Development of a Web-based Unified Arabic/American Sign Language Bilingual Dictionary

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ABSTRACT

A sign language dictionary allows the hearing impaired and deaf individuals to expand their abilities to communicate with other people by learning their respective sign language. In this paper, a web-based bilingual and bidirectional sign language dictionary is described that will allow the hearing impaired and deaf individuals to learn another target sign language without the need to learn the target mother or spoken language. The developed dictionary system provides a highly accessible visual interface to allow users to translate from the Unified Arabic Sign language (UASL) to the American Sign Language (ASL) and vice versa. The developed dictionary system as an assistive technology can contribute to social inclusion and the development of humans and societies for better future and opportunities. This dictionary can easily be integrated with a new sign language and extended to become a trilingual dictionary.

Keywords: Unified Arabic sign language; American sign language; dictionary; Bilingual dictionary; Deaf student;

Introduction and Background

Today's emerging information and communication technologies (ICT) have contributed considerably in advancing humanity in many fields such as education and human communication. Using these technologies, individuals with hearing impairment and deafness can benefit and learn a foreign language using sign language dictionary systems. Moreover, an easy access to the dictionary can increase their learning process and allow them to communicate whenever they need to help them improve their life styles and their contributions to their societies. Most of the currently available dictionary systems are either monolingual or bilingual systems targeting different sign languages with no Arabic adaptation. However, design and development of a dictionary that contains both the Unified Arabic sign language (UASL) and the American Sign Language (ASL) are important to educate the deaf and to provide researchers and professionals an easily accessible tool. Such a system will be the first online bilingual web-based dictionary developed in the Arab region targeting both the American and Unified Arabic Sign Language. Cross-referencing UASL and ASL phrases is unique and important to the deaf community. The dictionary will help both users of ASL and UASL to learn a foreign language and to cross communicate. This system allows the deaf individual to learn a targeted language without learning the mother tongue of that language as an intermediary language. Deaf individuals can benefit using the dictionary by extending their signs and/or adopt a new foreign language. This will help them use either sign language, Arabic, or

American to communicate and maximize their involvement in the society and with other cultures. Teachers can use it in schools for the deaf in teaching the sign language, understanding more about both sign languages, and for use in other educational purposes. Professionals can use it as a tool in their research activities relevant to people with special needs, specifically in the deafness-related fields.

A sign language is defined as the use of hand movements and gestures to visually express individual needs and as the means of communication between individuals. The sign language is commonly used by people, especially the deaf or with hearing impairment (Stokoe, 1978). The ASL in this dictionary was selected for many reasons. ASL is commonly used in the United States and in some other countries (Gardner & Gardner, 1969) (Starner, Weaver, & Pentland, 1998). ASL is recognized as a stand-alone language that can be acquired and used by any person (Liddell, 2003) (Suzuki, Horikoshi, & Kakihana, 2004). Also, many studies agreed that ASL is ranked high in usage in the United States (US) in comparison to other languages available in the US (Mitchell, Young, Bachleda, & Karchmer, 2006). Moreover, many of the bilingual dictionary systems use ASL along with their sign language such as ASL and Japanese Sign Language (JSL) (Suzuki & Kakihana, 2002), ASL and Spanish (Call, 2006).

Various sign language dictionary systems were introduced in many countries. The interesting ones are listed here. (Suzuki et al., 2004) described a bilingual sign language dictionary for both JSL and ASL allowing a user to directly learn a new sign language from their mother sign language without having to learn the new spoken language first. (Suzuki & Kakihana, 2002) described a Japanese and ASL dictionary system for Japanese and English users. The system allows a hearing impaired user to enter either a Japanese or an English word and get the corresponding Japanese and American sign languages. The system also includes a courseware to be used by volunteers and deaf children to learn sign languages. (Almohimeed, Wald, & Damper, 2011) and (El, El, & El Atawy, 2014) described a translation system that allows the deaf to access information published in Arabic by translating it into the Arabic sign language. (Mascio, Gennari, Melonio, & Vittorini, 2013) provided some desirable guidelines from the design of games for deaf children. (Gennari & Mich, 2008) outlined an intelligent user interface and the criteria used to assess it. (Di Mascio & Gennari, 2008) described an intelligent visual bidirectional dictionary for Italian sign language and Italian language. (Dasgupta & Basu, 2008) presented a unidirectional English language to Indian sign language. The Indian sign language generated are pre-recorded video streams. (D'Haro et al., 2008) outlined a Spanish speech to Spanish sign language translation system. (Dangsaart, Naruedomkul, Cercone, & Sirinaovakul, 2008) discussed an intelligent Thai language text into Thai sign language translation system allowing the hearing impaired and the deaf to enhance their communication and learning abilities. (Tokuda & Okumura, 1998) introduced a system translating Japanese into JSL. In this system, if the original input word could not be translated, the word is substituted by a similar word from the Japanese dictionary. (Almasoud & Al-Khalifa, 2011) described a system of translating Arabic text to Arabic sign language.

