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A PROPOSED MODEL BASED ON AUDIO-VISUAL AIDS FOR LEARNING THE ACCURATE ARABIC PRONUNCIATION

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ABSTRACT

This work aims at presenting a multi-agent educational model to learn the accurate Arabic pronunciation. The concentration is focused on how a learner accurately listens and sees the writing shapes and different sounds of any Arabic character. This is clear from the explanation of individual Arabic characters, a set of adjacent characters connected together, complete words, multiple words, or even a complete sentence. The model adopts several agents mainly: the learner agent, the tutor agent, the graphical user interface agent, and the domain knowledge one. The model is supported by multimedia capabilities which have a great effect on the learner's grasping level. The model easily enhances the interaction with the learner. This is clear from the adopted different activities such as: learner identification, concept selection, concept presentation, question-answering facility, feedback messages, advices, and learners' evaluation. The model was run and tested on a chosen sample of learners. Such sample was randomly chosen from both males and females. The model was implemented using Java, XML, MYSQL, and the Sound-Forge digital audio editing. From the learners' monitoring the model is useful and promising. It is interesting and attractive due to the supported multimedia facilities.

Keywords: Multi-Agent Model, Domain Knowledge, Multimedia Facilities, Arabic Language, and Performance Evaluation

1. INTRODUCTION

Computer assisted language learning is an important approach for facilitating the language learning process. It can be used to help learners who require additional support. The design of such language learning involves the principles of language pedagogy and methodology which may be

derived from different learning theories. The multimedia technology plays an important role in the educational environment. It offers opportunities for language learning with the integration of text, images, audio, video, and animation. Multimedia technologies support independent learning through student control of information and events. Multimedia technologies have proved a powerful catalyst for cooperative learning [Rahmah, 2006].

Using the computer technology in education is important as it gives individual attention to the learner and replies it him. It guides the learner towards the correct answer, and generally adapts the material to his/her performance. This flexibility allows the learner to choose between several modes of presentation [Abdallah Naba'h, et.al., 2009].

The organization of this work will be as follows: Section 2 presents the conceptual framework of the proposed model while Section 3 presents learning Arabic using different speech tract. Section 4 discusses the shapes and sound of Arabic characters. The implementation work and conclusion are presented in Sections 5 and 6 respectively.

2. RELATED WORK

This research work aims at presenting a model supported with audio-visual aids for learning the accurate Arabic pronunciation. Several efforts were presented in that area for its importance and vital role. Examples of such efforts are briefly mentioned as follows:

Abdallah Nabah, et.al presented a study to investigate the effect of using an instructional software program for learning the English language for Jordanian secondary students. The sample of study consists of two-hundreds and twelve students distributed on four experimental groups and four control groups. The study adopted an instructional software program for teaching the passive voice and an achievement test. The findings of the study revealed that there were statistically significant differences between the students' achievement mean score in grammar attributed to the instructional method of teaching [Abdallah Nabah, et.al., 2009].

Faryadi presented an effective interactive multimedia courseware to be utilized in Malaysian classrooms. A courseware for interactive instructional design for learning Arabic was developed, and incorporated as a cognitive load in multimedia learning. The author discussed the conceptual and theoretical approaches and utilized real instructional applications [Qais Faryadi, 2012].

M. Aldalalah, et. al investigated the effects of modality principles in instructional software among first grade students' achievements in learning the Arabic language. Two modes of instructional software were developed: audio with images, and text with images. The students were randomly assigned to any one of the two modes. The study concluded that the audio with images mode was an important aid to learning as compared to text with images one [M. Aldalalah, et. al., 2010] .

Sahrir, et. al. described an Arabic vocabulary learning prototype. This was for the elementary learners in the center for foundation studies in Malaysia. The authors attempted to develop and integrate a game-based learning application in an online platform. It is important to provide an interactive learning experience for learners who have been through traditional non-computer based Arabic teaching and learning methods. Their feedbacks and responses were then gathered and analyzed for the development principle. The development of that prototype was usable and practical [Muhammad Sahrir, et. al., 2012].

Osman presented a study that concentrates on formulating the necessary tools for acquiring the required skills during the teaching of Arabic literature. This was done for the Malaysian students studying Arabic poetry as well as the Arabic language. The author presented a multimedia package to promote motivation and increase the confidence level to take the challenge of Arabic literature [Rahmah Osman, 2012].

