Multimedia Educational Content for Saudi Deaf

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Abstract. Research demonstrates that deaf individuals are undereducated and most of them are illiterate or at least semi- illiterate. Educating individuals with disabilities, in general, is a good investment. It doesn't only reduce welfare costs and future dependence; it reduces current dependence and frees other household members from caring responsibilities, as well as allowing them to increase employment or other productive activities. In this scope, a national funded project is launched to develop an environment for teaching and learning for Saudi deaf, using both automatic translation from Arabic to Saudi Sign Language and 3D animation techniques called Avatars. As part of the project, this paper presents the development of educational material to allow access to vital information for deaf people by presenting essential knowledge needed in their daily lives in an easy manner to grasp and comprehend. Resources for the subject of Islamic Education is collected and indexed based on levels and depths of information to accommodate needs of various types of users targeted by our works.

Keywords: multimedia, educational material, 3D animation, Sign Language, Saudi Sign Language, Avatar technologies.

1   Introduction

United Nations (UN) estimates that around 10% of world population, or about 650 million people live with a disability [1]. Hearing loss is the most prevalent sensory disability globally. In 2004, over 275 million people globally had moderate-to-profound hearing impairment, 80% of them in developing countries [1-3]. In Saudi Arabia, deaf & hearing-impaired people represent 10.7% of disabled persons in the Kingdom according to a 2002 survey conducted by the World Bank [4].

Many studies indicate that deaf people around the world are undereducated, and most of them are illiterate or at least semi- illiterate. The World Federation of Deaf indicates that 80% of deaf people lack education [5]. Moreover, the global literacy rate for adults with disabilities is as low as 3% and 1% for women with disabilities according to a 1998 United Nations Development Program (UNDP) study [1], [6].

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For the above reasons, a lot of international bodies start developing specific educational curricula for the Deaf people to help them improve their living conditions and their integration in the society. New technologies have been used to ease multi-take advantage of the educational curricula, such as 3D animations and avatar technologies (e.g. [7-9]). In fact, enabling easy access for educational material to deaf people will be an empowerment for them toward more independence and self-reliance. This will engage them to be more independent, confident and participate proactively in their community.

Unfortunately, deaf Arabs are still encountering many difficulties related to their education due to several reasons: absence of official specification of many Arabic Sign Languages (e.g. unified dictionary, linguistic structure, etc.), which prevent their use as a medium of education, absence of educational signed content easily accessible and appropriate for deaf, and so on. In deed, we are aware of only few works related to the preparation of educational materials using appropriate technologies for deaf Arabs. The most relevant is the national Tunisian project[1], which represent great efforts aiming to develop learning materials and web-based environment for teaching deaf-pupils [10], [11].

In this paper, we present our efforts to collect and build a learning material for deaf people allowing them an easy access to essential knowledge needed in their daily lives in an easy manner to grasp and comprehend. These efforts represent a part of our work in a project, funded by the National Plan of Sciences, Technology, and Innovation, to build an environment for translation from Arabic texts to Saudi Sign Language (A2SaSL project) [12].

2   Development of the Educational Material

According to an in-depth survey, we conducted as a first phase of our ongoing project (A2SaSL), we noticed the scarcity of signed contents not only for Saudi Sign Language (SaSL) but also for almost all other Arabic Sign Languages (ArSLs) [13]. Abdel-Fattah indicated in [14] that not only very few Arabic signed-contents exit for just some ArSLs, but also the existing contents are available only in specific forms such as movies, TV series, and news bulletins. To overcome this deficit, we aim to help the Saudi deaf people community to improve their access to educational resources by providing them with a web-based environment for teaching and learning, based on automatic translation from Arabic to SaSL and 3D animation techniques called Avatars. This needs, firstly to prepare a convenient content that can be structured in an appropriate format easily accessible and comprehensible by deaf people.

2.1   Choosing the Domain

As a first work of its kind, we preferred considering the basic Islamic topics as they are highly required in Saudi Arabia, Arab world, and also all Islamic countries. In societies where Islamic education is primordial, providing deaf people community with access to such knowledge and principles will help them progress toward more

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[1] www.utic.rnu.tn/websign

normal life and become well religiously educated. So, five basic topics known as pillars of Islam are chosen to be the core of our educational content. They are Prayer, Pilgrimage, Fasting, Zakat, in addition to the topic of purity (cleanliness) as it is considered a prerequisite to perform legitimacy obligations. We hope that other Islamic topics be included in future upcoming works to expand the coverage of the material.

2.2   Selecting Material

Arabic contents covering everything related to the forth mentioned topics were collected in terms of elements, functioning and provisions. These texts have been gathered from authentic Islamic references used in the actual Islamic teaching. They have been further analyzed, reviewed, and simplified to comply with the needs and cognitive capabilities of deaf people. Their contents are also linguistically and legitimately revised to be sure of its correctness after such modifications.