The available work on bilingual dictionaries has been assisting certain deaf communities; however, there is a lack of Arabic adaptation, and not much is available on the subject at the time of the present study. A sign language is not universal, and there are hundreds of different

sign languages in the world and sometimes in the same country as in Japan (WFD, 2013). As an example, in the Arabian Gulf countries and due to cultural similarities, signed languages are similar, but not identical (Abdel-Fattah, 2005). During regional conferences, each country ends up needing several translators who have their own sign languages. As a result, a need has arisen for a UASL. The Council of Arab Ministers of Social Affairs, a committee within League of Arab States, in cooperation with field experts had developed a UASL. However, some deaf individuals from the old generation still prefer to use their local sign languages; thus, they reject the UASL. Albeit, specialized schools for the deaf have started to teach UASL as the only sign language in the schools. This would indicate that the UASL will be a dominant sign language in the region in the near future, once used by the younger generations.

Unifying Arabic sign language workshops was started in 1999 in the United Arab Emirates, Dubai with the participation of 16 countries and involving of deaf clubs and communities, resulting in the introduction of 400 unified sign phrases. In 2000, deaf experts, signers, and League of Arab States conducted a workshop in Syria resulting in additional 1500 phrases of UASL. An extension workshop, conducted in Qatar toward unifying the Arabic sign language in 2005, also resulted in the addition of 1500 UASL phrases. The Council of Arab Ministers of Social Affairs has encouraged all the Arab states to use the UASL to fully integrate the deaf into the society (UN, 2004). Consequently, the UASL is supported by many forum recommendations to be used officially in their respective ministries of education, UASL training courses are conducted to educate sign language teachers, and UASL is used in many broadcast TV channels. Thus, the recognition accorded to the UASL and the existing popularity of the ASL represent a good potential combination for a bilingual dictionary. The Kuwait Institute for Scientific Research (KISR) has previously developed state-of-art computer-based monolingual sign language dictionaries, such as the Kuwait sign language dictionary, the Unified Arabic sign language dictionary, the preschool sign language dictionary and the Scout sign language dictionary. These dictionaries have been very useful for both deaf individuals and professionals in schools in many countries in the Arab region. Also, KISR had developed a web-based application that provides all these developed dictionaries online. Most of the available literature on the UASL are either developing monolingual dictionaries or providing a comparison between UASL and other local sign languages. The new online bilingual UASL/ASL dictionary will be a new essential educational tool. The design and development of an online web-based UASL/ASL dictionary with more than 2400 signs for both targeted languages will have a tangible impact. Moreover, this web application is highly accessible and support different devices that are easily reachable by all users.

This paper emphasizes the importance of having a UASL and an ASL web based dictionary. Section two provides an overall system description and the guiding principles used in the development of the bilingual dictionary, and the technologies used are presented. Section three discusses the developed dictionary interface. Section four provides an assessment and evaluation of the developed system. Section five states the results and analysis of data collected. Section six presents the discussion part of current results. Finally, the last section provides the conclusion and discusses future work.

System Description

This developed application allows both American and Arab deaf individuals to learn a targeted sign language starting from their mother tongue without learning the targeted spoken mother language. Moreover, individuals who prefer to learn both targeted mother language and sign language, can choose the keyword of their mother language to trigger both ASL and UASL to appear along with keyword from the targeted language. Usability and accessibility of the application are two important quality requirements for the deployment of a successful application to be used by the deaf. Guidelines for designing usable digital applications were consulted when developing our web-based dictionary application (Mascio et al., 2013).

This web-based application is developed to map bilingual (Unified Arabic and American) sign language dictionaries by cross-referencing similar phrases in both dictionaries as depicted in Figure 1. A database stores UASL and ASL phrases and relates them to each other. In this online dictionary, the ASL was chosen despite the existence of an International Sign Language (ISL), since the ISL has a limited vocabulary and embodies a degree of complexity, thereby limiting its usability (Mesch, 2010). Research around the world has shown that the most nominated foreign language to use is the ASL. This is because the number of signers of ASL is high, and due to the availability of other ASL bilingual dictionaries which makes the future integration into trilingual dictionaries easier. Moreover, ASL is now recognized in many universities as a foreign language. By using this dictionary system deaf users will easily extend their knowledge in other sign languages (Suzuki & Kakihana, 2002).
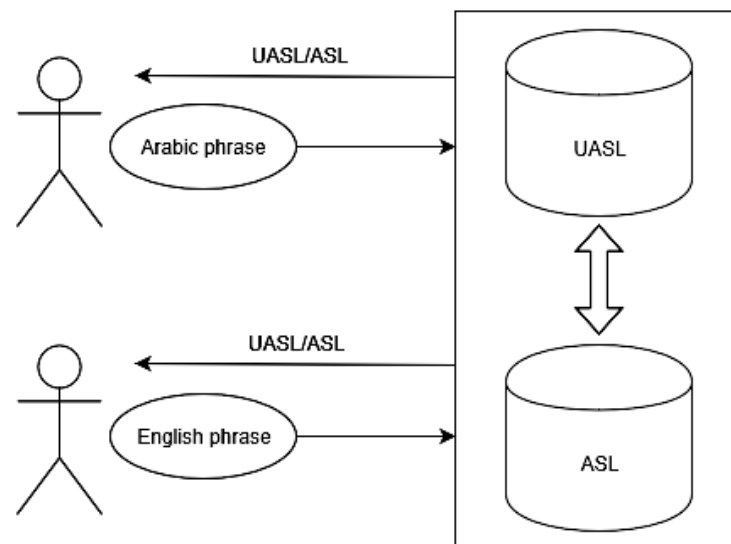
Figure 1. UASL and ASL cross referencing based on phrase key word