3. A CONCEPTUAL FRAMEWORK FOR THE PROPOSED ARABIC LEARNING MODEL

The proposed language learning model is an instructional approach that uses the capabilities of the multimedia technology. This involves the chosen domain knowledge and organization within the human memory as well as the nature of learners' errors. The model adopts a mixed-initiative teaching dialogue. This means that the interaction between the learner/user and model is allowable and goes both ways. The model also interprets and responds meaningfully to learner-initiated interactions. The main conceptual diagram of the proposed model is shown in Figure 1 while the main components of the overall framework are shown in Figure 2.

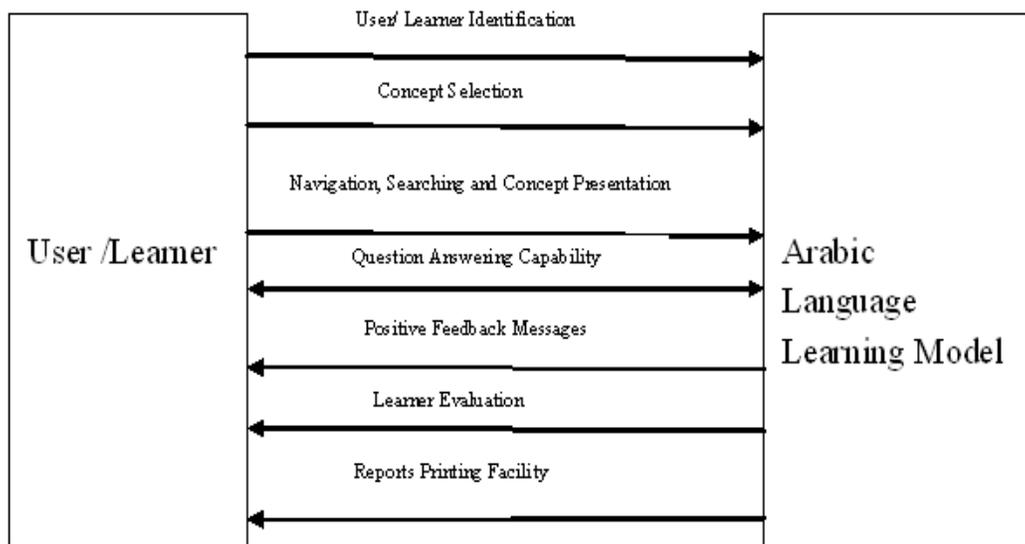


Figure 1: The Conceptual Diagram of the Proposed Learning Model

It is important to mention that the words 'learner' and 'user' are used interchangeably. As shown in Figure 1, the interaction between the proposed model and a user involves: identification of a learner (login name and password), navigation and searching in the adopted domain knowledge, selection of a required concept, explanation of the chosen concept, presentation of questions, analysis of the learner's behavior, display of positive feedback messages, and evaluation of the overall learner's performance [Qais Faryadi, 2012], [M. Aldalalah, et. al., 2010].

All the previous activities are collected in four agents mainly: the tutoring agent, learner agent, a user interface agent, and the domain knowledge one.

The language learning process is supported by the multimedia facilities [Muhammad Sahrir, et. al., 2012], [Rahmah Osman, 2012], [Abdallah Nabah, et.al., 2009], [Osamah Aldalalah, et. al., 2010].

The cognitive multimedia aspects in this work use the spoken text and/or audio in explaining the images of the Arabic characters. This includes explaining how to read, write and pronounce the Arabic characters, words, phrases, and even sentences.

This is done by presenting some words and sentences from the holy Quran. Figure 3 briefly shows the main principle of cognitive multimedia aspects considering the user sensory memory (ears and eyes).

