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Alves: Arabic Language Vocalization using an Expert System

Language

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ABSTRACT

In this work we aim to develop a Human-Machine Interface in which progressively are integrated tools for automatic natural language processing. Especially a speech synthesis system from a text modeled by an expert system; The final goal of this research is the production of voice which is more likely of that of human beings, both in terms of intelligibility and naturalness. This challenge requires knowledge of various kinds to be modeled by the essential tool of artificial intelligence which is the expert system. The approach is based on a conceptual analysis of the different stages of creating of our expert speech synthesis system from a text written in Standard Arabic.

INTRODUCTION

Design of Knowledge Based systems (KBS), especially Expert Systems (ES), is a key area of Artificial Intelligence (AI). Factors that underlay knowledge-based systems are knowledge acquisition, knowledge representation, and the application of large bodies of knowledge to a particular problem domain in which the knowledge-based system operates. These tools are designed to imitate human experts in various fields by exploiting a set of knowledge acquired from them. Appeared around 1975 (cf. the medical diagnostic system MYCIN [1]), they had a definite impact on AI as well as media coverage, which are sometimes exaggerated. The term ES is based on a separation between the knowledge needed to solve a problem and the reasoning mechanisms exploiting this knowledge. Significant progress has been felt in the field of speech processing in recent years giving birth to several applications suggested once by research laboratories and one another by companies [2].

The voice synthesis is an important part of the field of automatic speech processing which aims to provide the ability to talk to the machine. The synthesis of speech from text (Text to Speech) is the major component of speech synthesis; it principal objective is to transform an text input to a spoken voice output via a series of transformation applied to the text input.

The aim of our work is to try to marry the field of expert systems with that of the speech synthesis in order to give birth to an expert system capable of producing synthetic speech from a written Standard Arabic text with an acceptable quality.

RELATED WORKS

Several systems of speech generation are designed and published on the web nowadays, they are either paid or free and also multiplatform. The following table (Table 1) shows some preliminary work in the area of speech synthesis (This list is not exhaustive but provides some existing products), these applications allow the automatic generation of s speech for different languages:

TABLE 1: SOME SPEECH SYNTHESIS SYSTEMS

Historical applications	Famous Applications	Research Applications	Commercial Applications
* The talking machine Baron Wolfgang von Kempelen (1734-1804) [3] * The first «Voder» Bell society [4] * Automatic speech on IBM 704 (1961) * Speech «hardware» by Votrax	* Microsoft Narrator * Apple Siri * Google Translation Google Translation reader	* KALI - Speech [5] * The Mbrola project [6]	* AT & T Labs Research [7] * TTS Voice - imtranslator.net [8] * Demonstrator France Telecom [9] * Loquendo - TTS Demo [10] * Acapela HQ TTS interactive demo [11] * Pediaphon - Wikipedia Articles [12] * Oddcast SitePal - Text-to-speech [13]

PROBLEMATIC

In the literature, a number of studies on speech synthesis systems from a text exist, despite this, the speech synthesis field remains not fully mastered. However, researches conducted in recent years have resulted in an acceptable speech quality that affects nearly a natural voice.

Improve the quality of synthetic speech is a crucial problem. It occurs mainly by the fact that the understanding of the synthetic speech requests from the listener more effort compared with the case of a natural speech.

This additional effort is due, in reality, to the intra- and inter-speaker variability of the voice signal. Indeed, the real problem is that we still, till now, do not know very well how to model the enormous knowledge and useful information for the speech synthesis.

Our approach is to use an expert system to model this knowledge and build a system that can read any text written in Standard Arabic. According to search that we have done in the literature, not much work has studied the possibility of speech synthesis using an expert system, citing here works of [14], [15] and [16]. These, however, have not studied the Arabic language; so we believe that our modest work is among the first work of its kind that has explored the possibility of mixing the fruit of artificial intelligence with the Arabic language.