The implemented solution provides an easy access to the sign language content using an online web page. A graphical user interface (GUI) is adopted to accommodate both languages in terms of screen-space utilization and interface language. Moreover, since we know that deaf individuals have limited education all around the world especially in terms of their reading skills, a picture representing each phrase will be added. In addition, some of the GUI components are supported with explanatory pictures.

The looked after content can be found easily. The phrases will be displayed alphabetically in categories. In addition, a search function is added to search the list of phrases for a desired term. Due to low reading skills of deaf individuals, a finger spelling might be integrated in the search mechanism. An application programming interface (API) was developed to allow for an easy integration with a third language in the future.

3. Dictionary Interface

The developed dictionary is a useful learning tool that will benefit UASL and ASL users such as teachers, professionals, researchers and of course deaf students. An inquiry on Arabic or American key word yields both correspondence sign language video from the database. Both users can acquire more information if needed as the American and Arabic key words will show up at the bottom of each sign language video.

The main web application screen was designed to include both Arabic and English controllers, which would allow ASL and USAL users to interact with one-page view for getting information fast. The users can easily open and choose from the category list, and select the key word from the table to show the needed sign video. ASL and USAL videos provided with video controllers would allow users to stop, play, and navigate within the video. As shown in Figure 2 from the category list, the "Colors" category is selected which shows all corresponding key words in the "ASL" table. On the other hand, this action will also show the corresponding ASL key words on the "UASL" table and the UASL category "الألوان". Selecting a phrase from the ASL table will automatically highlight the corresponding UASL phrase and will show both UASL and ASL phrases videos.

Figure 2. Main Bilingual Dictionary web application

The content of ASL and UASL was provided by an expert in sign languages. Phrases from both languages are matched and entered into the database. In this dictionary, 1400 of the pre-collected Arabic signs were translated into their respective American signs. Additional 1400 phrases were filmed into suitable video format and were added to the previous 1400 signs, since the Arabic unified dictionary was extended, and these phrases were added. Arabic unified sign language dictionary is limited to 2800 phrases; hence, some of the American signs may have no respective phrases in the Arabic signs. In this case, sign language interpreter was consulted to fill in the corresponding ASL phrases. As per previously developed sign language dictionaries, each phrase is represented by a representative video of the sign, a demonstration image, and a finger spelling is used to represent the selected phrase. Users can test their progress by going through quizzes on the learned signs.

Figure 3 shows a video of a sign with controllers to allow control and playback of the video content. An expert in ASL was consulted to film the sign language videos and to put in place the list of phrases and categories in the ASL dictionary. Once the American phrases were collected, the matching Arabic phrases were checked. A list of all collected phrases was created with the relevant cross-referencing, and the phrases were arranged in categories and alphabetic forms.

Figure 3. Video of a sign incorporated with video controllers.

Sign phrases are important as they are the main elements of this dictionary. Sign video size and quality were optimized to deliver a convenient context to the users as shown in Figure 4. The sign language was filmed with a frame of width and height of 1920 x 1080. Videos were encoded using the H.264 video format which is supported by different browsers.
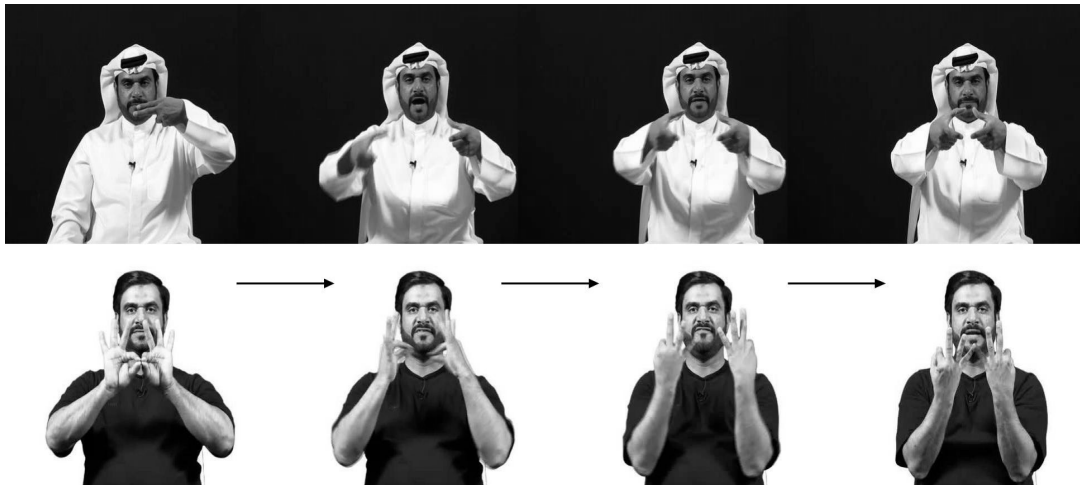
Figure 4. Image sequence of "Family" sing context, using UASL and ASL respectively.