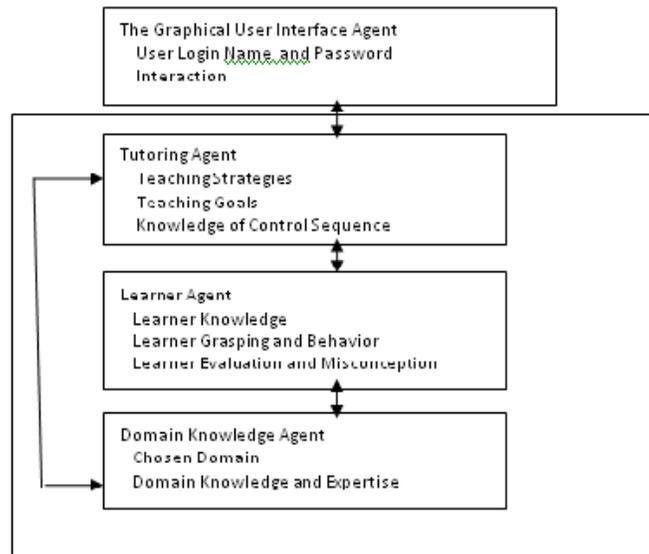


Figure 2: The Main Components of the Overall Framework of the Model

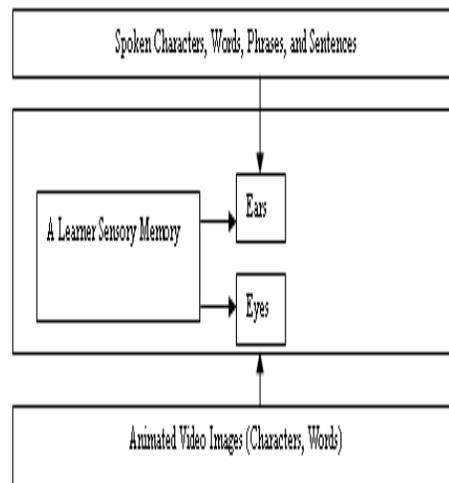


Figure 3: The Adopted Cognitive Multimedia Aspects

3.1 The Tutoring Agent

The tutoring agent provides the teaching strategy which is suitable to the learner's needs [R. Pishghadam and R. Motakef, 2012], [Robert Mack, et. al. , 1997], [Rahmah Osman, 2010], [Abdallah Abu Naba'h; et. al., 2009]. That agent contains statistics information and knowledge which are stored in the learner agent. The tutoring agent provides necessary knowledge so that tutoring goals can be achieved as shown in Figure 2. The agent also can control the sequence of concepts that will be displayed to the learner. The agent also presents the correct answer of any questions and gives the appropriate advice to the learner. Presenting such appropriate advices is important for enriching and developing the learner's skills. The agent also exploits any information about the tutor situation to present corrective actions and remedial instruction.

3.2 The Learner Agent

The learner agent plays an important role in the tutoring system. It considers the learner knowledge as well as the learner behavior. This is important for keeping track of the learner status and determining the most relevant presentation methodology. The learner information related to any concept can be stored in a database. The learner agent also involves the descriptions of learner's knowledge as well as any misconceptions as shown in Figure 2. With the cooperation between the learner agent and the tutoring agent a learner's answer is analyzed, evaluated, and appropriate feedback is presented.

3.3 The Graphical User Interface Agent

The language learning model is supported by a graphical user interface agent which is very important for interaction. The interface is supported by multimedia facilities. This includes images, video, and animation in addition to text. Using such means of multimedia, inputs and outputs can be entered to and displayed from the computer. The user interface handles different types of information to implement a dialogue form. Such dialogue is important to select a specific concept or topic for explanation, enter an answer to a question, display evaluation results, and others [Rahmah Osman, 2010], [Qais Faryadi, 2012]. Examples of the main screens of the user interface are shown in Figures 4 to 8 respectively.

3.4 The Domain Knowledge

The domain knowledge refers to the expertise related to the chosen subject material. The proposed model tries to exploit the domain knowledge for understanding the concept contents. This is important for the question-answering process which goes both ways. The chosen domain in this proposed model concentrates on how a user learns the accurate pronunciation of the Arabic characters. This can take place by referring to the words from the Holy Quran. This can be done through learning what is called Arabic speech units. Such units were grasped and defined by the Arabic linguists. The number of speech units; that cover approximately the pronunciation of the Arabic language on the different levels; is about one thousand two-hundreds and ninety seven. The different levels here mean: the Arabic character level, a set of contiguous Arabic characters, a complete single Arabic word, a compound Arabic word, and multiple-words. This means that learning the pronunciation of the Arabic language can be done through four levels as mentioned in the following Section.

