

# A Proposed Web Based Framework E-Learning and Dictionary System for Deaf Arab Students

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**Abstract--** E-learning is a useful tool that has contributed in facilitating education for people around the globe. There is a need, however, for making e-learning available to deaf people. This could facilitate teaching and learning for both teachers of the deaf and deaf people.

This paper presents an e-Learning System (LS) which offers Arabic Sign Language (ArSL) in correspondence to the text in the learning environment. The system is designed ably for deaf adults for the purpose of their lifelong learning. In the LS, the special needs of deaf learners are satisfied, e.g. bilingual information (Arabic text and Arabic sign language), high level of visualization and interactive and explorative learning. The basic objective of our e-learning system is the support of the equal rights of deaf people for their access to the education and training. Also dictionaries between Arabic and Sign Language are important parts of learning. It is possible for Deaf to find words as a sign language. Also that paper describes a bilingual sign language dictionary that can help Arab deaf student learn sign language directly from their mother language. As the use of computers becomes more widespread, it has become more convenient to study using computer software and/or the Internet facilities. The proposed dictionary system provides deaf students with an easy means of access using their mother-sign language so they don't have to overcome the barrier of learning the target-spoken language.

**Index Term--** learning, Deaf, WWW, Web System, Arabic Sign Language, interactivity

## I. INTRODUCTION

The Web is providing unprecedented access to information and interaction for not only a special group of people, but also people from any age and different groups. One important group of Internet users is people with disability. One group of the disabled people are deaf persons. Deaf persons have a special talking language [1]. They are using Sign Language (SL) which uses manual communication, body language and lip patterns instead of sound to convey meaning. Simultaneously, combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions are used to express fluidly a speaker's thoughts.

Like spoken languages [2; 3] different sign languages and dialects evolved around the world. According to the National Association of the Deaf [4] the American Sign Language (ASL) is the third most frequently used language in the United States, after English and Spanish. ASL has more than 4,400 distinct signs. The Arabic Sign Language (ArSL), which is used in Arabic nations and also serves as a case study SL in this paper, contains approximately 3500 different gestures for common words [5]. Signs require one or both hands for signing. Facial expressions which

accompany signing are also important since they can modify the basic meaning of a hand gesture [6, 7]. To communicate proper nouns and obscure words sign languages employ finger spelling. Since the majority of signing is with full words, signed conversation can proceed with the same pace as spoken conversation.

According to the World Federation of the Deaf (WFD) [8], 80% of Deaf people lack education or are undereducated, are illiterate or semi-literate. For this reason, deaf persons face difficulties when accessing written information via the Web.

Some of the Internet websites are especially developed for disabled persons. Some of these websites are e-learning applications for the disabled people. Forrest in [9] proposed an e-learning module that was developed to support library staff training in disability awareness. Debevc et al in [10] proposed an e-learning environment for improving computer literacy of the deaf and hard hearing persons. Also another work is done regarding SL dictionary.

A sign language dictionary can serve multiple functions. Primarily, it supports the learning process of sign language in special educational institutions for the deaf as well as enables normal hearing people who are in a daily contact with deaf people to learn to communicate with them in the SL. Another goal of an SL dictionary is to standardize a given SL. Since communities of deaf people are often isolated from each other there is a great tendency to develop local dialects which are then not easily understood by other communities of deaf people. A dictionary can unify the meaning of signs and at the same time define a standard way of performing a sign. A dictionary can also somewhat fill the gap in the number of qualified SL instructors.

Although monolingual SL dictionary systems for different languages have already existed, there are rare ones with entries for two or more languages [11;12]. And there is almost none deals with ArSL [13;14].

Authors of this paper proposed Web based e-learning system for deaf Arab. The next section of this paper is a survey for the of e-learning systems dedicated for deaf persons. analysis, design and implementation are presented. Authors conclude that the proposed system is efficient for deaf Arab. The proposed system also lays the ground applications for Arabic deaf.

## II. SURVEY

The survey is categorized in four categories depending on the use of that surveyed systems and the user category who interact with it.

- Interactive SL learning systems. Systems in this category are focused on teaching the deaf students in different countries.
- Content producing systems .Systems in this category provide conversion tools which are used for constructing, storing and maintenance for educational material .
- The third category is :Text-To-Sign Browsers. Systems in this category automatically converts the Web page content to SL. Research at that category is rare and still at the beginning .
- The fourth category is : Online Sign Languages Dictionaries .Systems in this category plays a very important rule in learning the SL for different languages.

#### A.. Interactive SL Learning Systems

Systems in this category are the most popular ones but for different languages. These systems help def users in the learning process .

Khwaldeh et al in [15] proposed a centralized based learning system, which aims to facilitate teaching and learning for both teachers of the deaf and deaf people. This system enables teachers and deaf to interact with each other. But this system is still limited in its use .

In [16] Gennari et al present LOGic-based e-tool for DEaf children (LODE) that aims at stimulating deaf children to globally reason on narratives written in Italian. Thus LODE presents children with e-stories and apt exercises that stimulate them to analyze the temporal relations between events, and to produce new relations consistent with the story .But this system doesn't support the Arabic language as it supports only the Italian language .

Kyun Ng et al in [17] proposed an E-Learning framework that creates a common platform for both normal and disabled students which will share the same influential of their academic achievement. The deaf students can communicate with instructor and other students by messaging over the chat-room system .But this system need training on using it and it doesn't support learning the SL in general .

To encourage the deaf children to ASL, Shirali-Shahreza et al [18] proposed a system which is implemented using PHP scripting language[19] .This system isn't used for e-learning as it could be used for web browsing.

