Design and Development of an Educational Arabic Sign Language Mobile Application: Collective Impact with Tawasol

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Abstract. This paper describes Tawasol, a multimedia system offering an innovative and engaging learning experience for people with hearing impairments. Tawasol is a project developed in collaboration between a university-based research group and a charitable foundation. We describe the novel system features specific to Arabic interfaces and signing conventions. Challenges that were faced in the design and development of the software are discussed.

Keywords: Arabic sign language ArSL · Deaf · Hearing impairment · Assistive technology · Education tool

1 Introduction

The prevalence of hearing impairments and the number of deaf/hard of hearing people in the Arab world is on the rise. According to the recent statistics by the Ministry of Economy and Planning in Saudi Arabia, there are 720,000 deaf in Saudi Arabia only. At the same time, there is a considerable insufficiency in deaf education. One important deficiency here is the absence of institutions and materials for sign language education [1].

Sign language (SL) is a visual-gestural language used by deaf and hard-hearing people for communication purposes. They use three-dimensional spaces and the hand movements (and other parts of the body) to convey meanings. It has its own vocabulary and syntax entirely different from spoken languages [2].

Even before they are one year old, both deaf and hearing children are capable of creating language. Hearing children learn the spoken language of their families. They also learn from media: TV, radio, movies, and computer programs with voice. Deaf children, unless they are born to deaf parents, frequently lack role models from whom to learn sign language. This may result in delayed language acquisition [3]. For many Arabic-speaking individuals who are deaf, Arabic text is a second language.

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People who are deaf/hard of hearing benefit from sign representations associated with text. Many studies show that using videos for representing signs has an important advantage over still images since movement plays an important role in sign language. A video image more accurately represents signs thereby providing students a greater understanding of the concept and method and increases their interest in learning [4, 5].

There is no consistency in the Arabic sign language. Although, two books were published about Arabic sign language; namely *The Arabic Sign Dictionary of Gestures for Deaf* published by the Arabic League in Tunisia in 2001, and *The Arabic Dictionary of Gestures for the Deaf II* which was a result of collaboration between The Arab States League, the Arab Union for Deaf, and the Arab Organization for Culture and Sciences along with the support of the Arab deaf. In both these books, it is clearly noted that there are different signs to the same word which often causes confusion and hinders those who speak these different Arabic sign languages from communicating [6, 7].

The sign language with the most published data is American Sign Language ASL, followed by British Sign Language BSL and German Sign Language. Studies on languages such as Arabic Sign Language and Indian/Pakistani Sign Languages are just beginning to emerge [8, 9]. Arabic speaking individuals with hearing impairments also lack interactive educational programs that help them to learn Arabic sign language.

Applications for Arabic sign language are limited. For example, after searching the AppStore using the keyword "sign language" in February 17, 2015, up to 342 applications were found under different categories; education, reference, and communication, and most of them were for American Sign Language ASL, British Sign Language BSL, and Japanese Sign Language JSL. However, only three Arabic sign language apps were found; 3D Arab Alphabet Sign Language, Palestinian sign language, and our app, namely Tawasol Arabic sign language.

For example, iSign [10] is an iOS-ASL application; this app contains up to 800 animated ASL phrases, ability to search within the app, and interactive quiz. Likewise, ASL Translator [11] is an iOS/Android-BSL application; This app is a text-to-sign generator and also contains ASL phrases; 30,000 + words; 1,400 + idioms and phrases; can translate up to 50 words at a time; 110 ASL phrases; video. Also, Japanese Sign Language [12] is an iOS-JSL application; this app contains basic JSL fingerspelling with Japanese and English text and shows images of hands for each letter.

In this paper, we present a mobile application that addresses the inadequate localized technology support for people who are deaf or have hearing impairments. Tawasol was designed as an iOS/Android application offering an attractive and engaging learning experience for deaf individuals, their parents and people around them who want to learn the Arabic sign language. Tawasol's main functions include a sign dictionary, tutorial activities, and fingerspelling.

2 Collective Impact in Collaboration with the Tawasol Center

Large-scale social change requires broad cross-sector coordination; the provision of bespoke assistive technologies for under-served populations often involves designers, developers, advocates, and funding organizations. Through carefully structured

processes, several studies have reported collective impact in collaborations between non-profit charitable foundations and developers from both academia and industry [13–15]. In these collaboration models, both the organization and the process it helps facilitate, is an example of collective impact, the commitment of a group of key actors from different sectors (e.g. technology, research, healthcare providers) to a common agenda for solving a specific social problem.