4. LEARNING ARABIC USING THE DIFFERENT SPEECH TRACT

Learning the Arabic language is done in both written and spoken manners. A learner can listen to the Arabic character or series of characters or word(s) based on what is called articulating phonetics. Such phonetics deals with the mechanism of sound production. It is known that the speech is produced with the help of some kind of sound making and sound articulating apparatus inside the human body called speech tract. Learning the accurate pronunciation of the Arabic language is focused on four categories of the speech tract. The tracts are: larynx containing the vocal cords, oral cavity (mouth), pharyngeal cavity (throat), and nasal cavity (nose). Some Arabic characters are spoken based on the inner part of the throat [Tarni Prasad, 2009].

Moreover, the learning of Arabic language also considers the vowel aspects regardless the types of such vowels: close vowel, open vowel, front vowel, back vowel, or central vowel. Learning of Arabic language also considers the lip-rounding [Tarni Prasad, 2009].

All the above themes can be used in presenting and learning the different types of Arabic speech units as shown in Figures 9 to 11.

4.1 Level 1: Learning Arabic Characters

Both the shape and pronunciation of each Arabic character are explained using text, audio, and video. It is important to mention that the shape of an Arabic character may change due to its location in the Arabic word. The model learns how to write and pronounce every Arabic character in different locations: at the beginning, at the middle, or at the end of a word. This can take place through the presentation of several concepts. The model also explains how to recognize the spoken Arabic character with vowel and actions. This is clear from the mouth and animated lips movement as shown in Figures 9 to 11, 14 to 19, and 23.

4.2 Level 2: Learning a Series of Arabic Characters of a Word

This level is concerned with explaining how to learn the shape and pronunciation of a series of characters in a word. This includes two, three, or more adjacent characters. These characters may be at the beginning or at the end of an Arabic word. The explanation of such characters will be also done using some of the multimedia facilities mentioned above. Examples of such explanation are shown in Figure 12.

4.3 Level 3: Learning a Complete Arabic Word

This level is going to explain how to listen and see the shape and pronunciation of a complete Arabic word. Different Arabic words are presented regardless their types: nouns, pronouns, articles, verbs, adjectives, modifiers, prepositions, or any other types. To facilitate such type of learning, the model is supported by a prototype Arabic dictionary. The model retrieves a required Arabic word to be explained to the learner in both forms: written and spoken. The explanation is supported by text, video, and animation. Figures 20 and 21; for example; show how to listen, see, and pronounce some Arabic words with 'repeated shaddah'.

4.4 Level 4: Learning Multiple Words or a Complete Sentence

This level is concerned with learning the accurate pronunciation of idioms (double word), and multiple words. Moreover, it presents the pronunciation of short or long Arabic sentences. The pronunciation of Arabic on the sentence level is supported also with audio-visual aids as in the above levels. Figures 13, 16, 20, and 22 show how to listen see, and pronounce some speech units of a verse from the Holy Quran.

5. LEARNING THE SHAPES AND SOUNDS OF ARABIC CHARACTERS

An Arabic word consists of a set of characters connected to each others. Many characters look similar but are distinguished from one another by dots above or below their central part called rasm. Such dots distinguish between characters that represent different sounds. The model is going to learn the original Arabic abjadi used for lettering in addition to the hijai order. The model presents how to learn the Arabic character style which may have different shapes depending on whether it will be connecting with a preceding and/or a succeeding character. The four distinct forms of an Arabic character (initial, medial, final, or isolated) are also presented. For more details the reader can refer to [Wikipedia, 2012].

The model also learns the characters that represent different phonemes. An example of this is the character 'alif' which can appear without diacritics'', with hamzah above ٱ, with hamza under ٱ, or with maddah ٱ. The model is going to learn the Arabic characters and words that are characterized with their forms in addition to the short movements (harakat) like fathah, dammah, or kasrah.