Another system is proposed in [20] which is an interactive program to teach ASL for K-3 mathematics by 3D animation. But this system is limited for a special type of courses and ages.

Straetzl et al in [21] proposed a Learning Management System (LMS) which offers German SL videos in correspondence to every text in the learning environment. But it doesn't support ArSL . And Drigas et al in [22] presented a similar LMS but for Greek SL . The systems are designed notably for deaf adults who want to maintain and improve their mathematical and reading/writing skills. These systems require large bandwidth for downloading videos .So the reliability of these systems is low.

Ohene-Djan et al [23] proposed a Kids Sign Online (KSO) system, which is designed to teach British SL (BSL) in tandem with English to deaf children. But this system supports a specific language BSL and doesn't support ArSL.

Stewart et al in [24] proposed a library that is available on the ASL browser website for teaching the ASL. For each word, the "ASL Browser" site has a movie shows a person saying the word using ASL .The movies are in Quicktime [25] format. Although this system supports a small sized movies but its reliability is still low.

#### B. Content Producing System

Using the systems in this category the deaf user can produce their content by themselves .

In [26] Webducation Software Planungs- und EntwicklungsgmbH carry out a project in close cooperation with the Austrian Association for hearing impaired and deaf people (WITAF). The system gives the possibility to generate and publish contents by deaf themselves on the learning platform

Efthimiou et al in [27; 28] proposed a platform environment that allows development of various educational applications accessible by deaf users for Greek SL (GSL).

#### C. Text-To-Sign Browsers

Systems in this category are very useful for the deaf as they convert the web page to the deaf user language ;SL .

In [29] Boldyreff et al proposed a text-to-sign browsers for users of BSL. It is currently limited in their use. One of the major problems is that BSL and ASL do not translate word for word into English or vice-versa, as they have distinct grammars of their own, and therefore it would be difficult to translate a site directly .This type of systems isn't available for ArSL.

#### D. Online SLs Dictionaries

These systems can encourage deaf users to increase their knowledge about the other language or about their own SL.

Dasgupta et al in [32] proposed a cross platform multilingual multimedia Indian SL (ISL) dictionary. However; this system doesn't provide the ArSL.

Troelsgård & Kristoffersen in [33] proposed a Danish SL (DSL) dictionary. For signers who have DSL as their first language, the dictionary will provide information about Danish SL such as synonyms and variants.This dictionary is a monolingual dictionary.

Vettori et al in [12] presented Electronic Bilingual Dictionary of Italian SL (ISL) and Italian but it doesn't support ArSL.

There is also another e-LIS dictionary proposed in [34] by which is the web bidirectional dictionary for ISL-Italian.

Suzuki et al in [35] proposed a Japanese and ASL Dictionary System for Japanese and English users.This dictionary doesn't support ArSL.

The Online SLs Dictionaries [36;37;38;39;40;41;42;43;44;45;46] constitute very important educational tools for the e-learning and training of SLs. To this direction many online dictionaries have been developed for different SLs. The majority includes a large number of signs and targets at signers as well as at students that learn a SL as second language. Each sign is accompanied from the material and includes, on one side one translational equivalent and the other side synonyms and antonyms in the SL. All that dictionaries don't support the Arabic language.

Mohandes in [13] proposes a system that translates Arabic text to ArSL. Words that correspond to signs from the ArSL dictionary calls a pre-recorded video clip showing the sign. If the word does not have a corresponding sign in the SL dictionary, it is finger spelled. But, this system depends on the videos and, videos need a large bandwidth for downloading.

About the ArSL e-learning systems, there is still limitation in developing e-learning applications which use the ArSL for teaching deaf people, and the already existent rare ones [30;31] are missing interactivity between the user and the system.

Based on this survey, authors proposed e-learning system for Arabic deaf. This system is dedicated for teaching deaf by converting the Arabic Web page to the ArSL. This system would be used in the Arabic e-learning for deaf persons.

Also part of the system could be used as Web-based dictionary for translating the English or the Arabic language to ArSL, which could be used for the deaf persons to word by word.

### III. THE PROPOSED WEB-BASED FRAMEWORK FOR ARABIC DEAF

This framework enables the deaf user to choose between two systems on the demand of his/her use. An e-learning System that is or the dictionary system as shown in fig.1

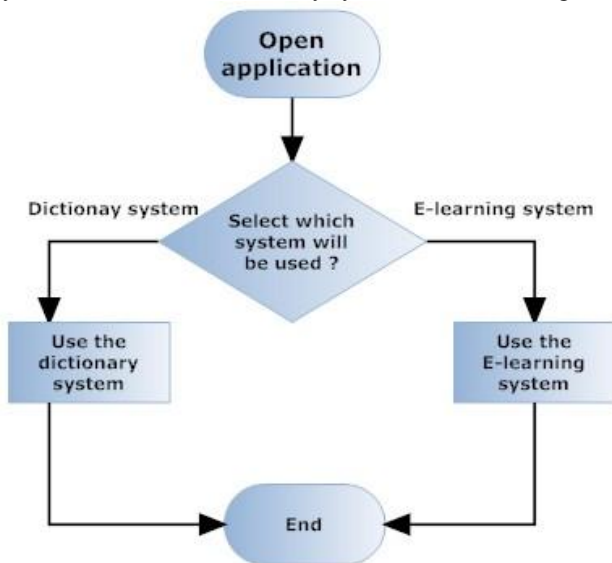


Fig. 1. The Framework flowchart

#### • The Proposed E-learning System for Arabic Deaf A. The Proposed E-Learning System Components.

The proposed system is shown in fig.2 and all of its components cooperate to produce the educational material for deaf in an interactive way. As shown in fig.1, the proposed system client and server side components are as follows:

- 1-User interface.
- 2-Web page scanner.
- 3-Content generator.
- 4-ArSL converter.
- 5-The ArSL library.
- 6-Web page to the ArSL format generator.
- 7-Final output formulator.

