Research of the features of biometric characteristics of phonemes of the Kazakh language

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Abstract

Nowadays, biometric features are actively used in many areas related to ensuring the security of access to information and in the tasks of unique identity identification. As well as, it is well-known that the study of the biometric properties of the phonemes is an important factor in speech recognition, speech protection and determining the accent features of language. The use area of speech recognition and the definition of accentual features of languages will be continuously expanded in the near future in connection with both the undoubted convenience for the user of voice commands and with the progress in the accuracy of speech recognition. Thereby, broad study of the biometric characteristics of Kazakh phonemes is becoming increasingly important.

In this article, we will consider researching of the features of biometric characteristics of phonemes of the Kazakh language.

Key words: speech-processing, phonemes, biometric characteristics of phonemes, pitch and formants

1 Introduction

In recent years, the main trend in researching is in the field of speech recognition. The development of modern speech technologies goes towards implementing a full cycle of learning speech recognition systems with biometric characteristics to determine the accentual features of languages. In addition, the biometric technologies in the near future will play a major role in the issues of personal identification in many areas. Moreover, the use of biometric technologies are varied: access to jobs, and network resources, data protection, access to certain resources and security.

Development of high-precision speech understanding technologies is necessary not only for speech recognition and for translating it into text, also to understand the content of the conversation in order to answer questions and maintain a dialogue. This technology has been developed for many languages such as English, Russian, Spanish, German and etc., but not for Kazakh language. In this article, we started our research from the part which has considered the biometric characteristics of phonemes of the Kazakh language. The study of the biometric features of phonemes is the fundamental beginning of speech recognition.

2 Biometric features of speech

It is known that, by the biometric features of speech is implied pitch frequency, fundamental frequency, formants, step period and so on.

For speech recognition, speaker verification, speech synthesis, etc., one must extract the features of the speech segment such as fundamental frequency, formants, linear predictive coefficients (LPC), mel frequency cepstral coefficients (MFCCs), cepstral coefficients, line spectral pairs, 2-D and 3-D spectrogram. There are some time-domain features and some transform-domain features, such as frequency domain, cepstral domain, wavelet domain, discrete cosine transform (DCT) domain amd so on [2].

We will mainly consider fundamental frequency, formants, introduction to LPC and its relation to formants and the measurements of fundamental frequency and formants of phonemes of Kazakh language in this study. It has been studied pitch and formant measurements in time domain, frequency domain, spectrum domain and cepstral domain.

Voiced speech is generated when the excitation comes from a periodic pulse train generated by vocal cords. These vocal cords vibrate with their natural frequency of vibration like a tuning fork and generate pulses at regular intervals. We can extract the parameters related to vocal tract, functioning as a circular waveguide are formants, LPC, etc [2].

A speech signal consists of different frequencies, which are harmonically related to each other in the form of a series. The lowest frequency of this harmonic series is known as the fundamental frequency or pitch frequency. Pitch frequency is the fundamental frequency of vibrations of the vocal cords. This frequency generated by vocal cords in the form of the filter to produce a speech signal. Thus, speech is basically a convolved signal [2].

In the Kazakh language there are 37 phonemes, 12 of them are vowels and 25 are consonants. Specific phonemes of the Kazakh language: ә, і, ө, ү, ұ, ң, ғ, қ, h. By the program Matlab and Praat it was studied and obtained biometric features of phonemes of the Kazakh language. It has been done speech analysis by fundamental frequency, formants, LPC coefficients and its relation to formants and the measurements of fundamental frequency of phonemes

of the Kazakh language.

These biometric characteristics is the fundamental beginning of speech synthesis and speech recognition.

So, by the biometric characteristics of phonemes, fundamentals of recognition systems that require preliminary training for Kazakh phonemes were considered, as well as those capable of recognizing the voice of the announcer.

3 Conclusion

In this study, we considered performing independent researches in the field of speech recognition and synthesis. It was carried out the study for fundamental frequency, formants, pitch frequencies of phonemes, oscillographic and spectral studies of speech signals, and a specialized system of speech analysis of the Kazak language.

References

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