Moreover, the model explains how to pronounce those words with 'shaddah'. The term 'shaddah' means two similar adjacent characters are merged together in one character only like the Arabic words 'شَدْد' and 'عَدْد'. Initially they are 'شدد' and 'عدد' respectively without 'shaddah'. The model

also explains those Arabic characters that are similar to each others in their shapes but differ in their spoken due to their associated dots. Examples of such characters are: (ب، ت، ث), (ج، ح، خ), (س، ش), (ص، ض), and so on. The model also learns those characters that are written but not spoken like the character 'ا' in the Arabic past verb 'اسمعوا'. The model also learns how to read, write and pronounce those sounds that are spoken but not written like 'ا' after the Arabic character 'هـ' in the Arabic words 'هذه، هذان، هؤلاء'.

The model also presents how to learn ligatures which are common in Arabic. The components of a ligature for 'الله' (God in English) are: alif, hamza wasl, lam, shadda, dagger alif, and ha. The model also learns what is called nunation (Arabic تنوين) by adding a final-n to noun or adjective. The vowel before it indicates grammatical case. In written Arabic nunation is indicated by doubling the vowel diacritic at the end of the word.

Vowels are also presented in this work. In Arabic grammar the vowels are used since they are crucial to the grammar. An Arabic sentence can have a completely different meaning by a subtle change of the vowels. In important Arabic text like the holy Quran, three basic vowel signs are mandated, like the harakat. Such vowels are: fathah /a/, dammah /u/, and kasrah /i/. An Arabic syllable can be opened (ending with a vowel) or closed (ending with a consonant). In closed syllables, the closing consonant does not carry a vowel by making it with a diacritic called sukun (سكون) to remove any ambiguity especially when the text is not vocalized [Wikipedia, 2012].

6. IMPLEMENTATION WORK

This section is concerned with the implementation of the adopted proposed model. This includes several themes mainly: platform, capability, applicability, and some working screens or snapshots.

6.1 The Implemented Work Platform

The learning model was developed and implemented. In this concern, three important themes were implemented mainly: programs, databases, and a powerful interface. The model contains a set of program modules which were implemented using both Java language as well as XML. The created database here is of type relational database and was implemented using MYSQL. The model is supported by a graphical user interface and it was developed using Photoshop, Flash, and Sound Forge digital audio editing. This means that listening, seeing, and pronouncing the Arabic characters are presented with multimedia facilities.

For more details about the above mentioned themes, the program modules enable users to choose a required concept. They facilitate searching and matching the user demand with those exist in the database. The programs facilitate also presentation of the Arabic concepts. The programs enable users to ask then receive the answer or vice-versa. The program modules support users with positive feedback messages as one way of advising.

The database on the other hand contains the Arabic alphabet: different shapes and phonemes. The attributes of each character are presented in that database. Such attributes are related to the characterization and features of each character regardless the position of such character in an Arabic word. The different phonemes of Arabic characters are also pre-stored in addition to how to listen, see, read, write, and pronounce the Arabic characters. The database also stores a lot of words from the Holy Quran. Moreover, the database contains a set of questions that are presented to the learner to check the learner understanding level. The questions are chosen randomly after explaining the Arabic concepts. The programs, databases, and all software tools are stored on a server to access that developed work either locally or remotely.

6.2 The Model Capabilities

This model presents a set of valuable activities. This includes (but not limited to) the following:-

- 6.2.1 Learn how to write and speak the Arabic alphabet. The different writing styles and different phonemes are presented both written and spoken. The work correlates between a character display and its synchronized sound during listening. This involves the individual and connected Arabic characters, complete words, multiple words, and even sentences.
- 6.2.2 Enhance the learner with a set of enrichment examples. This is done by presenting the same tutoring concept several times upon the user demand.
- 6.2.3 Facilitate the question/answering process. This is achieved by asking questions to be answered by the learner and vice-versa.
- 6.2.4 Present useful advices. This occurs through positive feedback messages for removing any misunderstanding from the learner.
- 6.2.5 Evaluate the learner performance. This is done by presenting a quantitative evaluation for the overall learner belief. The model presents the percentage of the correct answers relative to the whole presented questions. This is easy by keeping track of a learner status through record-keeping.
- 6.2.6 Support emails and interaction with learners. This is clear from the enhanced graphical user interface to ease the interaction with the learners. The interaction goes both ways and is based on multimedia facilities.