The design of the dictionary web application incorporated a GUI that can be used by both Arabic or English users. The GUI space utilization, as well as the clarity were highly considered in the design, because one web view includes both languages, and both users can easily navigate through phrases. The phrases are displayed in a list stored alphabetically or by category. GUI components are supported by explanatory pictures for deaf users with low reading capabilities. The infrastructure consists of scalable storage space to host future videos of sign language phrases. The web application design specification allows the administrator for a full access permission and manipulation rights, such as the ability to add, edit, and remove sign language phrases, categorize sign language phrases, add, edit, and remove categories. Users on the other hand, are permitted rights using the application by viewing sign language phrases alphabetically, and in searching for phrases across dictionary databases in English or Arabic language, using the main web search field.

The application was developed, tested, and uploaded to the production server. To reach a high number of beneficiaries, the website was promoted via web advertisements, social networks, personal connections, and conferences. As more visitors use the website, further analysis will be conducted to gauge browsing patterns and overall satisfaction with the website. A feature-rich application is useless if users have a hard time interacting with it. Therefore, it is crucial to test the usability of the application and to adjust the user interface according to results from usability studies and integrate best user experiences in future releases. Sign language dictionaries are often primarily intended to be used by users who can hear but people who have deaf relative or friend. The bilingual application, however, must be usable by deaf people as well since they will be interested in looking up phrases in foreign sign languages. The usability and user experience studies discussed in the next section consider both hearing and deaf users.

Methods

Two types of assessment and validation techniques were developed and conducted for the online bilingual sign language dictionary system, namely, an online questionnaire and ethnographical observations. A questionnaire was answered by the first group of 17 adults' who voluntarily

participated, including researchers, teachers, and professionals. The group consisted of 10 males and 7 females ranging in ages from 23 to 55 years old. Participants of the first group in the selection process met the criteria as follows: (a) have sign language background, (b) interested to participate in the study, (c) are a computer literate and skilled in   modern technology (mobile, etc.). The online questionnaire URL were distributed to the participants by email, including brief instructions about the study and were told that comments or suggestions may be included in filling out the questionnaire.

The second group included volunteers of 15 deaf students, recruited from both Deaf Schools and Kuwait Deaf Sport Club. They consisted of 15 males with ages ranging from 10 to 14 years old. Selection criteria were based on the following: - (a) having potential of learning foreign language such as ASL, (b) having almost the same level of knowledge of the Arabic sign language, (c) had previous experience of computer-based tools and/or mobile technology, (d) showed commitment to a study session to be able to experience the new web-app tool for approximately 15 min.

The approval was obtained from administration of both deaf school and deaf club. The teacher from the deaf school has been delegated to facilitate the study individuals' recruitment and to provide sign interpretation while collecting feedbacks and comments from deaf candidates. The same teacher helped in facilitating communication with the deaf members of the deaf club. Observation sessions also took in the school lab. A laptop was connected to 4G LTE and all common browsers were installed to allow access to the online bilingual sign language dictionary.

General instructions including URL were given to deaf participants. Each person was asked to access URL of the Online Bilingual Sign language dictionary from the laptop provided, using his preferable browser. Instructions and task were presented to the students with the help from a sign language interpreter. The ethnographical observation sessions were conducted to deaf students one after another in sequence each for 15 min, with follows up of 5 min. of interview session. After the end of the session, they were asked to answer a questionnaire.

The first group was tested on both the Arabic and English parts of the online dictionary; whereas, the second group was tested only on the Arabic part. The English language acquisition of deaf students showed to differ, although their ages are similar. Thus, for consistency of results, they were advised to start using only the Arabic part. The ethnographical observation technique was used to observe the second group of users while interacting with the system. In addition, the participants from the second group were informally interviewed to obtain information regarding their retention of the learned signs and to get information on what they like to see more in the system. The online questionnaires used for the first and second group are shown in Appendices 1 and 2, respectively. Summaries of the answers to the online questionnaires are provided in both Table 1 and Table 2.

Table 1. Summary of the answers to the online questionnaire to researchers, teachers, and professionals.