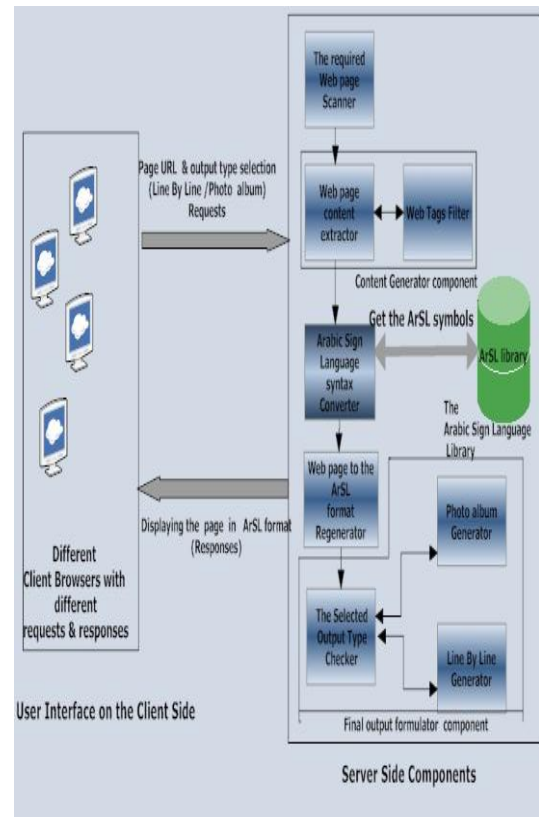


fig. 2. The System Architecture

Proposed system client side component is user interface and the server side components.

#### • The Client Side Component

**The User Interface :** Through which the user enters the required URL then he/she chooses a selection for the output type (as a photo album displaying or reading line by line). Then the request is processed through the server side components and the response is sent back to the user.

#### • The Server Side Components

a) **The required Web page Scanner :** It's the first component in the server side of the application. It opens the required Web page and scans the full content of it, then the scanned content is passed to the next component.

b) **The Page Content Generator :** It has two subcomponents: 1-Web page content extractor & 2- Web Tags Filter.

c) **The Web page content extractor** extracts the Arabic Web page content.

d) **The Web Tags Filter component** eliminates each tag in the extracted content and returns with only the pure page content. Then it passes the extracted content to the next components.

e) **Arabic SL syntax Converter :** Translates the required Web page to the ArSL, getting the synonymous SL words from the ArSL library.

**ArSL library :** This library contains about 3500 Arabic gestures corresponding to the most common Arabic words. Then the output of the ArSL syntax converter is passed to the next component.

f) **Web page to the ArSL format Regenerator:** This component converts the signs to an adequate format for the

Web ,by regenerating the Web page content with its tags again .

g)The Final Output Formulator :The user output type selection is considered by this component It has three subcomponents .

h)The Selected Output Type Checker: This subcomponent checks the output selection of the user and then calls one of the following subcomponent .

i)Photo album Generator component : If the user selected to see the output in a photo album displaying format ,the formulator calls the Photo album Generator component that generates the signs as a photo album show

j)Line By Line Generator component : If the user selected to see the output in a line by line (as the usual reading type) displaying format ,the formulator calls the Line By Line Generator component that generates the signs as a regular Web page but each word is represented as a sign .

k)Finally , the response ;the web page translation to the ArSL , returns to the user with his required displaying type . The response of the system displays an avatar as a response to the translation.

The following is a flowchart representation of the described system .

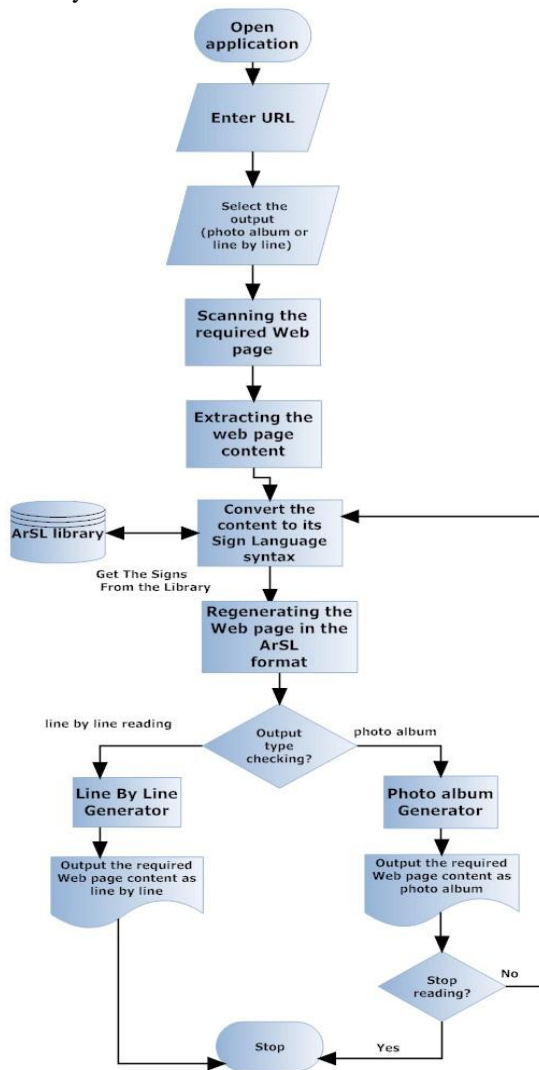


fig. 3. The System Flowchart

As shown in fig.3; the deaf user enters the URL of the required page and selects his preferred output type (photo

album or line by line reading) then the page is scanned in the system to extract the page content of it .Then the content is converted to the SL syntax using the ArSL library and after a few seconds the required page is converted to the same webpage but in the deaf user own language ;SL and in his preferred output type.