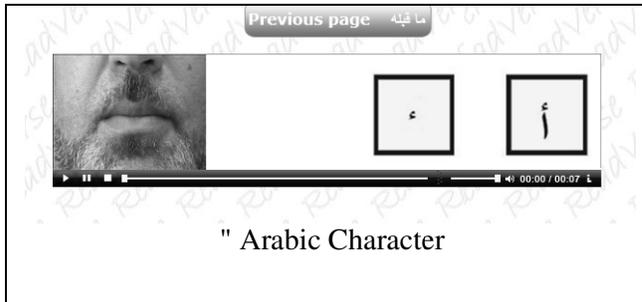
6.3 The Model Applicability

The implemented learning model was applied on a sample of learners. That sample was randomly chosen from both males and females. It was a good idea to test that learning model on a sample of non-Arabic speakers. In fact, there were some difficulties to contact foreigners like those working in different embassies in Cairo. The authors need much effort to take formal permissions from those embassies; so this approach couldn't be done.

6.4 The System Screens Snapshots

The implemented work presents several screens that show the different activities. Such screens are supported by text, character and word images, animation, mouth and hand movements.

Learning the Arabic characters and words in this work is done by presenting how to listen, see, and pronounce some words from the Holy Quran. It is also a good chance to learn how to read, listen, and see the accurate pronunciation of a word, set of words, a complete word, or a complete sentence. A complete sentence in the holy Quran is called 'verse'. Figure 4 shows the main screen of the Arabic learning model as well as the Arabic guide for enunciation. This is important because it enables learners to master the precise enunciation of Arabic characters and words with different values (Tashkeel). Figure 5 presents both the Arabic audio dictionary and the Arabic enunciation tools. Such tools include: the Arabic alphabet, the alphabet shapes, 'tashkeel', and essential sounds. This also involves some sort of word manipulation facilities. Searching for a required word in the Holy Quran is one of such facilities. Once the required word is found, some related information are retrieved such as sura number, sura name, verse number, the verse containing the required word, the Arabic verse sound, and so on. Figure 6 shows the shapes of the Arabic characters and the capability for a user to enter a required Arabic character/ word to listen to its corresponding sound. Figure 7 shows the tokenized and connected verse words of the retrieved sura. Figure 8 shows the instructions for hearing the sound of a segment, word, or syllable. Figure 9 shows how to read, see, and listen to the Arabic audio characters. Figures 10 and 11 show; for example; how to pronounce the Arabic characters "أ" and "ك" respectively. Figure 12 shows the Arabic compound characters. Figure 13 presents how to read, and listen to the Arabic words with a special feature such as the repeated shaddah. Figure 14 shows reading and listening of an Arabic character with finger movements. It