GENERAL SCHEMA OF OUR SYSTEM

The task of a synthesizer is to ensure the reading of a given input text. Since it is impossible to record all the sounds that correspond to all the words of this text which can be written in any language; the solution is to define the speech synthesis system as a system of automatic production of speech that is based on a transformation of the orthographic text into a sequence of sounds or phonemes using an expert system (Figure 1);

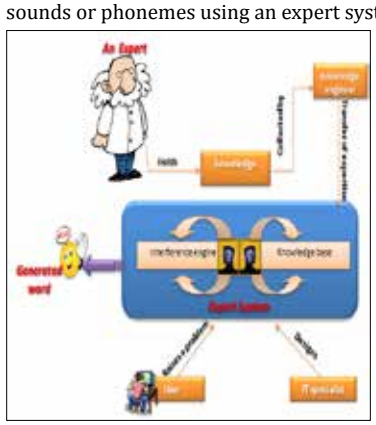

Figure 1: Functional diagram of our Expert System

An expert system is a computer software designed to simulate human expert on a particular and a specific and well-defined subject area through the operation of a number of explicit knowledge provided by the expert himself [17]. To build this system our work targets the following steps:

· **The creation of the knowledge base :**

A knowledge base includes knowledge specific to an explicit given field, it is often stored under a form usable by a computer. It may contain rules or facts; so we shall talk about rules base or the fact base [18].

With our knowledge base will model two things: knowledge through our sound database and the chain of characters entered by the user; and the know-how through the use of all rewrite rules necessary to transcribe the text into a phonetic spelling chain; this is to model the linguistic knowledge of human beings by a set of rules that can be written under the following form:

/ LG (Left Graphem) / + / C (Character) / + / RG (Right Grapheme) / = [Phoneme].

Here is an example of pronunciation rules:

The pronunciation of the word / al / " ال "

+ / أ / + / ل / + / LC / = [a] concatenate [L] concatenate [LC]

+ / أ / + / ل / + / SC / = [A] concatenate [SC]

Where # is a sign of the beginning of a sentence,

SC is a solar consonant,

LC is a lunar consonant,

- If the character that follows the " ال " /al / is Lunar then read the sound [a] concatenated with the sound [l] followed by the sound of the lunar consonant[LC]
- And when the " ال "/ A l / is followed by a solar consonant, we get the sound [a] concatenated directly by the sound of the solar consonant [SC]

Our fact base incorporates two types of facts: permanent facts of the field and the facts inferred by the inference engine.

· **the inference engine :**

An inference engine (from the verb "infer" which means "deduct") is a program corresponding to a simulation algorithm of deductive reasoning. It allows expert systems to conduct logical reasoning and derive conclusions from a fact base and a rule base.

The inference engine may implement:

a formal logic of order 0 (propositional logic), order 0 + or order 1 (predicate logic)

a forward chaining , backward chaining or mixed [19]

In our case we used SWI-Prolog (Programming Logic) as the inference engine, it is a descriptive programming language (facts and relations) and prescriptive (inference); it is based on the logic of 1st order. The programming language, Prolog, was born of a project aimed not at producing a programming language but at processing natural languages; in this case, French. The project gave rise to a preliminary version of Prolog at the end of 1971 and a more definitive version at the end of 1972 [20].

Among the predicates we use in our design; we give two examples as follow:

```
concate ([], L2, L2).
concate (L1, [], L1).
concate ([H | T], L2, [H | R]): - concate (T, L2, R).
top ([], []).
top ([Head | Tail], Result): - api (Head, R1) / / api is
the alphabet phonetic International / /
top (Tail, R2)
concate (R1, R2, Result).
```

Responding to a request from the user, Prolog have to trigger a predefined reflection based on its inference rules (deduction) using the knowledge. Prolog has two mode of "thinking"; the forward chaining (deduction of the solution from facts) or the backward chaining (The reverse process) to produce new knowledge.

THE ADVANTAGES AND DISADVANTAGES OF OUR SYSTEM

Our system also has some positive and some negative aspects regarding its use, this set can be summarized in the following Table 2:

TABLE 2: ADVANTAGES AND DISADVANTAGES OF OUR SYSTEM.