#### B. The E-learning System Analysis

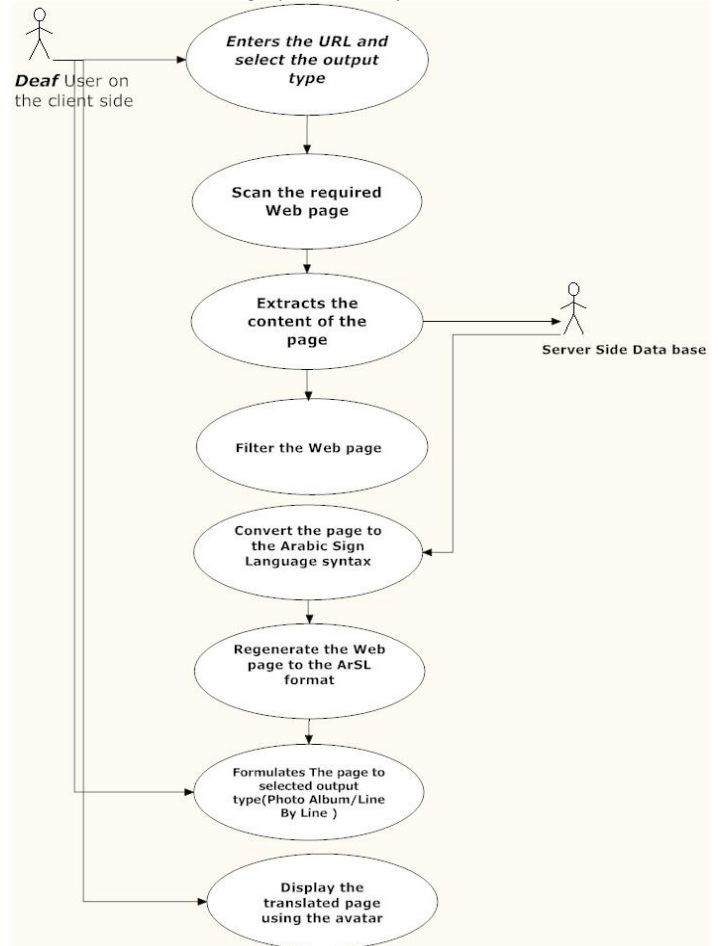


fig. 4. The E-learning system use-case

The first step of building our system is to analyze it . The analysis is shown in fig.4 ; in which the user will interact with the user interface at the client side to enter the URL of the page to be translated into the ArSL then his request will be passed to be processed .The page related to the entered URL will be scanned then its content will be extracted and filtered from the tags .Then , the content will be translated into the ArSL using the server side DB .The ArSL represented by an avatar will be regenerated as a Web format and the final output type will be formulated .Finally , the output will be displayed to the user as a response .