" Arabic Character

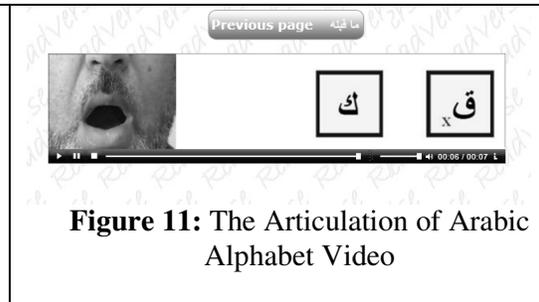


Figure 11: The Articulation of Arabic Alphabet Video

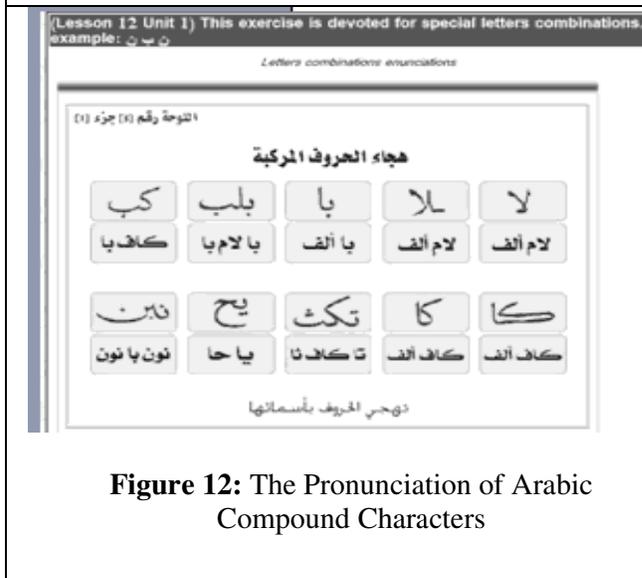


Figure 12: The Pronunciation of Arabic Compound Characters

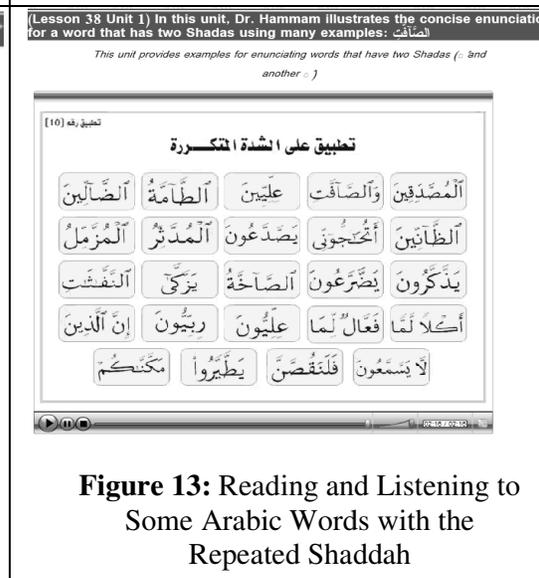


Figure 13: Reading and Listening to Some Arabic Words with the Repeated Shaddah

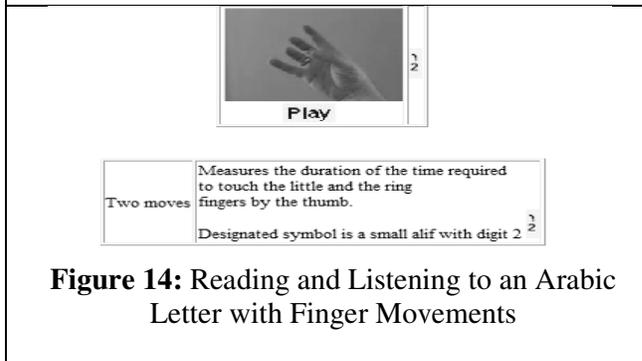


Figure 14: Reading and Listening to an Arabic Letter with Finger Movements

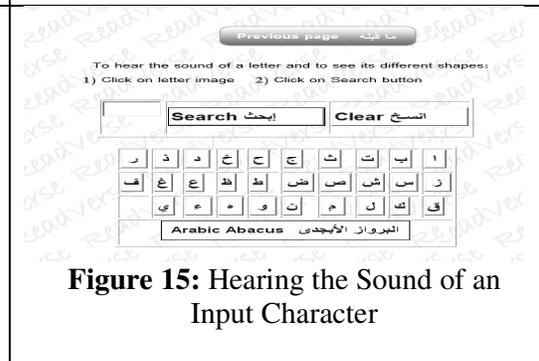


Figure 15: Hearing the Sound of an Input Character

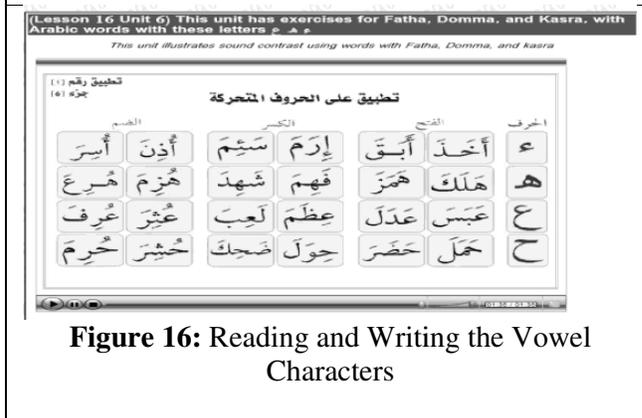


Figure 16: Reading and Writing the Vowel Characters

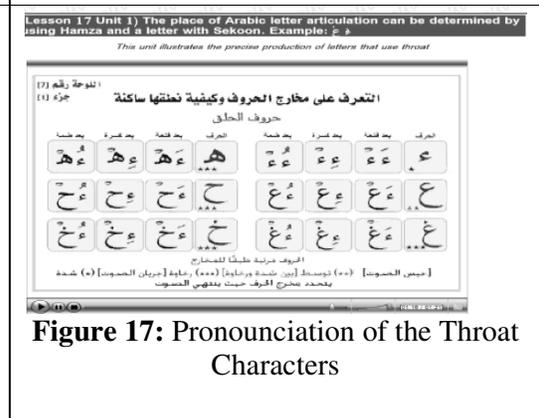


Figure 17: Pronunciation of the Throat Characters



Figure 18: Pronunciation of the lips characters

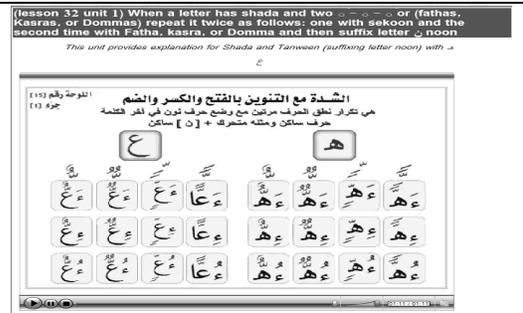


Figure 19: The Arabic Characters with Shaddah and Vowels

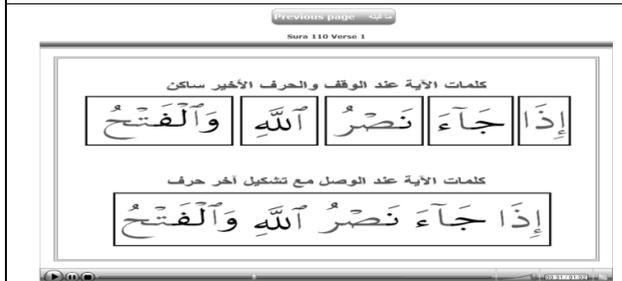


Figure 20: Listening, and Pronouncing the Speech Units of a Verse From the Holy Quran.

Arabic video search, search word - النّاس

Tashkeel	Pronunciation	Root	English Translation	Action
النّاس	النّاس	نوس	Mankind / People	Display
والنّاس	وَالنّاس	نوس	Mankind / People	Display

Figure 21: Tashkeel, Pronunciation, Root, and English Translation for the Required Word

