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DEVICE BASED ON SPECTRAL ANALYSIS FOR DETECTION AND CORRECTION OF SPEECH DEFECTS IN UZBEK SPEAKING CHILDREN

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Abstract: *The article discusses the possibilities and necessity of using a device based on spectral analysis to detect and correct speech defects in Uzbek-speaking children. The device relates to medical technology and special pedagogy, can be used in diagnostic studies and rehabilitation processes related to measuring the correctness of pronunciation after installing cochlear implants in (Uzbek-speaking) children with hearing loss, to improve hearing and speech correction in hearing-impaired children, aimed at improving correct pronunciation. pronunciation, development of hearing and speech. Technically, the visualization of sounding speech in this complex is achieved by capturing sounds with a microphone, converting them in an additional device, transmitting a signal to the processor, and then displaying the components of sounding speech on the device screen in the form of informative images with animation elements. The display remains on the monitor screen for any time necessary for the analysis of the activities carried out.*

Keywords: *speech therapy simulator, hardware-software complex, spectrum analyzer, speech signals, fragments of speech signals, spectral analysis, Fourier transform.*

INTRODUCTION. Processing of speech signals underlies a wide range of technical problems. However, due to the complexity of the structure of the speech signal, the insufficient knowledge of the mechanisms of both speech production and speech perception, the achieved level of solving speech problems to a large extent does not reach the level with which these problems are solved by the human body. An analysis of existing approaches to the processing of speech signals and individual fragments of speech signals in various speech applications makes it possible to determine the range of unresolved problems that prevent the creation of highly efficient technical solutions to these problems.

MATERIAL AND METHODS. Foreign hardware and software systems "Visible Speech" and "Ling Wave" are expensive, do not support the Uzbek language in the settings, do not analyze words spoken in Uzbek and do not show errors when pronouncing Uzbek speech. [2]

Fig.1. Speech therapy simulator Delfa -142.1

A known device is the Delfa-142.1 simulator. The simulator allows you to work with any speech units from sound to text, solve various speech therapy tasks: from correcting

speech breathing and voice to developing the lexical and grammatical side of speech, introduce game moments into the process of correcting speech disorders, repeatedly duplicate the necessary type of exercises and speech material, use various stimulus material (pictures, letters, syllables, words, sentences, sounding speech), work at different levels of complexity depending on the student's capabilities, simultaneously with speech therapy work, correct perception, attention, memory.

The possibility of an individual approach to each student, the level and variety of stimulus material is provided with the help of a system of basic and user dictionaries. [3]

The device has the following disadvantages:

1-The language of the program according to version 1.4 is Russian and Kazakh, according to version 1.7 it is Russian and does not support Uzbek speech signals.

2-The simulator is not intended for use in medical purposes or for the provision of medical services.

3-Sufficiently high price for the consumer.

Consider device for phonetic speech analysis, containing a microphone, a unit segment analysis, spectrum analyzer, normalization unit, measurement unit similarities, a decision block, a block of memory of standards, characterized in that in it introduced a RAM unit and a switching unit, and the spectrum analyzer is installed after the segment analysis block, the input of which connected to a microphone, and the output to the spectrum analyzer, its outputs - to the block normalization, to the information output of which is connected the block of operational memory, and to the output of the latter - through the switching unit is connected information input of the memory unit of standards, the control input of the switching unit is also connected to the output of the decision block, the input of which is connected to the output of the block similarity measurement, the first input of which is connected to the output of the normalization block, and the second input - to the output of the memory block of standards, which is the output devices. The disadvantage of this device is an unreasonably large number of phonetic types of segments in the analyzed speech signal, which limits its functionality. [4]

RESULTS AND DISCUSSION. The task of the device created by us is to identify and correct speech defects in Uzbek-speaking children after cochlear implantation, by creating a hardware-software complex based on the spectral analysis of Uzbek speech.

The problem is solved by the fact that the device is controlled through the display screen. On the screen, you can select the necessary sections: spectral analysis of Uzbek speech, detection of incorrect pronunciation in speech, error detection, in this section, the Uzbek words spoken by the user are compared with the reference words included in the device program, if the word is pronounced correctly, an encouraging icon appears, if it is pronounced incorrectly, the repeat icon appears again. [5,8,9,11]

In the section of non-speech sounds, for hearing-impaired children, the main sounds associated with the environment, nature, home and school, as well as images representing them, appear. There is also a test section to determine if children are learning this information correctly, which asks what the sound means, and if the child answers correctly, the next question is asked. In another section, homework sounds and Uzbek words are played 3 times in a row in a given unit of time from the device.

