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CREATING A MODEL OF THE INFLUENCE OF SOUNDS ON THE EMOTIONAL STATE OF MAN

The environment is full of various sounds - signals registered by human and animal hearing organs, which in terms of frequency and strength merge into a monotonous, incoherent sound. The physical carriers of signals reaching the hearing organs are acoustic (sound) waves – mechanical waves that propagate in the air and are perceived by the hearing organs. Human hearing organs can perceive sounds in a fairly wide range of frequencies and intensities. The range of sounds heard by a person is limited by two threshold curves: the lower one is the threshold of perception, the upper one is the threshold of pain sensations. The human hearing threshold is 0 dB at a frequency of 1000 Hz, and the pain threshold occurs from a sound of 140 dB. We know that as long as there have been wars, mass battle cries and drumbeats oppress the enemy. The sirens of attack planes and bombers make him feel terrified and want to run away. Now an explanation has been found for this: loud sounds excite a person, contribute to the influx of a large amount of hormones into the blood, in particular, adrenaline, as a result of which there is a feeling of danger and fear. A description is given in the work of existing approaches to assess the impact of sounds on the emotional state of man, which is the basis towards creating a model for analyzing the impact of sounds on the emotional state of man based on application of the the theory of discrete emotions. Generated values for emotional evaluation of sounds.

Keywords: emotions, sounds, emotion recognition, sound processing, assessment of emotional state, theory of discrete emotions.

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СТВОРЕННЯ МОДЕЛІ ВПЛИВУ ЗВУКІВ НА ЕМОЦІЙНИЙ СТАН ЛЮДИНИ

Навколишнє середовище сповнене різноманітними звуками – сигналами, що реєструються органами слуху людини і тварини, які за частотою і силою зливаються в одноманітне незлагоджене звучання. Фізичними носіями сигналів, що доносяться до органів слуху, є акустичні (звукові) хвилі – механічні хвилі, які поширюються в повітрі і сприймаються слуховими органами. Органи слуху людини можуть сприймати звуки в досить широкому діапазоні частот та інтенсивності. Область звуків, які чує людина, обмежується двома пороговими кривими: нижня – поріг сприйняття, верхня – поріг больових відчуттів. Поріг слуху людини становить 0 дБ на частоті 1000 Гц, а больовий поріг виникає від звуку у 140 дБ. Скільки існують війни, відомо, що масові бойові крики, барабанний бій пригнічують противника. Сирени літаків-штурмовиків та бомбардувальників викликають у нього жах, бажання втекти. Тепер цьому знайдене пояснення: гучні звуки збуджують людину, сприяють надходженню в кров великої кількості гормонів, зокрема, адреналіну, внаслідок чого виникає відчуття небезпеки, страху.

Емоційна інформація існує в будь-якому звуці, вона може сприйматися по-різному в залежності від об'єкта, на який чиниться вплив. Не тільки людська мова, а й музичні твори і навколишні звуки містять емоційну інформацію. Таким чином, поняття емоції, яке ми буде розглянуте в цій статті, є результатом впливу звуку на людину, тобто його враження.

Емоційні реакції на біологічно значущі події необхідні для виживання людини. У людських емоцій законно відстежують зміни в акустичному середовищі. Зміни акустичних атрибутів, які добре знайомі з людськими емоціями в мові і музиці, також викликають систематичні емоційні реакції, коли вони відбуваються в звуках навколишнього середовища, включаючи звуки дій людини, тварин, механізми або природні явища, такі як вітер і дощ. Результати показують, що людські емоції налаштовані на зміни акустичного середовища. Описана емоційна модель на основі дискретної теорії емоцій, конкретизовані категорії емоцій для подальшого використання в експерименті для емоційного оцінювання звуків.

Ключові слова: емоції, звуки, розпізнавання емоцій, обробка звуків, оцінка емоційного стану, теорія дискретних емоцій.

Introduction

Emotional information exists in any sound, it can be perceived differently depending on the object affected. Not only human speech, but also musical works and surrounding sounds contain emotional information. Thus, the emotions, which we will consider in this article, is the result of the impact of sound on a person, that is, his impression.

Emotional reactions to biologically significant events are necessary for human survival. Human emotions are legitimately tracked by changes in the acoustic environment. Changes in the acoustic attributes familiar to human emotions in speech and music also elicit systematic emotional responses when they occur in environmental sounds, including the sounds of human action, animals, machinery, or natural phenomena such as wind and rain. Therefore, it is obvious that human emotions are directly related to changes in the acoustic environment.