Q2: Will you use the dictionary again?	14 Y 3 N
Q3: Will you recommend others to use the dictionary?	14 Y 2 N 1 Missing
Q4: Have you ever learned a foreign language using a computer?	7 Y 10 N
Q8: Have you met any problems in the video presentation of the sign?	10 Non 5 Sometimes 2 Always
Q9: How fast was the download and appearance of the video?	9 Fast 6 Medium 1 Slow
Q10: Did you need to seek extra help when you used the dictionary?	3 Y 14 N
Q1: How was your experience with the dictionary?	9 Excellent; 4 Very good; 1 Good; 0 Acceptable; 1 Not acceptable
Q5: Was the dictionary easy to use?	8 Very easy; 7 Easy; 1 Average; 1 Difficult 0 Very difficult
Q6: Did the video for a sign help to explain the sign clearly?	14 Excellent; 4 Very good; 0 Good; 0 Acceptable 1 Not acceptable
Q7: How easy was to access the sign and displaying it?	9 Very easy; 3 Easy; 2 Average; 2 Difficult; 1 Very difficult

Table 2. Summary of the answers to the online questionnaire to deaf students.

Q1: Do you know what is the purpose of this web application?	14 Y 0 N 1 Not sure
Q2: Was it useful to you? Would you like to use it again?	15 Y 0 N
Q3: Would you like to use it when you travel?	15 Y 0 N
Q4: Did you face any problems when using this web application?	0 Y 13 N 2 Little
Q5: Did you need help to use this web application?	2 Y 13 N
Q6: Were the videos clear?	15 Y 0 N
Q7: Did you need to seek extra help when you used the dictionary?	0 Y 15 N

The questionnaire included questions related to both the usability and user experience aspects and the technical aspects and qualities of the system. The aspects included were as follows:

- Accessibility and portability – the system was accessible from different platforms and web browsers and from different remote locations.

- Availability – the system was available anytime the user would want to use it and obtain results.

- Appeal – the system was appealing and attractive to use and enjoyable.

- Completeness – the user found answers to all of their queries.

- Clarity and correctness – the answers to the user queries were all correct and clear, and the user did not need to seek additional help from other sources.

- Performance – the system provided an answer to every user's query in a reasonably acceptable time, regardless of the location and time of access.

Results

As shown in the summary in Table 1, most of the 17 teachers, professionals, and researchers rated the online dictionary very highly, and indicated that they had an excellent experience. Also, they showed that the web-app is easy to use and useful, and they also provided recommendation as follows: 1) the videos should be downloaded faster without sacrificing their quality, 2) quiz section be added to all the system in order to check the knowledge and retention of the learned signs, 3) contextual online hints on the use of the system be provided, 4) expanded information on the definition and examples of use of the sign to be used by the learner at home be provided, and 5) some enhancements be done related to the clarity of the presentation and interface.

Similarly, according to the summary shown in Table 2, the 15 deaf students rated the dictionary very highly. Only a couple of them had difficulties in using it. Also, they all agreed that video contents are clear and have helped them to learn easily. After the experimenting session with the web-app, they were asked during the interview if they can retain any sign and its correspondent translation from the web application. We found that 40% of the deaf students have successfully memorized two signs or more and 60% retained at least one sign. The retention rate of the learned signs was high and indicated that they have been acquainted with the web-app and had a successful experience. They recommended 1) the use of larger fonts on the screen, 2) larger display of videos, 3) more help and hints on the use of the learned sign, 4) inclusion of a video or animation to explain how to use the dictionary for the first time they access the web-app, 5) more guidance on the next steps to perform while using the dictionary, and 6) provision of an App version for phones and other handheld devices.

We believe that incorporating most of the remarks and requirements of the intended users as collected from the questionnaires, interviews, and observations, will definitely enhance the usability and user experiences of the online bilingual dictionary system.

Inferential analysis for bilingual sign language dictionary was performed by cross tabulation of two relevant questions from the questionnaire (refer to Table 3 and Table 4). To prove the usability, two questions were selected "was the dictionary easy to use?" (Q5) and "Did you need to seek extra help when you used the dictionary?" (Q10). From a total of 17 individuals in the first group, 8 persons agreed that the web-app is very easy, and they did not need additional help when they used it, except for one person who requested help. Furthermore, another 7 respondents indicated that the web-app is also easy, they approved that they do not require help while using it, except for one participant. Moreover, only one user rated that web-app is acceptable and did not request any help.

From a total of 15 deaf individuals in the cross tab "Did you need help to use this web application?" (Q5) and "was it useful to you? Would you like to use it again?" (Q2). Thirteen deaf users stated that web-app is useful and like to use it again; they found it easy, and they do not need to request any help while using it. Furthermore, only two of users stated they needed help and found it useful and like to use it again. Based on the aforesaid interpretation, both groups have experienced the dictionary system and, they consider it easy and valuable.

Table 3. Cross tabulation analysis of first group (Teachers, Professionals, and Researchers).