In the context of assistive technologies, the Software and Knowledge Engineering Research Group at King Saud University (skerg.ksu.edu.sa) in Saudi Arabia, has been involved in collective impact initiatives. These initiative are characterized by a centralized infrastructure, a dedicated team of researchers and developers, and a structured process that leads to a common agenda, shared measurement, continuous communication between the stakeholders from non-profit organization and in healthcare delivery contexts.

The Princess Al-Anoud's charitable foundation has many projects; Tawasol Center is one that was founded in 2013. Tawasol Center is a private, non-profit organization dedicated to creating technologies and services that benefit deaf and hard of hearing individuals [16]. Tawasol Center's mission is to support and promote equal access and opportunities to education, employment and public services by individuals who are deaf or hard of hearing. In fact, many deaf and hard of hearing people face language, education, information and employment barriers and are unable to access other agencies providing essential services. Thus, Tawasol Center addresses an important need in the community.

Tawasol Center offers services addressing key issues facing the deaf and hard of hearing individuals. They provide information and referral, sign language training, free courses and community outreach. To help businesses and employers comply with the Saudi with disabilities by providing sign language interpreting and real-time captioning services. Moreover, they have Twitter account and YouTube channel in order to upload sign language videos.

3 Context-of-Use

Our research has revealed how there is a lack of educational resources that serve individuals who are deaf/hard of hearing and people around them. Furthermore, the lack of uniformity in Arabic sign language became an obstacle to the deaf community in communicating with people from other native Arabs. This has motivated us to develop an Arabic Sign Language education application to support the needs of deaf people and help them to effectively utilize their communication abilities and integrate them in society.

Tawasol was primarily designed as an educational tool. However, it can also be used in mediating communication between the user and others. Interaction with this application takes place when hearing people are trying to learn Arabic sign language or in the middle of a conversation that involves an individual with hearing impairments and another hearing individual that is not accustomed to the Arabic sign language where the application will act as a communicator.

4 System Description

Insufficient and inadequate support for Arabic-based sign language applications was the motivation for developing Tawasol in cooperation with Tawasol Center. Tawasol is an educational iPhone/iPad application that is developed in the area of assistive and educational technology to support adults with hearing impairments. The key contribution of this application is providing an Arabic sign language educational resource for Arabic-speaking populations, which is not available in the market today. Unlike the majority of available sign language systems, Tawasol supports other novel features. We use the Tawasol center's created Saudi sign language videos to build a mobile application. Tawasol app contains a dictionary, tutorial, and fingerspelling editor.

Dictionary. Consists of different categories representing Arabic words as shown in Fig. 1(a). Each category contains a number of words; when a word is selected, a corresponding video clip of the selected word sign appears with its pronunciation as shown in Fig. 1(b). Dictionary features: Search function that lets users look up a specific word, Repeat; Determine number of repeating the sign, Sound control; Determine with/without pronunciation, and Favorites allow the user to add favorites words on the (My words) list.

Tutorial. As a quiz; a player matches a presented sign language video to the correct word from a list of different words as shown in Fig. 2. The user has the ability to customize the quiz by selecting various difficulty levels; number of presented word options 2, 3 or 4.

Fingerspelling. The App will take a phrase entered by the user and then display the Sign Language symbol for each letter in the phrase as illustrated in Fig. 3.