Another function of the device is to measure the sound of the pronunciation of a set of known letters and sounds when approaching a special microphone without interference. For example, - the sound “a” - the dynamic range of sound is measured in dB when the sound is pronounced in the process of pronunciation and displayed on the screen. [6]

The mechanisms of speech activity are very complex, they include mental and systemic language processes, motor processes of speech generation, analysis and decoding of a

speech signal, that is, its understanding. The situation is much more complicated in the presence of hearing loss in a child, when it is necessary to compensate for hearing loss. In this case, additional sensory channels should be used in the learning process. So far, the question of the systemic interaction of analyzers of various modalities in the mechanisms of perception has not been studied enough. [13,15,16,18]. The device is illustrated by two figures, where Fig. 2 shows the static connection diagram of the device, Fig. 3 shows the dynamic diagram of the device displayed on Proteus.

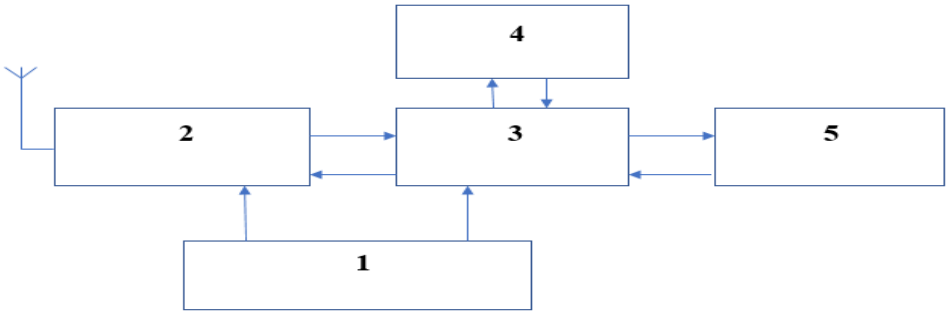

Fig. 2: 1. Power supply system, 2. Microphone, 3. Information processing module, 4. Input/output devices, 5. Storage system.

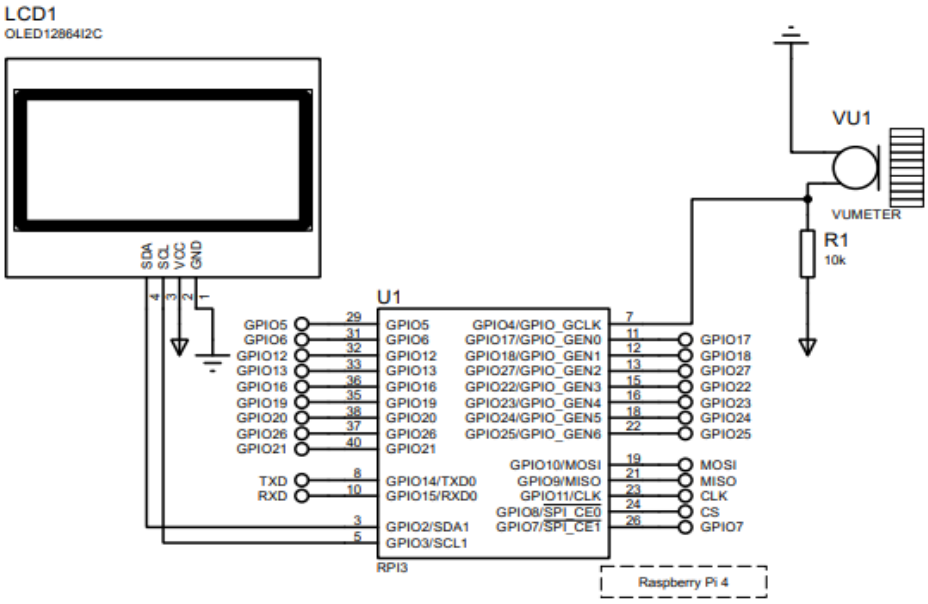

Fig. 3: LCD1 - touch screen 10.4', single board mini PC - Raspberry 4B, VU1 – microphone.

According to figure 2 and figure 3, a device based on spectral analysis for the detection and correction of speech defects in Uzbek-speaking children, contains1. Power supply system, 2. Microphone - clearing special sound interference, 3. Information processing module -Raspberry Pi4 single board minicomputer, 4. I/O devices -10.5 inch HD color touch displays for Mini PC Raspberry Pi4, 5. Storage system -64 GB SD flash memory.