	Q10: Did you need to seek extra help when you used the dictionary?	Yes	No	Grand Total
Q5: Was the dictionary easy to use?	Very easy	1	7	8
	Easy	1	6	7
	Average	1	0	1
	Difficult	0	1	1
	Very difficult	0	0	0
	Grand Total	3	14	17

Table 4. Cross tabulation analysis of second group (deaf students).

	Q2: Was it useful to you? Would you like to use it again?		
		Yes	No	Grand Total
Q5: Did you need help to use this web application?	Yes	2	0	2
	No	13	0	13
	Grand Total	15	0	15

Discussion

Similar translation systems/tools have provided varied functionalities in the same website, which might increase the complexity and make the website ineffective. In this bilingual dictionary, we focused on cross-referencing sign language translation, and this helped to form a bilingual sign language dictionary, thereby achieving our main target, allowing visitors to reach their goal. Moreover, in comparing the current dictionary system with that previously developed by KISR, i.e., the preschool sign language dictionary is an offline dictionary that needs to be installed in the personal computer and in a certain operating system to make it handy, accessible, and usable.

The home page of the web-app is very important in getting users' impressions and keep them use it. Handspeak (Lapiak, 2016) is an ASL online sign language dictionary with lots of sign language resources and different navigation features in the main page. UASL/ASL dictionary home page on the other hand, focuses on the main idea of cross-referencing both sign language

and in attracting user's attention on what they are looking for without the need to navigate further. Moreover, the NZSL online ("The Online Dictionary of New Zealand", 2016) has excellent multimedia content and advanced ways of phrase searching; The Spreadthesign ("Sign language dictionary - SPREADTHESIGN", 2016) has good content of multi sign languages and different ways of phrase searching. However, both websites are not mobile friendly. Because of the current mobile devices with different screen sizes, it is important to comply with them all and view the web-app content clearly to the users. The developed UASL/ASL system interface has been designed to be accessible for different devices and support different screen sizes. Sign video, integrated with spoken phrase, gives better experience for hearing users and match their expectations, while many sign language web-apps have neglected this feature. Some of online dictionaries provide additional control over video content, such as slowing or speeding up the video play. This feature helps and supports users' visual perceptions toward the context of the sign language video. It is recommended that such feature be considered in the future updates of the UASL/ASL sign language dictionary.

The classification of the phrases has allowed visitors to locate the phrase and reach their goals in a timely manner. Distribution of information on screen is comfortable to most users. In their evaluation of application, they said they like the colors used in the graphics user interface - GUI. The UASL/ASL video signs in the same web page view provided an enjoyable experience to the users. Result is consistent and clear when selecting from the UASL or ASL category.

As a learning outcome, deaf users will be able to advance their knowledge toward a more effective communication and social interaction in the society. Deaf families will be better educated by using an online dictionary they can refer to it whenever they need. Since the dictionary is easy to use, deaf users will get motivated to learn a foreign language. It can also help them adapt to different cultures and behavior. Family with a deaf member will perform better in searching for phrases and thus communicate efficiently. All these outcomes could help with the inclusion of the deaf in the society. The second group indicated that the dictionary is easy to use; content is good; and content retrieval is fine. These factors are very important as they can help teachers use the web-app in the classroom without sacrificing class time. Teachers and professionals are able to have the online dictionary as a reference for UASL and ASL. Professionals and researchers can know more about both UASL/ASL sign languages based on the intended context which can help in advancing and supporting the future of both languages.

This study was focused on the development of the bilingual sign dictionary. A good user experience is important in contributing to an increase rate of web app acceptance and usage; it also facilitates learning process and reaching users goal. The user's easy interaction in searching and finding the required information will positively affect their perception. Moreover, getting the acceptable and attractive video content will help and motivate them to learn. The learning outcome measured during the interview was intended to check on the student's perception and their qualitative experience. In addition, an accessible and mobile friendly web-based could allow users to access the web-app anytime anywhere; this will encourage users to learn and increase their learning outcomes. The web-app has high quality design, and this helps attract individuals. Furthermore, based on the questionnaire, the content of the sign video is clear and is able to answer

users' queries. Moreover, the users agreed that they got responses fast. UASL/ASL video context contains cultural touches as the sign interpreter wears the formal cultural clothes in UASL videos, while ASL interpreters are shown wearing t-shirts.

Conclusion and Future Work

A sign to sign language dictionary offers great value to the hearing impaired and deaf communities in the Arab region, the US, and other countries. Without such a dictionary, in order to learn a foreign sign language, a deaf person has to learn four different languages to reach that goal, i.e., learn the spoken mother language, the mother sign language, the targeted spoken language, and the targeted sign language. Providing multilingual sign language dictionaries reduces the learning process into only two languages, i.e., mother sign language and targeted sign language. This will result in saving time and effort needed by deaf users. An Arabic deaf individual needs to learn other sign languages to improve their communication skills and knowledge. Introducing a usable bilingual sign language dictionary will speed up the learning process and open new era of cooperation with foreign individuals which will have a great impact on their social lives and careers. Developing a bilingual sign language dictionary will provide deaf individuals with an efficient tool to assist them in learning a foreign sign language without the need to learn the corresponding spoken language. In addition, this bilingual web application dictionary can be highly useful to researchers to carry out sign comparison among different languages. Providing this free-of-charge web application will have a positive impact on deaf individuals in the Gulf Cooperation Council (GCC) and the Arab region, as well as for ASL users and ASL communities.

