of a database of the captured 3D motions of Arabic sign language. The sign language motion will be recorded using data gloves. A graphical conversion of the digitized sign language will be re-animated using standard. In addition, speech is captured by microphone, the recognized words is saved to be translated to signs. They can also serve as the input to further linguistic processing in order to achieve speech understanding.

Most of the current available mobile applications (iOS and Android) seek to serve the deaf and dumb people in a very limited way. For instance, there are some applications that teach the English letter only and some of the others show the sign and what it means. Motivated by the wide uses of smartphones in our daily activities and the provided accessibility features have paved the way to use mobile applications effectively in making the deaf people more independent in their community. The application guarantees ultimate communication with the disabled users and vice versa. The key feature of this application is employing the Arabic language as a medium of communication to learn the sign language terms and to communicate with deaf and dumb people in a simple and creative way.

2. Design and Development

The new system is consisting of several parts for learning, playing and converting the Arabic text to sign language and vice versa. The first part is used to teach deaf and normal people the sign language. Learning option is attractive and organized into several groups. Each group contains items that are related to each other (e.g. animals, friends and family…etc). After choosing the group a list view will appear for several images and sign representation. Moreover, a clear explanation is shown for how to make the sign in motions. Fig.1. show the sequence diagrams for learning and converting signs to text choices. Fig.2. display some screenshots of the learning and converting options. Clearly the system will refer to two sets of databases. The first database is signs database that contain all the images of the signs. The second database contains the equivalent meaning for every single sign.

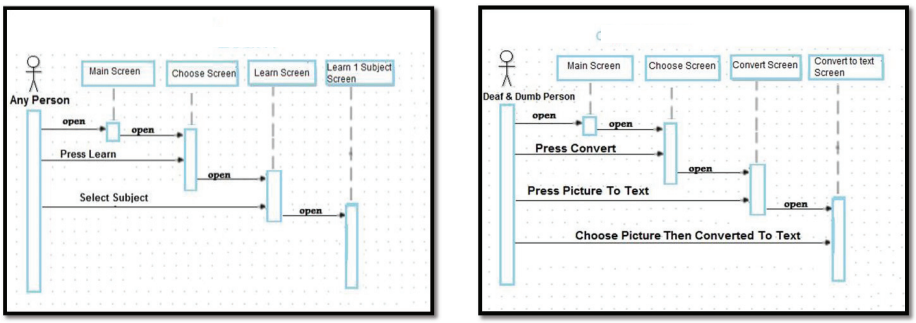

Fig.1. Sequence diagrams for learning and converting signs to text

The new application provide an interactive Android game, which is based on finding the similarities between four pictures represent four different things in Arabic sign language. For example: pain, fatigue, hospital and doctor (indicate the word patient). Fig.3. shows screenshots of the learning game. The proposed deaf game provides a new method to increase the knowledge of the sign language in a fun and attractive way. This game might motivate

parents, friends, teachers and any normal people to learn the sign language in order to communicate with deaf person in the family, community or even in the class room.

(a) (b) (c) (d)

Fig.2. displays screenshots of the learning option and converting text option. (a) Choose the group (b) Learn a static sign language for every element of the group (c) Learn detailed sequence of how to move the hands and the facial expression to show signal (d) Deaf person choose the sign images and the application will convert it to readable phrase.

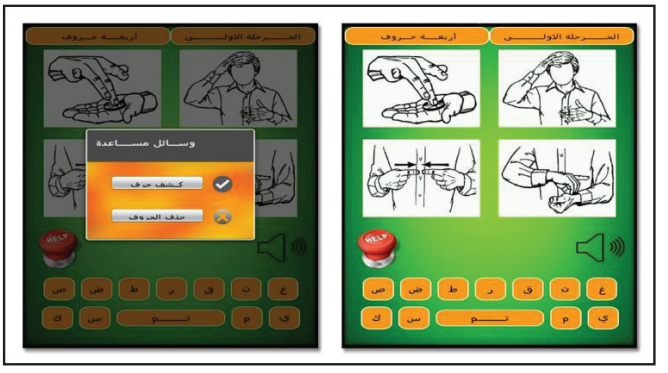

Fig.3. Screenshots of the learning game.

