Probabilistic Approach to Arabic Speech Correction for Peoples with Language Disabilities

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ABSTRACT

This work consists in achieving an automatic speech correction system for continuous Arabic speech with large vocabulary in mono-speaker mode. Two vectors to be generated: the first is an Arabic speech standard (probability of occurrence of each Arabic bi-phoneme), the second gives a probabilistic representation of the speech sequence to be corrected. Using these two vectors, phonemes that pose pronunciation problems to speakers and their replacements can be identified. The rest is a game of substitutions and belonging tests to an Arabic lexicon. For that, an acoustic model for Arabic speech and a lexicon of 4 million distinct words have been built. Results of the work were encouraging and present a reference for other works for people with language disabilities. A correction rate of 97% is reached.

Keywords: Acoustic Model, Arabic Language, Automatic Speech Correction, People with Language Disabilities, Phonetic Transcription

1. INTRODUCTION

The Human-machine communication (Alain, 1994 and Daniel, 1995) is in successive development which imposes from one day to another, new applications. Automatic spoken language processing is one of the techniques to facilitate Human-machine communication. But the important number of people with language disabilities presents one of principal obstacles for this technique. As this population is not immune from the human-machine communication, the automatic speech correction becomes a required necessity. In this context, we will present our automatic speech correction system of continuous Arabic speech. The main idea is the comparison between an Arabic phonetized speech and a bi-gram phonetisation model, using the bijective relation between the speech and its phonetic transcription. (A speech sequence has just one phonetic transcription and vice versa).

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2. PROBLEMATICS

2.1. Arabic Language

Arabic is the language spoken by the original Arabs. It counts more than 445 million speakers to be ranked the 4th in number of speakers and ranked the 8th in number of pages that circulate on the Internet (Web1, 2013 and Sil International, 2005). With its morphological and syntactic properties, the Arabic language is considered difficult to learners in the area of automatic language processing (ALJLAYL, 2002 and LARKEY, 2002). Wrong pronunciations increase this difficulty. The latter presents an advantage to introduce other means to facilitate the comprehension of Arabic discourses; then automatic speech correction will take place.

2.2. Human-Machine Communication

Human-machine communication environment is an environment that provides communication in different modes (by keyboard, gestural, vocalic...).

Vocalic communication between human and machine can intervene in different areas, we can mention:

- **Voice services** like the speaking clock, the weather, reservation tickets...
- **Quality Control**: In many environments the possibility to discharge workers through a voice interface, brings an undeniable gain freedom and speed of movement.
- **Avionics**: Several airline companies introduce in the dashboard level the possibility to launch a voice command without interrupt completion of the current task.
- Data entry like voice dictation.
- **Formation**: Children and adults are attracted by endowed speech games (video games, educational games ...). Language Learning Assisted by Computer and language laboratories began to introduce increasingly voice methods.
- Assistance to people with disabilities.

We mention that several factors prevent an ideal Human-machine communication, we note some examples:

- **Internal Factors**: Ambiguity (Merhbene, 2013), implicit, language model, acoustic model...
- **External Factors**: Noise, climate, type of speech (continuous, single words)…
- Factors due to speakers: handicap, native or non-native…

A mispronunciation from the speaker can falsify information submitted to the machine; which increases the difficulty of a good communication. Therefore, the solution is to introduce a speech correction module in the machine to adjust information before treating. The human-machine communication environment can be represented as follows in Figure 1.
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