### C. The E-Learning System Design

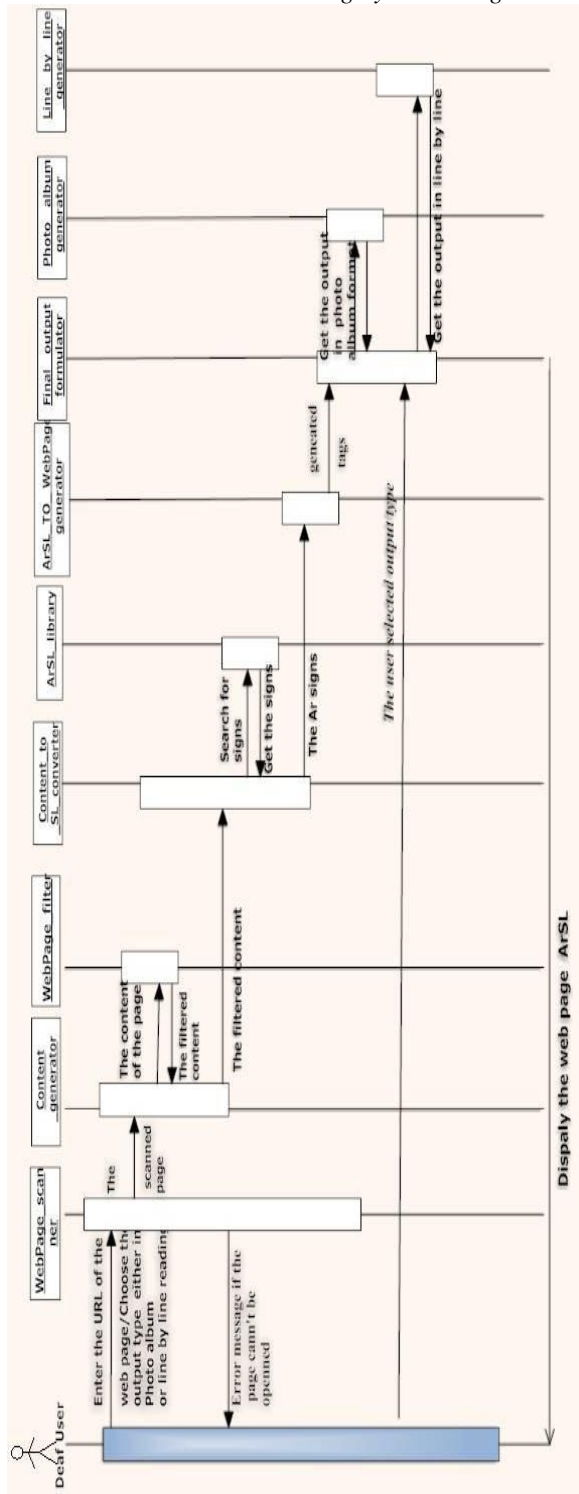


fig. 5. The Scenario Diagram Of The E-learning System

As shown in fig.5 the scenario of the proposed e-learning system is as following . The user sends his request to the server side in the form of the URL entry and the output type selection . The URL will be scanned via Webpage\_scanner module and if the page can't be found a suitable error message will be sent again to the user . The scanned Web page ,if it's correct, is sent to the Content\_generator module which in turn use the Webpage\_filter module to filter the Web page from the tag .Then , the Content\_generator module will send the pure content as a message to the

Content\_to \_SL\_converter module which will use the ArSL\_library to convert the Arabic words in the page content to the ArSL .Then, the signs is sent to the ArSL\_TO\_ WebPage generator module which generates the signs in a suitable Web page format & generates the Web tags .The generated Web tags and the user selected output type is sent to the Final output formulator which will checks the request and generate the final output using two separate sub\_modules. If the user selection is "the output in photo album format", it will use Photo\_album\_generator module. If the user selection is "the output in Line\_by\_line reading format", it will use Line\_by\_line\_generator module .Finally , the response will be sent to the user in his preferred format .

### D. The E-learning System Case Studies

This system is implemented entirely in PHP language and MySQL [47]. Because PHP is a well known open source and platform independent language, most of the web hosting companies support it .

The first case study is a system that is used to teach deaf students the concept of the family using Arabic text and ArSL as shown in fig.6 .

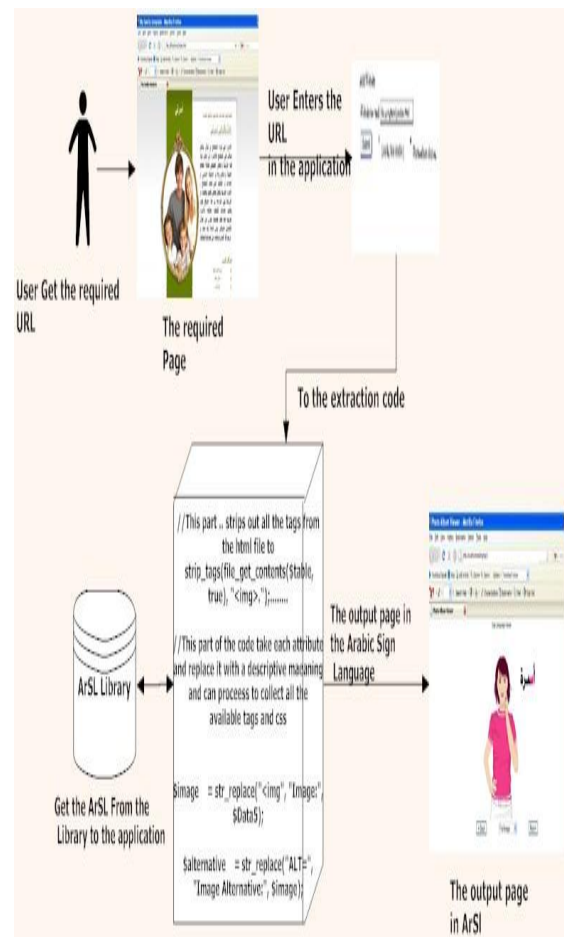


fig. 6. The E-learning System Implementation 1

Another case study is prepared to teach students the mathematical concepts ,such as square area rule , in a certain web site .Fig.7 shows that the deaf student only enters the URL of that site and check the output type then after very few seconds the page is converted into ArSL.

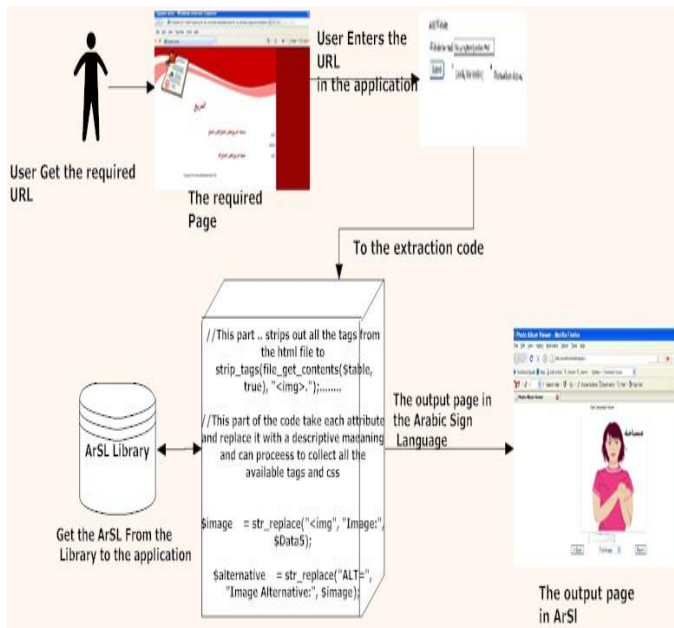


fig. 7. The System Implementation 2

### • The Proposed Web-Based Dictionary For Deaf A. The Proposed Web-Based Dictionary For Deaf Components

The deaf user enters the text to be translated and after a few seconds the required text is converted to his own language ; SL. Our dictionary contains ,for the first time ,English- ArSL and Arabic-ArSL web translator.