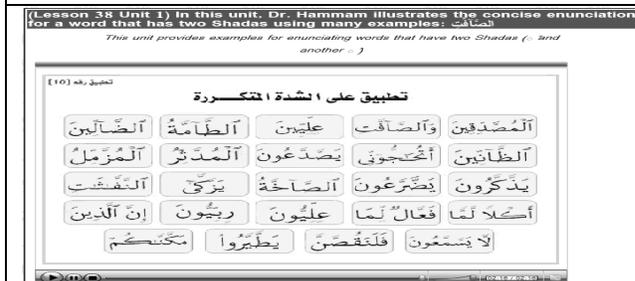


Figure 22: Listening, and Pronouncing Arabic Words with Repeated Shaddah

Arabic Word Game Score : 0%

Please, type only one letter

Please complete the word لِب

Search ابحث Clear اانسح

ا	ب	ت	ث	ج	ح	خ	د	ذ	ر
ز	س	ش	ص	ض	ط	ظ	ع	غ	ف
ق	ك	ل	م	ن	ه	ة	و	ي	
ء	أ	إ	آ	أى	ؤى	وى			

Arabic Abacus البرواز الأبجدى

Figure 23: Completing a Missing Character After Listening to the Whole Word

7. CONCLUSION

This work presented a model for learning the Arabic language. That model mainly aims at presenting how learners accurately listen, see, and pronounce the Arabic characters and words. The model was implemented, applied, and tested on a chosen sample of learners. It is easy to say that the adopted model is promising and useful. The model is O.K. due to its interactive capability with learners. The multimedia facilities play an important role in the learners' attention and their grasping. This is due to the effectiveness of text, images, video, and sound. All learners appreciated the work due to its effectiveness in explaining the Arabic characters and words. Moreover, the females' behaviors were slightly better than those of the males.

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