Table 1. Extracts from collected texts

Topic	ID	Content	Topic	ID	Content
Fasting (الصيام)	1	تعريف الصيام	**Purity** (الطهارة)	1	باب الوضوء
	2	الصيام لغة الإمساك		2	تعريف الوضوء
	3	أقسام الصيام		3	الوضوء شرعاً يعني استعمال الماء في أعضاء مخصوصة بكيفية مخصوصة
Pilgrimage (الحج)	1	تعريف الحج	**Zakat** (الزكاة)	1	تعريف الزكاة
	2	الحج لغة القصد إلى معظّم		2	الزكاة لغة التطهير والنماء
	3	حكم الحج		3	حكم الزكاة
	4	فرض في العمر مرة على الفور		4	الزكاة ركن من أركان الإسلام الخمسة
Prayer (الصلاة)	1	حكم الصلاة	**Prayer** (الصلاة)	1	تعريف الصلاة
	2	الصلاة فرضت بالكتاب والسنة والاجماع		2	الصلاة لغة الدعاء
	3	فمن أنكر ذلك فهو مرتد عن دين الإسلام بلا خلاف		3	وشرعاً قربة فعلية ذات أقوال وأفعال مخصوصة

Texts are formatted and stored in an appropriate structure to ease their access and manipulation. Each document is split into separate sentences and/or short paragraphs conserving the meaning. This helps to be understood by deaf people and also to produce accurate translation to Sign Language. Obviously, all segments (sentences and/or paragraphs) are internally stored in relation with their original documents. In the following table (table 1), we report an extracted texts of the five considered topics to have a clear idea about their contents.

3   Preparations of Videao-Based Multimedia Content

It is known that the use of multimedia technologies in education increases the efficiency of learning. The use of images and videos in educational materials are generally highly required to support students understanding and grasping the material.

For the deaf people, they need to receive all the information in visual form as they cannot access the acoustic channel. So, it is very important that the material is completely presented for deaf people as visual signed-content using their own sign languages.

In our work, we are transforming the written content we collected to visual signed content following high quality standards. Firstly, we produced an accurate textual translation of all segments of texts. Second, high resolution video recording of all the written contents described above are performed. Third, a sign dictionary is deduced and being used as support for the educational material as we will see later.

3.1   Producing Video Recording of the Written Content

All the collected Arabic content we described above have been transformed to signed visual content by recording human signers performing sentences. This has been done as follows: 1) a team of deaf people and interpreters were selected to help executing this task; 2) working groups are formed to work in parallel on the texts collected for the five topics; 3) each group is asked to write for each segment of the text, the best translation they agreed on; 4) after cross-validation between groups, they proceed to their video recording; 5) video recording are also mutually revised and validated for accuracy not only for the quality of videos but also for the homogeneity of used-signs over all the contents. We notice, that this double translation (written and visual) of the content will allow many benefits: 1) easy learning for both deaf and hearing, as written concepts can be aligned with their visual realizations; 2) short video segments can be used separately to prepare specific instructional material; 3) transformational rules between Arabic and SaSL can be extracted; 4) some lexical/linguistic features can also be deduced.

3.2   Building Sign Dictionary

One of the main difficulties still encountered in Saudi Sign Language is related to the absence of official dictionaries [13]. Saudi Arabia is one of the Arabic countries that still have no unified sign dictionary despite an increasing official importance given to deaf. In fact, a large project for documenting Saudi Signal Language seems to be launched or will be in the near future by the Prince Salman Center for Disability Researches[2]. For the time being, no official dictionary is available at the best of our knowledge.

For the religious domain as it is our field of work, we notice an unofficial attempt recently initiated by some individuals at the Saudi Federation Sports for the deaf[3] to collect some words from the Holy Quran and then to create signs for them. It seems this work is still running and did not finish yet. Moreover it is very limited and concerns

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[2] `www.pscdr.org.sa`
[3] `www.deafsp-sa.com`

only some Quranic words. We hear about another initiative launched recently in Qatar within the ongoing efforts to develop the unified Arab sign dictionary [15-17]. It consists of collecting religious terms that are mostly used in Islamic world and to create a unified signs for them. Unfortunately, we did not obtain enough information about this work. Indeed, we were interested in this work for just comparison purposes since we are working on Saudi sign language and not the unified sign language.

Our approach consists in building a large dictionary to be an infrastructure of the educational material. An animated version of this dictionary has also to be created using avatar technologies (see the next section). These versions (textual and animated) will allow automatic generation of multimedia learning contents. For this purpose, we resorted to building our sign dictionary from the content we collected. We extracted a list of unique words from the Arabic texts along with their meanings. This approach is better than the other attempts wishing to collect a list of separate words as in Arabic a same word may indicate completely different things depending on its meaning in a specific context.

Some relevant terms have been added to the dictionary to ensure a good coverage, like the Arabic sign alphabet and numbers. Islamic Education requires knowledge of numbers, counting and finger spelling. Finger spelling is a concept used by deaf people to sign unknown words using the sign alphabet instead of creating new signs. For more details on the creation of the sign dictionary, you can refer to [13].

4   Preparations of Avatar-Based Multimedia Content

Most adequate representation of signs is highly needed to allow deaf people memorizing concepts by visualizing them many times and from different angles. These circumstances motivate the use of 3D animated avatar technologies as a new medium of multimedia contents. In the next section, we will highlight the advantage of using avatar technology over video recording.