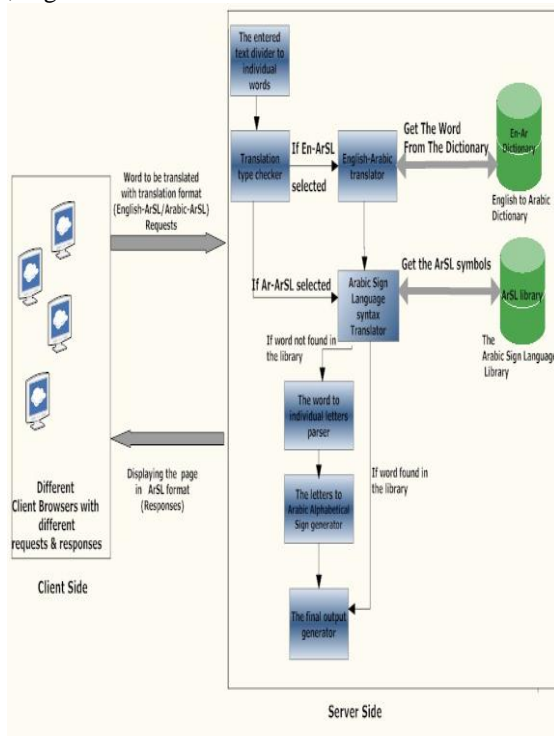


fig. 8. The Dictionary Block Diagram Architecture

As shown in the fig.8 , the system consists of two sides ;the Client side and the server side components:

### • The Client Side And The Server Side Components:

The client side of the application : Through which the user enters the required text then he/she choose a selection for the translation (English-ArSL or Arabic-ArSL ).

### • The Server Side Components

Then the request is processed though the server side components .

a) The text to individual words divider : It's the first component in the server side of the application. It divides the text to individual words which are passed to the next component.

b) Translation Type Checker : It checks the user selection if the user selected English to ArSL , the words are passed to the English-Arabic translator component .If he/she selected Arabic to ArSL , the words are passed to the ArSL syntax translator component .

c) English-Arabic translator : Checks if the words exist in the En-Ar dictionary If so, the Arabic corresponding words are passed to the ArSL syntax translator component .If not ,an error message is displayed .

d) ArSL syntax Translator : If the words exist in the library , the translator gets the required words to the ArSL getting the synonymous signs from the ArSL library ,which contains the Arabic gestures for the Arabic language words and the translated signs are passed to the Final output Signs Formulator component .If the words don't exist in the library ,they are passed to the next components.

e) The word to individual letters parser : It divides each word into individual letters to be translated into finger spelling .

f) The letters to Arabic Alphabetical Sign (Finger spelling) generator: In this component , each letter is translated to finger spelling .

g) Final Output Signs Formulator : this component is formulated in an adequate Web format .

The following is a flowchart representation of the described system .

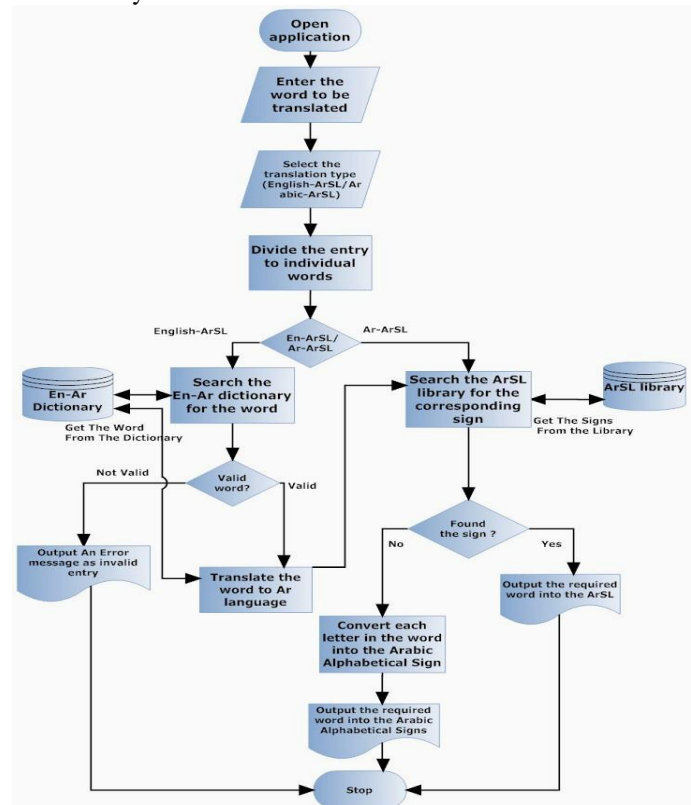


fig. 9. The Dictionary Flowchart

As shown in fig.9 ; the deaf user enters the text and selects the language to be translated in. Then the text is divided into individual words. Depending on the user selection language ; the text is converted to the SL syntax using the ArSL library and the ASL library .If the entered text isn't in the library it's converted to the alphabetical signs .After a few seconds the required page is converted to its corresponding deaf user own language ;SL .