A device based on spectral analysis for the detection and correction of speech defects in Uzbek-speaking children works as follows. After connecting the power supply system (1) of the device to the power source, the device turns on, the necessary options are selected, the (Uzbek word) is pronounced through a microphone (2) that clears the sound from noise,

the signal enters the information processing module (3), is displayed on the input / output (4), the received digital information is compared with the standard, the speech signal, which is stored in the data storage system (5). After comparing the data, the result is filtered from noise, the signal enters the information processing module (3), and is displayed on the input/output device (4).

The analyzed speech signal *x(t)* with duration *T*, received by the microphone, is divided into a sequence of *M* segments $x_m(t)$, *m=1, 2,...,M,* with duration *τ=T/M* each in the segment analysis block. For each successive segment $x_m(t)$, starting from the first $x_1(t)$, in the spectrum analyzer, using the well-known method for determining the power spectrum of the autoregressive process, the current spectral power density is estimated in the range of discrete values of the frequency *f* from *0* to *F*. In the normalization block, the power spectrum of the autoregressive process is determined. process $\check{G}_m(f)$ with normalization of its variance of generating noise. In the similarity measurement block, the signal xv(t) closest to the signal x_m(t) from the set of previous signals $x_1(t)$, $x_2(t)$,,..., $x_{m-1}(t)$ is determined from the normalized power spectrum $\check{G}_m(f)$.) in the metric $\rho_j(x_m)$, where *j= l,2,...,m-1*. For example, this may be the Kullback-Leibler information metric. To determine the calculation of the auto regression coefficients, a recurrent Berg-Levinson procedure with a high rate of convergence is usually applied. The resulting mismatch value ρ_v (x_m) in the decision block is compared with the threshold level ρ_0 and, under the condition ρ_v (x_m) > ρ_0, is added from the RAM block through the switching unit to the current list of phonemes X_1, X_2,..., X_R, which is stored in standard memory block, additional phoneme X_{R+1} with normalized power spectral density $\check{G}_m(f)$. under initial conditions *R=0* for the first signal x_1(t). In this case, the resulting composition of the phonemes of the speech signal in the memory block of the standards is determined by the set of spectral power densities from the resulting, after the M-th step, the list of phonemes X_1, X_2.

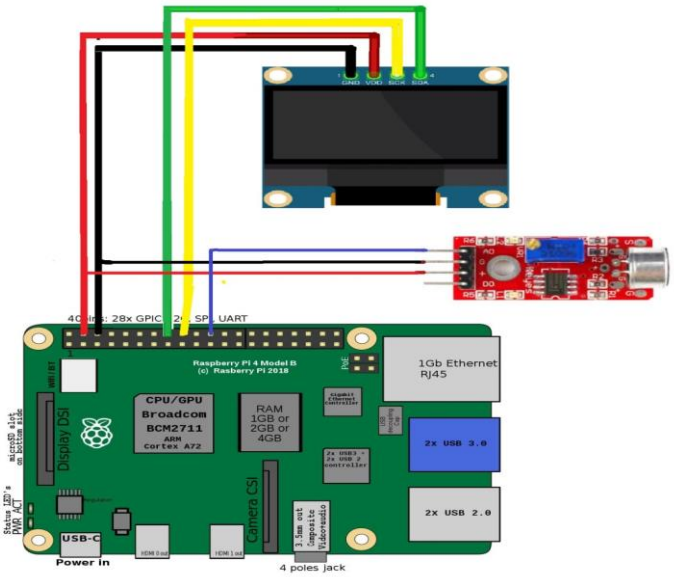

Fig. 4. Scheme of the device for the spectral analysis of speech.

With any teaching method, the starting point in mastering the skills of reproducing various elements of speech is the perception of these elements. The separation of the components of the speech signal into different sensory channels allows the student to productively analyze the oral speech of the teacher (as a sample), control his own pronunciation. With self-control, a biofeedback mechanism is implemented, which acts as a highly effective learning tool.

CONCLUSION. The solution refers to the technique of automatic pattern recognition based on spectral analysis of speech signals and can be used for automatic segmentation of speech signals at a key stage of setup and training systems for automatic processing and recognition of speech signals. [7]

-In order to use such simulators in Uzbekistan, you need an option that supports the Uzbek language, contains special words in the Uzbek language selected by deaf teachers and should show errors in the correct pronunciation of the words of Uzbek-speaking children who have cochlear implants.

-To rehabilitate and improve hearing and speech in children with cochlear implants, devices that analyze the correct pronunciation of words, as international experience shows, should be used today in phonetic departments of hospitals, clinics and rehabilitation centers to restore hearing and speech in children with hearing impairments.

-It is necessary to take into account the financial condition of the consumer, since the installation and further use of cochlear implants requires a lot of money.

The device developed by us corresponds to the price category for the Uzbek market.

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