4.1   Advantage of Using Avatar for Building Educational Content

Methods for representing signs using computers have been evolved from images, to video-clips and finally to 3D technology called avatars. Avatars are virtual human signing as 3D animated images to simulate natural movements of people [18]. In an avatar-based approach, signs are created as text-files by avatar software (sign-editor) then they can be visualized using a component in the avatar software (sign-player) as a 3D animation. The created files for animated signs are very much smaller than videos and images of these signs. Thus the storage space required is minimal, and the download / visualization is very fast.

A report from the eSIGN (Essential Sign Language Information on Government Networks)[4], a well known European funded project, indicated many advantages of using avatar over video, such as: 1) browsing more quickly through information, 2) controlling the speed of signing, 3) changing the view angle of the virtual signer, 4) etc. [19]. Avatar has also many advantages on video when speaking about the creation of the signed content and its maintenance.

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[4] http://www.visicast.cmp.uea.ac.uk/eSIGN

In addition to the above, important studies were interested in the comprehensibility of signed contents based on avatars compared to video-based contents. Hurdich from Vcom3D[5] conducted a research study at the Florida School for the Deaf and Blind and showed an increase of comprehension of a story from 17% to 67% after seeing it signed vs. being read [20]. Parton evokes in his paper [18] that another research study conducted by Seamless Solutions[6] reported that none of the students in their study encountered difficulty understanding the avatars. Kipp and al. [21] compare avatar performance with human signers and present a measure of real comprehensibility of the avatar (delta testing). They indicate that non-manual components and prosody are the most issues for a possible increase of comprehensibility beyond 60%. Naqvi and al. [22] conducted a study to test the effectiveness of digital representations of sign language content; they asked two groups of non-signers to watch a sign language lesson with either a digital video or a digital avatar. It was found that participants learning sign language with the Avatar had a higher learning rate than video.

4.2   Creating 3D Animation: Animated Sign Dictionary

One of the important features of 3D animation systems is that they try to be independent of SLs in terms of the possibility of creating and animating sequence of movements. So, we surveyed the avatar-based signing systems that are available and compared them in order to select an appropriate one to be used for our project.

Comparison of avatar-based signing software developed for animating SLs has been limited to parameters that respond to our needs: presence of sign-editor and plug-in sign-player, quality of graphics, reality of animation, possibility of controlling body parts and the motion speeds, etc. This means that we surveyed only systems that have such parameters. List of these software can be found in this paper [24] lastly published in Arabic.

After a convenient animation system was identified, we focused on the creation of our animated signs and how they can be visualized later-on from inside our system (plug-in player). The eSIGN software was selected to be used in our work. It has been chosen based on the features he offers, which are superior of those given by the other available software. For example, he has two separate components, one for creating signs (offline) and another for playing them (on fly) and can be plugged in our application. Also, he has other important parameters, such as quality of graphics, reality of animation, full control of body parts, facial expression, etc.

The sign dictionary we built from the collected Islamic content is being transformed progressively to an animated sign dictionary [25]. For each sign, we have to simulate its high quality video by transforming it to an animated format. This is done by manipulating hand-shapes, body parts, and many other parameters of the avatar through the features provided by the eSign software. We have to notice the difficulty of this task, which needs long time and big efforts. Every time an animated sign is created, it has to be validated by the deaf people team to ensure its correctness. This manner of working guarantees a good quality, but it is very time consuming. To help accelerating this work and to be able to build a large animated dictionary, we called for a collaborative strategy (see the next section).

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[5] http://www.vcom3d.com
[6] http://www.signingbooks.org/doku.php

4.3   Strategy for Expansion: Collaborative Strategy

To help building a large animated dictionary, we proposed a collaborative strategy to allow contribution from SaSL experts and interested people. Two stages of contribution are allowed to external collaborators: 1) creating animation corresponding to video-clips we provided; 2) proposing new contents by providing, and uploading on our system, high quality compressed video files with their corresponding animated files created using our integrated sign-editor avatar. Based on the opinion of an official focus group, signs are accepted and inserted in the dictionary or refused and deleted from the system. Video files are requested to verify that the corresponding animation was correctly and accurately created. It may happen also that the person proposing the sign may not be so familiar with the creation of animation; so, the video will be used by our team to create the animation. Video files are removed once animations are verified / created.

5   Conclusions

In this paper we presented the development of educational material for deaf people at different stages: 1) Islamic resources in well chosen topics are collected and indexed; the choice of this subject was driven by two essential factors: the centrality of learning and disseminating teachings of Islam to all segments of our society, as well as the potential for expansion of the project, knowing that the lexicon and keywords for this subject are not just common to Arabic only, but it could easily be expanded to all Muslims around the world; 2) the written content has been transformed to visual signed content by recording human signers performing textual segments following high quality standards; 3) An avatar-based 3D animations are created for religious terms; they are used to generate multimedia sequences to build a free context materials for educational purposes; 4) a strategy of expansion for creating large animated contents is sketched. We expect that this material will greatly help deaf centers to better educating deaf children and adults.

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