### B. The Dictionary System Analysis

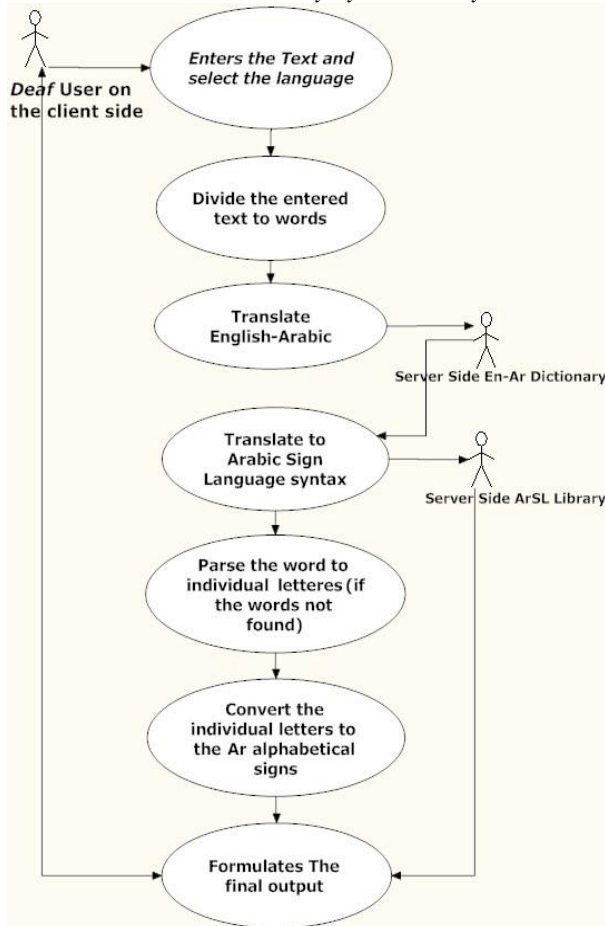


fig. 10. The Dictionary system use-case

The analysis of the dictionary system is shown in fig.10 ; in which the user will interact with the user interface at the client side to enter the text to be translated into the SL and the language of the translation then his request will be passed to be processed .The text will be divided into individual words .Then, the English text will be translated into Arabic language depending on the En - Ar dictionary on the server side .Then , the words will be translated into the ArSL using the server side ArSL library .If the words aren't found in the library ( like the names ) they will be parsed to individual letters then they will be translated into the alphabetical signs . Then the final output will be formulated to be displayed again to the user .

### C. The Dictionary System Design

As shown in fig.11 the scenario of the proposed dictionary system is as following . The user sends his request to the server side in the form of the text entry and the language selection . The text will be divided into individual words via Text\_Divider module. The words with the language selection

are sent to the Translation\_Type\_Checker module which in turn sends the entered words to the English-Arabic\_translator module ( if the entered text is in English) to translate the word into Arabic language using Arabic-English Dictionary module . Then , the ArSL\_Syntax\_Translator module will translate each Arabic word to ArSL using the ArSL\_library module which contains the gestures that corresponds to the popular Arabic words .If the word doesn't exist in the library (like the names ) it is sent to the word\_to\_individual\_letters\_parser module , which sends the individual letters to the The letters\_to\_Ar\_Alphabetical\_Sign\_generator module which generates the Alphabetical sign for each letter . Finally , the Final\_output\_formulator module which formulate the final output that will be displayed to the user .

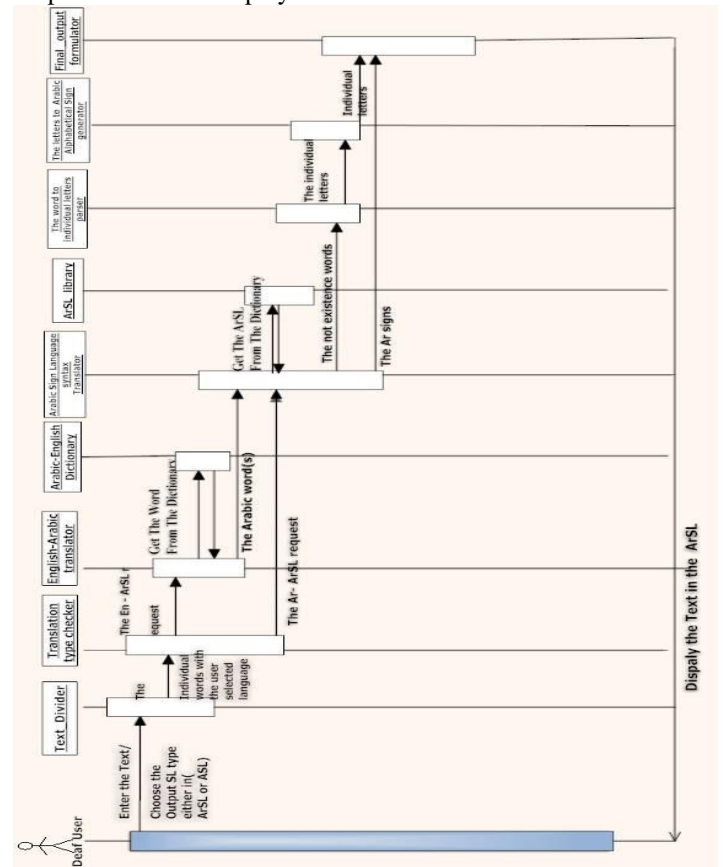


fig. 11. The Scenario Diagram Of The Dictionary System

### D. The Dictionary System Case Study

This system also is implemented entirely in PHP language and MySQL [47]. The whole of the case study can be summarized in the fig.12 .The main page of the application where the user enters the URL of the required web page and choose the translation type(either English-ArSL or Arabic-ArSL) then the entry is passed to the selection checker and language translator. The Arabic word is passed to the ArSL translator .Finally, the output is displayed .for the user.