User assessment and experimentation were conducted to measure the users' achievements and performance in knowledge acquisition when using the developed bilingual dictionary. Teachers, professionals, researchers, and deaf students have participated in online questionnaires, observations, and interviews. We have developed our questionnaires around assessment criteria similar to the ones introduced by Gennari and Mich (2008), including accessibility and portability,

availability, appeal, completeness, clarity, correctness, and performance. The results showed that the users are highly satisfied, and they want to use such tool. Future plans are envisioned to include more ASL and UASL videos into the dictionary and to cover more categories. A modified version of the dictionary system is being developed to consider most of the constructive comments and feedback obtained from the intended users. Furthermore, a future plan is to consider the newly born deaf individuals to allow them access to the bilingual sign language acquisition process and help them achieve better results in their language development process. Also, it is intended to consider a third sign language by integrating it in the application infrastructure to be implemented in the upcoming versions. Similar trilingual systems were introduced and described in Call (2006) for ASL, Spanish, and English, and in Suzuki et.al., (2006) for ASL, Japanese sign language (JSL), and Korean sign language (KSL).

References

Abdel-Fattah, M. A. 2005. Arabic sign language: A perspective. Journal of Deaf Studies and Deaf Education, 212 -221.

Almasoud, A. M., & Al-Khalifa, H. S. 2011. A proposed semantic machine translation system for translating arabic text to arabic sign language. Paper presented at the Proceedings of the Second Kuwait Conference on e-Services and e-Systems, 23.

Almohimeed, A., Wald, M., & Damper, R. 2011. Arabic text to arabic sign language translation system for the deaf and hearing-impaired community. Paper presented at the Proceedings of the Second Workshop on Speech and Language Processing for Assistive Technologies, 101 -109.

Call, M. 2006. ASL/Spanish/English trilingualism of Hispanic/Latino deaf children in the united states. Retrieved March, 21, 2012.

D'Haro, L. F., San-Segundo, R., Cordoba, R., Bungeroth, J., Stein, D., & Ney, H. 2008. Language model adaptation for a speech to sign language translation system using web frequencies and a map framework. Paper presented at the Proceedings of the 10th International Conference on Spoken Language Processing (ICSLP-Interspeech), 2199- 2202.

Dangsaart, S., Naruedomkul, K., Cercone, N., & Sirinaovakul, B. 2008. Intelligent thai text–Thai sign translation for language learning. Computers & Education, 51(3), 1125 -1141.

Dasgupta, T., & Basu, A. 2008. Prototype machine translation system from text-to-indian sign language. Paper presented at the Proceedings of the 13th International Conference on Intelligent User Interfaces, 313 -316.

Di Mascio, T., & Gennari, R. 2008. An intelligent visual dictionary for italian sign language. J.Web Eng., 7(4), 318- 338.

El, A., El, M., & El Atawy, S. 2014. Intelligent arabic text to arabic sign language translation for easy deaf communication. International Journal of Computer Applications, 92(8).

Gardner, R. A., & Gardner, B. T. 1969. Teaching sign language to a chimpanzee. Science (New York, N.Y.), 165(3894), 664 -672.

Gennari, R., & Mich, O. 2008. Designing and assessing an intelligent e-tool for deaf children. Paper presented at the Proceedings of the 13th International Conference on Intelligent User Interfaces, Spain. 325 -328.

Liddell, S. K. 2003. Grammar, gesture, and meaning in american sign language Cambridge University Press.

Mascio, T. D., Gennari, R., Melonio, A., & Vittorini, P. 2013. Designing games for deaf children: First guidelines. International Journal of Technology Enhanced Learning, 5(3 -4), 223- 239.

Mesch, J. 2010. Perspectives on the concept and definition of international sign. World Federation of the Deaf.Available at Www.Wfdeaf.org/wp-content/uploads/201203//Perspectives-on-the-Concept-and-Definition-of-IS_Mesch-FINAL.Pdf.

Mitchell, R. E., Young, T. A., Bachleda, B., & Karchmer, M. A. 2006. How many people use ASL in the united states? why estimates need updating. Sign Language Studies, 6(3), 306- 335.

Starner, T., Weaver, J., & Pentland, A. 1998. Real-time american sign language recognition using desk and wearable computer based video. Pattern Analysis and Machine Intelligence, IEEE Transactions on, 20(12), 1371 -1375.

Stokoe, W.,C. 1978. Sign Language Structure. Silver Spring, MD, Linstok Press.