In developing this application, the Android SDK and native development kit (NDK) were used. Android applications are primarily divided into two sections; Java source code and XML layout. The source code is structured via the Java package hierarchy and the XML layout. The XML value files that make up the bulk of the non-code assets the application flow chart is simple and does not have many decision nodes, which makes the application fast and responsive.

3. Results and Discussion

The proposed technology was tested using three different ways. First test was performed inside SDK to check the functionality. The second test was achieved by launching the application on different phone devices. The third test was executed by asking 10 deaf persons and 15 normal volunteers to use the application. In the first verification test, the application was simulated to test the functionality of the application. All tests were performed for code verification and library checking on the application without any errors or bugs. No false positives or negatives were recorded. The second test was performed to ensure that the application is working correctly on different screen sizes and resolutions, it was tested on various devices from different manufacturers such as: Sony Xperia Z2, Samsung Galaxy S4, Samsung Galaxy S6, and LG G2. In this test, the application worked properly on the different devices.

For the third verification test, we used usability testing that gives direct input on how real users use the system, we evaluated our application by testing it on real deaf users. 10 deaf or dumb people and 15 normal volunteers use the application for more than a month. We carefully created scenarios, or realistic situations for testing purposes. The subjects then tested if their signs are understood effectively and efficiently. The questionnaire contains five simple questions with a scale of five answers (1 = Poor, 2 = Fair, 3 = Good, 4 = Very Good, 5 = Excellent). The questions are designed to investigate if the application: is easy to use, has clear instructions, is helpful, and has short response time. The last question intended to find if the subjects are willing to use it on daily basis. Fig.4. depicts the histograms of the collected data.

The results show that about 95% of the deaf and dumb were satisfied about the easiness of using the system. Interestingly, all the deaf people who use the application found the application useful and gave it 3 to 5 points and all of them were excited about using it on daily basis. Moreover, the doctors specialized in teaching sign language have agreed that the idea of creating such application is beneficial for deaf, dumb and normal people at all levels.

4. Conclusion

In this paper, we presented a mobile application to help deaf and dumb people in their daily activities. The key feature of this application is engaging the Arabic language as a medium of communication to learn all the sign language terms. The proposed assistive application allow normal people to communicate with the targeted people without having any previous knowledge on signs language. The new application was tested on real deaf, dumb, and normal people. All the deaf and dumb found the application valuable and most of them wanted to use on regular basis.