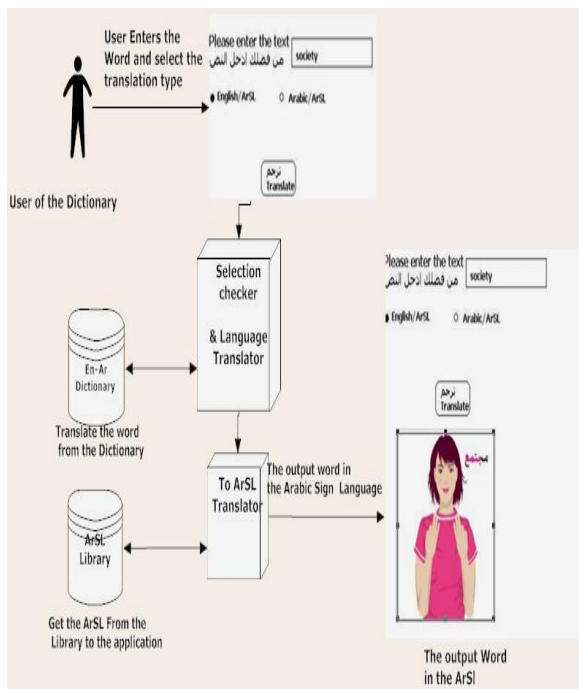


fig . 12. The Dictionary Implementation

#### IV. VALIDATION OF THE WORK

This system was validated in Meet Hadar school for deaf and hearing impairments students in Mansoura city . System was tested in three classes at that school and the total users were ten users whose ages were from 10 to 14 years old . The questioner was prepared in paper based forms which contained twelve questions that were prepared for them in Arabic language .These questions in order are :

Do you have any experience in the computer ?

Yes To some extent No

Did you visited any websites before ?

Yes To some extent Never

Is it easy for you to deal with our web application ?

Yes To some extent No at

all

Is the presentation good for your needs ?

Yes To some extent No

Is it easy for you to understand the message of the navigated website ?

Yes To some extent No

Is the figures used for the presentation is pleasant for you?

Yes To some extent No

Are the colors used in the application is pleasant for you ?

Yes To some extent No

Would you like to use our web application again ?

Yes of course To some extent No

Never

Did you prefer the idea of the application ?

Yes To some extent No

Which type of reading did you prefer?

Line By Line Word By Word

Please write down the goal of our application as you understood .

.....Would you like to add any notes or additions for our application ?

The results for the first nine questions of the validation are shown fig. 13 .

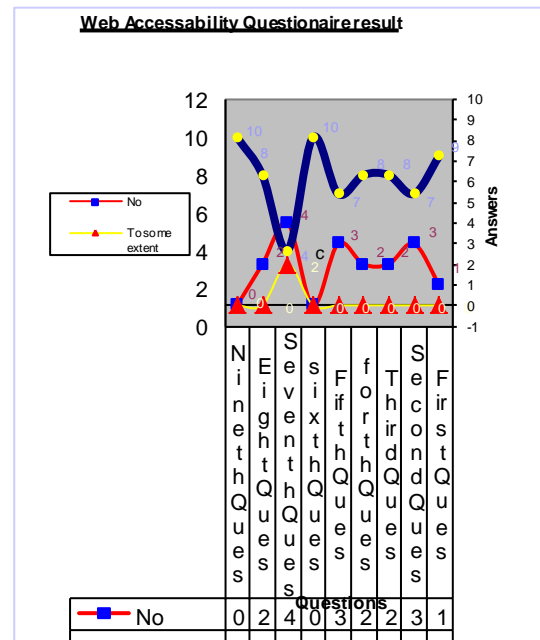


fig. 13. The Validation Results

The results for these questions showed that 90% of the validation sample well users for the computer and about 10% don't use the computer .About 70% use the internet in their daily life and about 30% don't use the internet . The system and its different characteristics took about 79% full approval . And about 19% is the majority approval .And only the colors characteristic was rejected by 2% of the system user . About 50% preferred the word by word reading type and about 50% preferred the line by line reading type . 100% of the test sample explained the goal of the system fairly .And we got some notes in the twelfth question and ideas about making some adaptation in the system like more color options and many avatars types for the variety and adding some new characteristics as lip reading for the avatar . And all of these notes will be taken in the account in the future .

#### V. CONCLUSION & FUTURE WORK

As described in this paper, the use of SL. furthers the reading competence of deaf people and enhances their acceptance and understanding of learning content presented to them. But most of the deaf adults did not get school education in sign language and therefore lack basic reading and mathematical skills needed for further vocational training. The low reading skills also restrict their possibilities of information gathering and self directed learning. Based on these findings, a dictionary and e-learning system is adapted to the needs of deaf People.

The use of sign language animation for each text block is the most important feature. Providing sign language animation will help the users improve their reading skills and enable them to learn more independently. Also E-learning system for deaf adults has been proposed.



Regarding the dictionary system, authors are currently working to expand this bilingual dictionary to a courseware dictionary. Authors are planning to test it and obtain feedback and suggestions. The e-learning part is validated as shown in the last section of the paper and in the future work authors will validate the whole system and test on another deaf school.

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