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A. O. BEREZA
V. V. KOVTUN

EXPERIMENTAL RESULT OF THE AUTOMATED SPEAKER RECOGNITION SYSTEM OF CRITICAL USE IDENTIFICATION

Vinnytsia National Technical University

Abstract

Class of automated speaker recognition systems of critical use with determination of limitation is identified in the thesis. Neural generalized criterion of quality evaluation of such systems taking into account the certainty of speakers recognition is formulated.

Keywords: Automated speakers recognition systems of critical use, reliability, authenticity, neural classifier, criterion of recognition systems evaluation

Introduction

Critical systems take a special place among the existing classes of automated systems and they operate with high reliability and save its predicted level during the whole life cycle of automated system regardless of any external conditions [1-3]. At the creation of critical systems approved and known methods and technology are preferred to the latest developments that have not passed comprehensive empirical verification. Resource-consuming technology, the use of which for the development of current automated systems is disadvantageous, are allowed at the creation of critical systems for which the main thing is reliability of functioning.

Research results

To train the neural network classifier, 10% of the base of standard records were used, uniformly distributed among the classes of speakers and by the noise / signal ratio. The rest 90% of standard records were divided in half between control and testing sample and were given to the neural trained network classifier of the speaker recognition module [1]. The obtained results of speaker recognition from control and testing samples were used to calculate the probabilities of the errors occurrence of the first and second kind by formulas with a fixed probability of correct recognition, which decreased from 99% to 80% in 1% steps. Will distinguish Bark-cepstral coefficients and characteristics of the frequency of the fundamental tone from the speech tone , these parameters best describe the individuality of the work of such important organs of formation of speech signals by a person as an articulatory track and a series [2]. Period of fundamental tone was determined on those intervals [3].

If K - dimensional space of threshoulds values T^K exist, in which function $R(t',t'')$, which describes percentage of errors of the first kind, and function $E(t',t'')$, which describes percentage of errors of second kind are determined, $t',t'' \in T^K$, and $K = 2M$. Then the optimization problem is formed in this way:

$$F(t',t'') = \min_{T^K} R(t',t'') \\ E(t',t'') \le C_i, \tag{1}$$

where

$$E(t',t'') = \frac{100}{N} \cdot \sum_{i=1}^{2M} \sum_{X} l((g_i \neq \max_k g_k) \wedge (g_j = \max_k g_k) \wedge (x \in C_i)) \cdot l((\max_{1...k} g_k \geq t_i') \wedge (\max_{2...k} g_k < t_i'')),$$

$$R(t',t'') = 100 \cdot \frac{\sum_{i=1}^{2M} \sum_{X} l((g_i = \max_k g_k) \wedge (x \in C_i)) \cdot l((\max_{1...k} g_k < t_i') \vee (\max_{2...k} g_k \geq t_i''))}{\sum_{i=1}^{2M} \sum_{X} l((g_i = \max_k g_k) \wedge (x \in C_i))}.$$

It was managed to achieve the ratio of the probabilities of occurrence of errors of the first and second kind in 0,01%/0,09% for authenticity 99% and up to 7%/3% for authenticity 90% appropriately having solved optimization problem (1) by standard gradient method and having used optimal thresholds values T^{Kopt} in the neural network classifier. Graphical representation of the recognition results is shown on the picture 1.

To formulate universal criterion of authenticity evaluation of the automated speaker recognition system of critical use it remains to formulate principles of considering parameters of system use [4]. Since conditions of the system use and list of parameters that will be described by variables priori, it is offered to form their list analogically of the formation of dynamic arrays in modern programming environments, dividing them into groups of continuous parameters, values of which need to be formulated for falling in the interval [0,1] and group of discrete parameters. The result of speakers classification improved after modification implementation and it was managed to achieve ratio of probabilities of occurrence of errors of the first and second kind 0,05%/0,05% for certainty 99% and to 7,7%/2,3% for authenticity 90%/. Graphical representation recognition of results is shown on picture 1.
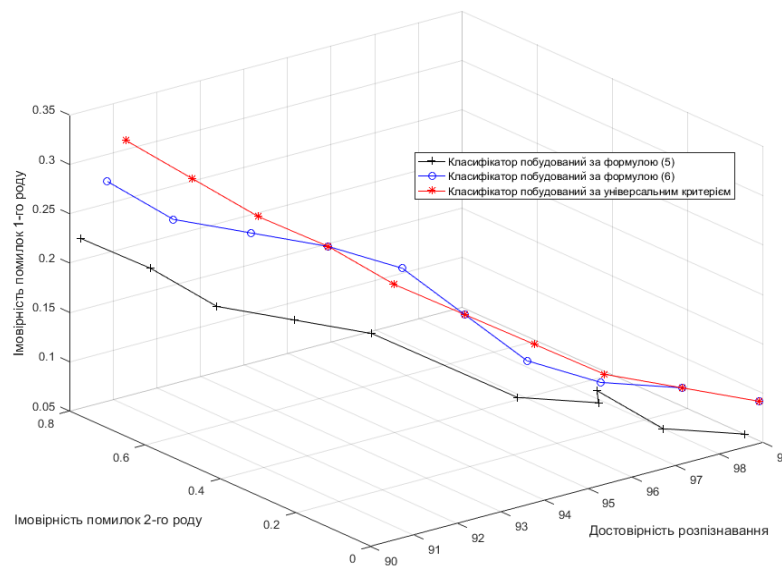
Picture 1 – The dependence of the authenticity of recognition, the probability of occurrence of errors of the first and second kind on the type classification function

Conclusions

Obtained the theoretical results were embodied in a modification of the input layer of three-layered perceptron, which finalizes speakers recognition process by coagulation neural network of deep studying, that has allowed to achieve the ratio of probabilities of errors of the first and second kind in 0.05% / 0.05% for the authenticity of 99% and up to 7.7% / 2.3% for authenticity of 90%, appropriately.

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Bereza Artem O. — Department of Automation and computer control systems, Vinnytsia National Technical University, Vinnytsia, e-mail: artembereza2017@gmail.com

Kovtun Vyacheslav V. — Docent of the Department of Computer control systems, Vinnytsia National Technical University, Vinnytsia