Suzuki, E., Horikoshi, M., & Kakihana, K. 2004. Bilingual sign language dictionary for learning a second sign language without learning the target spoken language. Paper presented at the Proceedings of the Workshop on Multilingual Linguistic Ressources, 93-96.

Suzuki, E., & Kakihana, K. 2002. Japanese and american sign language dictionary system for japanese and english users. Paper presented at the LREC.

Suzuki, E., Suzuki, T., & Kakihana, K. 2006. On the web trilingual sign language dictionary to learn the foreign sign language without learning a target spoken language. Paper presented at the Proceedings of the International Conference on Language Resources and Evaluation (LREC2002), Italy. 2307-2310.

Tokuda, M., & Okumura, M. 1998. Towards automatic translation from japanese into japanese sign language. Assistive Technology and Artificial Intelligence, 97-108.

UN. 2004. UN enable - promoting the rights of persons with disabilities - contribution by council of arab ministers of social affairs. Retrieved from http://www.un.org/esa/socdev/enable/rights/contrib-arab1.htm

WFD. 2013. Sign language. Retrieved from http://wfdeaf.org/our-work/focus-areas/sign-language.

Lapiak, J. 2016. Sign Language • ASL Dictionary | HandSpeak. Handspeak.com. Retrieved 8 May 2016, from http://www.handspeak.com/.

The Online Dictionary of New Zealand Sign Language - NZSL Online. 2016. Nzsl.vuw.ac.nz. Retrieved 8 May 2016, from http://nzsl.vuw.ac.nz/.

Sign language dictionary - SPREADTHESIGN. 2016. Spreadthesign.com. Retrieved 8 May 2016, from https://www.spreadthesign.com/.

Appendices

Appendix 1:

Unified Arabic Sign Language / American Sign Language Bilingual Dictionary

Online Questionnaire to Teachers, Professionals, and Researchers

1. How was your experience with the dictionary?

    1 Not Acceptable   2 Acceptable   3 Good   4 Very good   5 Excellent

2. Will you use the dictionary again?

    Yes   No

3. Will you recommend others to use the dictionary?

    Yes   No

4. Have you ever learned a foreign language using a computer?

    (Any language in addition to the descriptive languages)

    Yes   No

5. Was the dictionary easy to use?

    1 Very difficult   2 Difficult   3   Average 4 Easy   5 Very easy

6. Did the video for a sign help to explain the sign clearly?

    1 Not clear   2 Acceptable   3 Good 4 very good   5 Excellent clarity

7. How easy was to access the sign and displaying it?

    1 Very difficult   2 Difficult   3 Average   4 Easy   5 Very easy

8. Have you met any problems in the video presentation of the sign?

    1 No   2 Sometimes   3 Always

9. How fast was the download and appearance of the video?

    1 Fast   2 Average   3 Slow

10. Did you need to seek extra help when you used the dictionary?

    Yes   No

Appendix 2:

Unified Arabic Sign Language / American Sign Language Bilingual Dictionary

Online Questionnaire to Deaf Students

1. Do you know what is the purpose of this web application?

Yes   No   Not sure

2. Was it useful to you? Would you like to use it again?

Yes   No

3. Would you like to use it when you travel?

Yes   No

4. Did you face any problems when using this web application?

Yes   No   Little problems

5. Did you need help to use this web application?

Yes   No

6. Were the videos clear?

Yes   No

7. Did you need to seek extra help when you used the dictionary menus?

Yes   No

تطوير قاموس الكتروني موحد
للغة الاشارة باللغتين العربية / الأمريكية

علي حميد القلاف

معهد الكويت للأبحاث العلمية، الكويت

الخـــلاصـــة

يسمح قاموس لغة الإشارة للأشخاص ضعاف السمع والصم بتوسيع قدراتهم للتواصل مع الآخرين من خلال تعلم لغة الإشارة الخاصة بهم. في هذا البحث، تم وصف قاموس لغة إشارة ثنائي اللغة وثنائي الاتجاه على شبكة الإنترنت، وهذا القاموس يسمح للأشخاص ضعاف السمع والصم تعلم لغة إشارة مستهدفة أخرى دون الحاجة إلى تعلم اللغة الأم أو اللغة المنطوقة المستهدفة. يوفر نظام القاموس المتطور واجهة مرئية يسهل الوصول إليها، والتي تسمح للمستخدمين بالترجمة من لغة الإشارة العربية الموحدة (UASL) إلى لغة الإشارة الأمريكية (ASL) والعكس. يمكن اعتبار هذا القاموس المُطور تكنولوجيا مساعدة يمكنها أن تسهم بشكل إيجابي في الاندماج الاجتماعي وتنمية الأفراد والمجتمعات من أجل مستقبل وفرص أفضل. يمكن إضافة لغة إشارة جديدة إلى هذا القاموس بسهولة وتوسيعه ليصبح قاموساً ثلاثي اللغات.