Advantages	Disadvantages
- it is used for an unlimited size of vocabulary - it can be used to bring help(assistant) to visual impaired people because of its speed compared with the reading in Braille - no constraint for Arabic texts to read - it assures an acceptable quality of the synthesized sentences. - It is flexible and can be integrated into any interactive system where the voice is the means of communication with the user.	- The synthetic words are little far from the natural. - A good quality of voice requires a good segmentation - The difficulty in developing all the phonological rules and models of grammar which are used in the phase of transcription. - The group of exceptions words which is used in transcription by lexicon is not finished (not finalized) such as at any time we can insert new exceptions.

CONCLUSION AND PERSPECTIVES

In this work we have proposed a speech synthesis system from a text written in Standard Arabic using the modeled by an expert systems; we focused first on the assessment of the different stages of building an expert system including the construction of the knowledge base which consists of two parts which are: the construction of the facts database and the construction of the rules database, without forgetting the inference engine.

Indeed, our model offers the possibility to use the advantages of artificial intelligence represented by expert systems to improve the quality of existing voice synthesizers.

To conclude this report, it is interesting to note that despite the existence of some products on the market, speech synthesizers are not completely ready. These tools do not speak with any natural that human beings are capable of. It should be noted that the speech, although intelligible, requires more concentration on the part of researchers.

Currently researchers in speech synthesis are working on:

- Improving the variability of the synthetic voice over time, such as adding the opportunity to enhance expressiveness (happy voice / sad voice/ angry voice / quiet, etc.).
- Developing of voice conversion methods that increase the rapidity of creation of new synthetic voice.

This bridge between the world of writing and that of oral plays an important role in improving today's technology, despite of this, our system still a hope for the visually impaired persons.

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REFERENCE

[1]R. Davis. Meta-rules: Reasoning about control. Artificial Intelligence Journal, 15:179-222, 1980. | [2]Jean-Paul Haton, "Artificial intelligence"; Text of the 263rd conference of the University of all knowledge given on 19 September 2000. | [3]"Wolfgang von Kempelen and his talking machine", Operation of CFMI - University Charles de Gaulle - Lille 3 Design of the operation: Jean Jeltsch, Muriel de Poorter CFMI - Université Charles-de-Gaulle - Lille 3. | [4]http://en.wikipedia.org/wiki/Voder . | [5]http://elsap1.unicaen.fr/KaliDemo.html | [6]http://tcts.fpms.ac.be/synthesis/ | [7]http://www.research.att.com/ ttsweb ~ / tts / demo.php | [8]http://text-to-speech.imtranslator.net/ | [9]http://tts.elibel.tm.fr/tts | [10]http://www.loquendo.com/en/demos/interactive_tts_demo.htm | [11]http://demo.acapela-group.com/ | [12]http://prt-i61.fernuni-hagen.de/ ~ bischoff / radiopedia / index_fr.html | [13]http://www.oddcast.com/home/demos/tts/tts_example.php?sitepal | [14]Synthesis - An Expert Expert System for Improving Naturalness in Synthetic Speech Katherine Morton, Paper for Expert Systems 87: Brighton, December 1987 - and for publication in the Proceedings. Copyright © 1987 Katherine Morton. | [15]Bruce Arne Sherwood, Alberto Maria Segre and Wayne B. AN EXPERT SYSTEM FOR THE PRODUCTION OF STRINGS phoneme FROM ENGLISH TEXT UNMARKED USING MACHINE INDUCED RULES Proceeding AECL '83 Proceedings of the first conference on European chapter of the Association for Computational Linguistics Pages 35-42. Dickerson University of Illlnols at Urbana-Champaign Coordinated Science Laboratory 1101W. Springfield, Urbana, IL 61801 USA | [16]Aggoun, Abderrahmane; Bourgault, S.; Dincbas Mehmet (Bearb.) SYNTHEX: an expert system for speech synthesis from text.. In: SPLT 1984 | [17]Mehdi Braham, Oumaya Abbes, Maroua Trabelsi Mehdi Dahmen, Rania Nouaari, "Artificial Intelligence: Diagnosis by expert system analysis model of actors: MACTOR" | [18]http://fr.wikipedia.org/wiki/Base_de_connaissance | [19]http://fr.wikipedia.org/wiki/Moteur_d% 27inf% C3% A9rence | [20]Alain Colmerauer and Philippe Roussel, The birth of Prolog, November 1992