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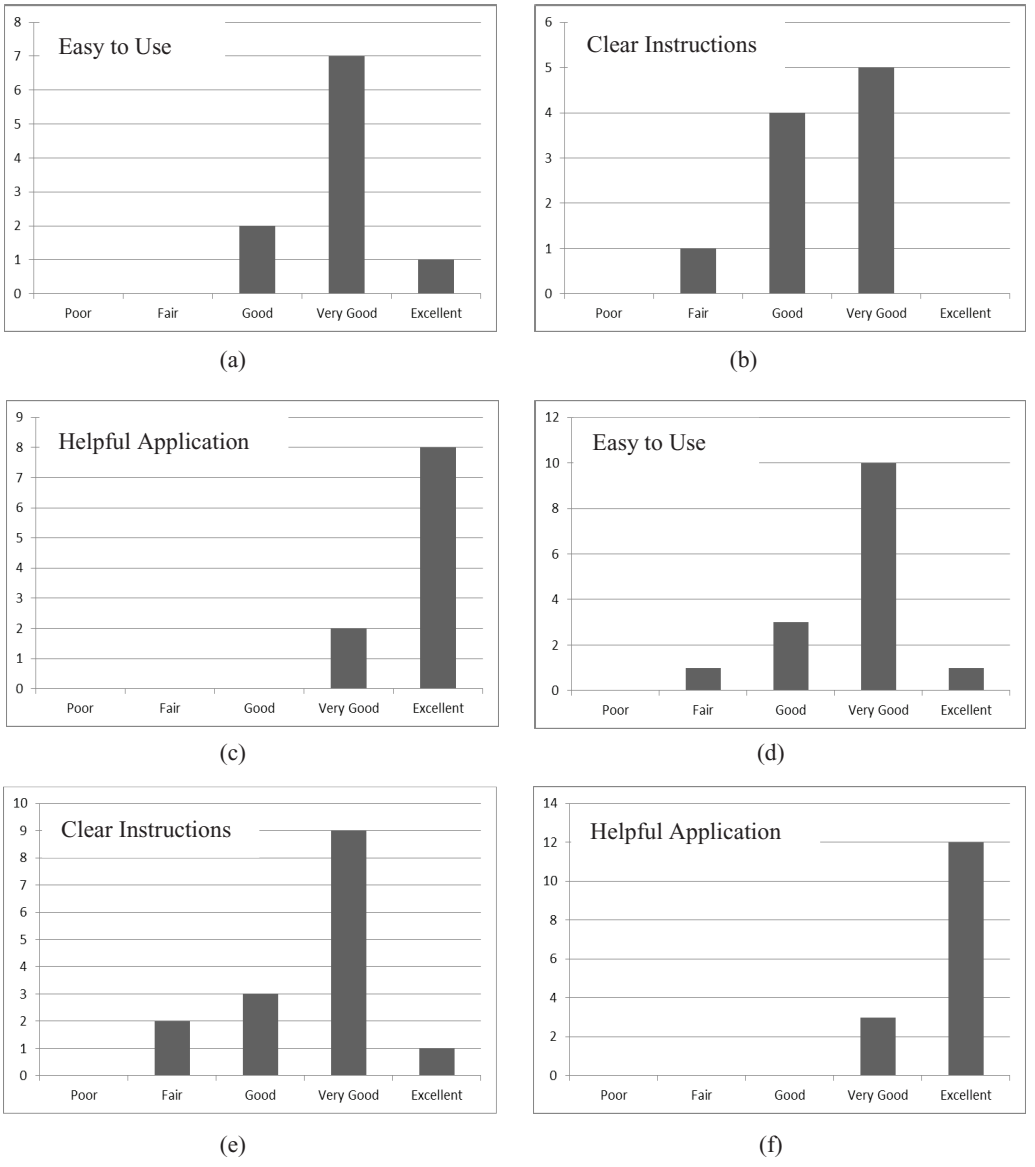

Fig.4. The histograms of the collected data. (a) Easy to use, (b) Clear instruction, (c) Helpful application collected from of the deaf and dumb people. (d) Easy to use, (e) Clear instruction, (f) Helpful application collected from normal people.

References

1. Cheadle B. Future Reflections. *The National Federation of the Blind Magazine for Parents and Teachers of Blind Children,* 1985 4(3).
2. fcc.gov. 711 for Telecommunications Relay Service. *Federal* Commu*nications Commission. Archived from* the original, Retrieved 22 February 2015.

3. Brian S. Microsoft and NBC Complete Web Divorce. *The New York Times*. Retrieved 9 October 2012.
4. Brashear H .Improving the efficacy of automated sign language practice tools. *ACM SIGACCESS Accessibility and Computing - ASSETS* no. 89, 2007, ACM New York, NY, USA.
5. Kennaway J. R., Glauert J. R. W. and Zwitserlood I .Providing signed content on the Internet by synthesized animation. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 14(3), 2007, ACM New York, NY, USA.
6. Michaud L. N. and McCoy K. F .Modeling user language proficiency in a writing tutor for deaf learners of English. *'99 Proceedings of a Symposium on Computer Mediated Language Assessment and Evaluation in Natural Language Processing, Association for Computational Linguistics Stroudsburg*, PA, USA, 1999.
7. Patil D., Jadhav A., Chavan A., and Nikam S. Android Application for Deaf People. *Imperial Journal of Interdisciplinary Research (IJIR)* 2(3), 2016.
8. Halawani S.M. and Zaitun A.B. An Avatar Based Translation System from Arabic Speech to Arabic Sign Language for Deaf People. *International Journal of Information Science and Education*. ISSN 2231-1262, 2(1) (2012) pp. 13-20.