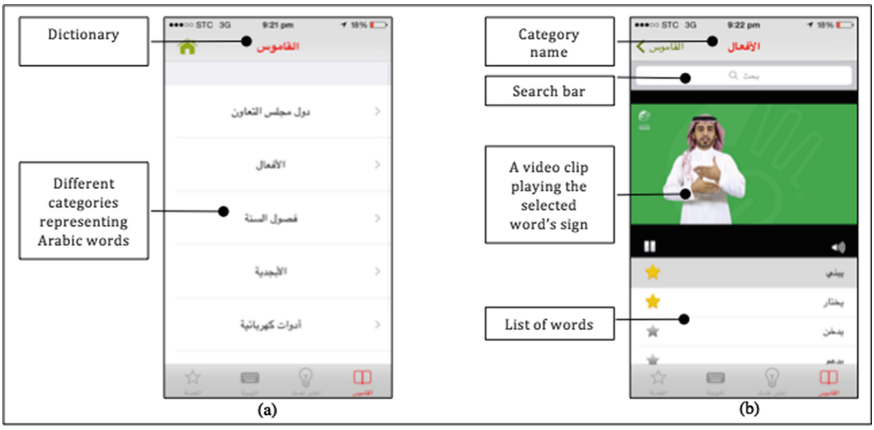

Fig. 1. (a) Category (b) Dictionary

Fig. 2. The tutorial interface

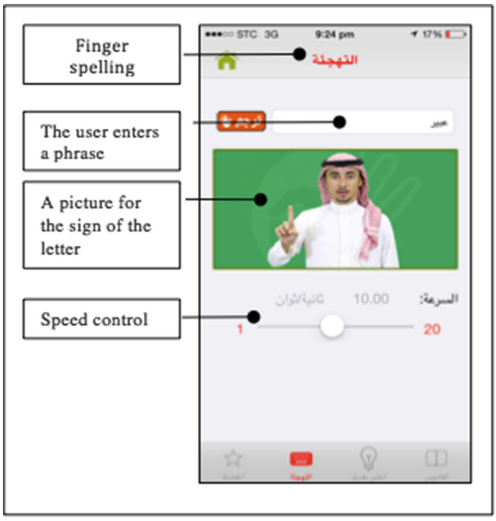

Fig. 3. The interface for fingerspelling

5 Design Considerations

As prior research has indicated (e.g. [17, 18]), portable electronic devices, in this case, tablets and smart phones are more engaging in learning contexts than printed material. In addition to that, their portability allows them to be used at anytime and anywhere.

The design approach followed the User-Centered Design framework [19]. Iterative cycles of review were conducted including low-fidelity prototypes as shown in

Fig. 4, and involving stakeholders as design collaborators to review mockups. This paper considers the design of the iOS version of the application. A similar approach was followed in the design of the Android version.

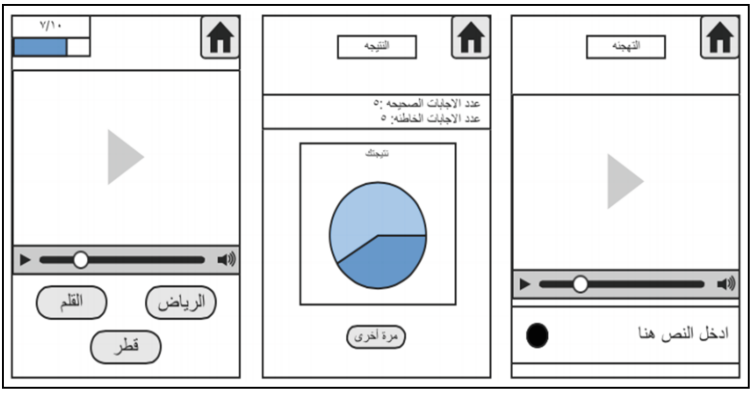

Fig. 4. Low-fidelity prototypes

The interfaces were designed to adhere to accessibility and usability guidelines, in addition to Apple's Human Interface Guidelines [19]. Multi-media editing was conducted from the software development side to ensure consistency and quality. The media used in both these applications were.png images and.mp4 videos of Arabic sign language letters and words. These recourses will be stored on a web server linked to a webpage/client to allow for easy and convenient updating and addition of recourses. Furthermore, the below features were considered to ensure that the signs' videos have the advantages of the video-based system over the text\image-based system:

- The videos used were up-to-date, high quality and recently created in late 2014.
- The background of these videos are simple, and with a unified theme.
- To ensure consistency that consequently supports learnability, the speed of all the sign videos is the same.
- An interpreter that was young, no-glasses, and was wearing the Saudi custom clothing (thobe), was chosen to represent the sign language videos to ensure clear presentation of facial expressions as shown in Fig. 5.

Fig. 5. Interpreter

6 Conclusion

In this paper we presented the Tawasol App [20] as an example of collective impact projects conducted in the context of research collaboration between non-profit organizations and academia. Tawasol aims to help people of the deaf group who need to communicate with others. Communication applications such as Tawasol would help to build and exchange knowledge and establish bases of mutual understanding for the individual with the community.

The design and development of such assistive technologies provide evidence to suggest that large-scale social change can stem better from cross-sector coordination between research and academia rather than from the isolated intervention of individual organizations. Evidence of the effectiveness of this approach is still emerging in our local context, but these examples suggest that considerable progress could be made in alleviating many of the serious and complex social and technological challenges if nonprofits and academia were brought together around a common agenda for developing effective technological solutions to create collective impact.

For future work, further improvements to the application will be carried on, more functions will be added, and new words and categories to the dictionary such as (Human Body, Science and Weather, Plants, School, Health and Safety, and Sports). In addition, user acceptance testing sessions will be conducted on the targeted population with focus on assessing the engagement of their learning experience.

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