Related works

In most studies related to the assessment of emotions, dimensional models are used, they are most common in the studies of B. Schuller and K. Drossos [1-3]. This study uses a discrete model of emotions, as the aim is to

determine the influence of specific sound parameters on the emotional state of man. If in dimensional models a person puts estimates of valence and excitation and already on the basis of these values the listener analyzes and determines the emotion, then in our case, it will be the values of sound parameters such as frequency, tone, timbre, volume.

In the theory of discrete emotions, all people have an innate set of basic emotions that are cross-culturally recognizable. These basic emotions are described as "discrete", because they, according to researchers, differ in the difference between human facial expressions and biological processes [4]. Theorists have conducted research to determine which emotions are the main ones. A popular example is Paul Ekman and a cross-cultural study by his colleagues in 1992, in which they concluded that there are six basic emotions are anger, disgust, fear, happiness, sadness and surprise, Ekman explains that each of these emotions led to special characteristics that allow them to express themselves to one degree or another. Each emotion acts as a discrete category, not an individual emotional state [5].

Main part

Emotional information exists in any sound, it can be different depending on the object affected. Not only human language, but also musical works and surrounding sounds contain emotional information [6].

Emotional reactions to biologically significant events are necessary for human survival. In human emotions legally track changes in the acoustic environment. Changes in acoustic attributes that are familiar to human emotions in language and music also elicit systematic emotional responses when they occur in environmental sounds, including sounds of human, animal, machinery, or natural phenomena such as wind and rain. The results show that human emotions are tuned to changes in the acoustic environment.

It is necessary to consider the question: what type of model should be used to differentiate emotions: discrete (categorical) or dimensional. These approaches are very complementary. It is well known that discrete emotions in the space of higher dimensions can be conditionally reflected in the lower space of dimensions. The valence and excitation of two dimensions are most often chosen, although it can be shown that the space of influence is best structured by four dimensions - adding force and novelty to valence and excitation. The choice of categorical or dimensional approach depends on the relevant research context and specific objectives [7-9].

The proposed emotional model will follow the theory of discrete emotions, and will contain a wider range of specific emotions in the category. Such estimates can be obtained using a large number of expert evaluations, which is quite difficult due to the small number of known experts, or by averaging the evaluations of a large number of average listeners.

The values for assessing the emotional state are given in Table 1. The values of the assessment will be both the categories and the values themselves.

To pre-evaluate the sounds, a website has been created with downloaded sounds from different categories. Users are presented with the options for assessing the sound from table 1, then, depending on their perception, you need to choose the appropriate assessment. Emphasis should be placed on objective evaluation, so any of the proposed compositions should be evaluated without reference to a specific case from the life of the listener. This fact will allow you to more accurately assess the impact of sounds on the emotional state.

Table 1

Sound evaluation options

Categories / Emotions	Happiness	Surprise	Disgust	Anger	Sorrow	Fear	Con-tempt
1	Delight	Stun	Abomination	Fury	Sadness	Perplexity	Neglect
2	Hope	Surprise	Rejection	Malice	Sorrow	Anxiety	Hatred
3	Tenderness	Confu-sion	Hideousness	-	Misfor-tune	Tension	-
4	Appreciation	-	-	-	Solitude	Agitation	-
5	Delight	-	-	-	-	Concern	-
6	Love	-	-	-	-	-	-
7	Touched	-	-	-	-	-	-
8	Sympathy	-	-	-	-	-	-
9	Gladness	-	-	-	-	-	-

The proposed sounds, their parameters, ratings and the users themselves are stored in the database, for further analysis of the compositions that did not participate in the experiment. Thus, based on the discrete theory of emotions, an emotional model of the impact of sounds on a person was created. The physical model of the database with the main tables, attributes and their relationships are presented in Figure 1. In the process of developing a website it is possible to expand and refine the structure of the database. The essentials are needed to store estimates:

1) Mark - emotional ratings available to users;
2) User - users and their parameters
3) Sounds - sounds and their characteristics

The emotional sounds database is based on the online engine FindSounds.com. It consists of 390 hand-selected audio files from more than 10,000. To provide a set with a balanced distribution of emotional connotations,

it was decided to use the following eight categories taken from FindSounds.com: animals, musical instruments, nature, voice sounds, people, sports, instruments and vehicles. With this choice, the database is a wide range of the most common sounds in the everyday environment [10].

To gather information and conduct an experiment, all users (senior students) were asked to make a decision according to the proposed list of emotions from table 1 for a particular composition.

Based on the received answers and the formed database, it is planned to teach a combined neural network consisting of recurrent and convolutional neural networks. The architecture of the program for emotional assessment of sound at the stage of learning and analysis is shown in Figure 2.

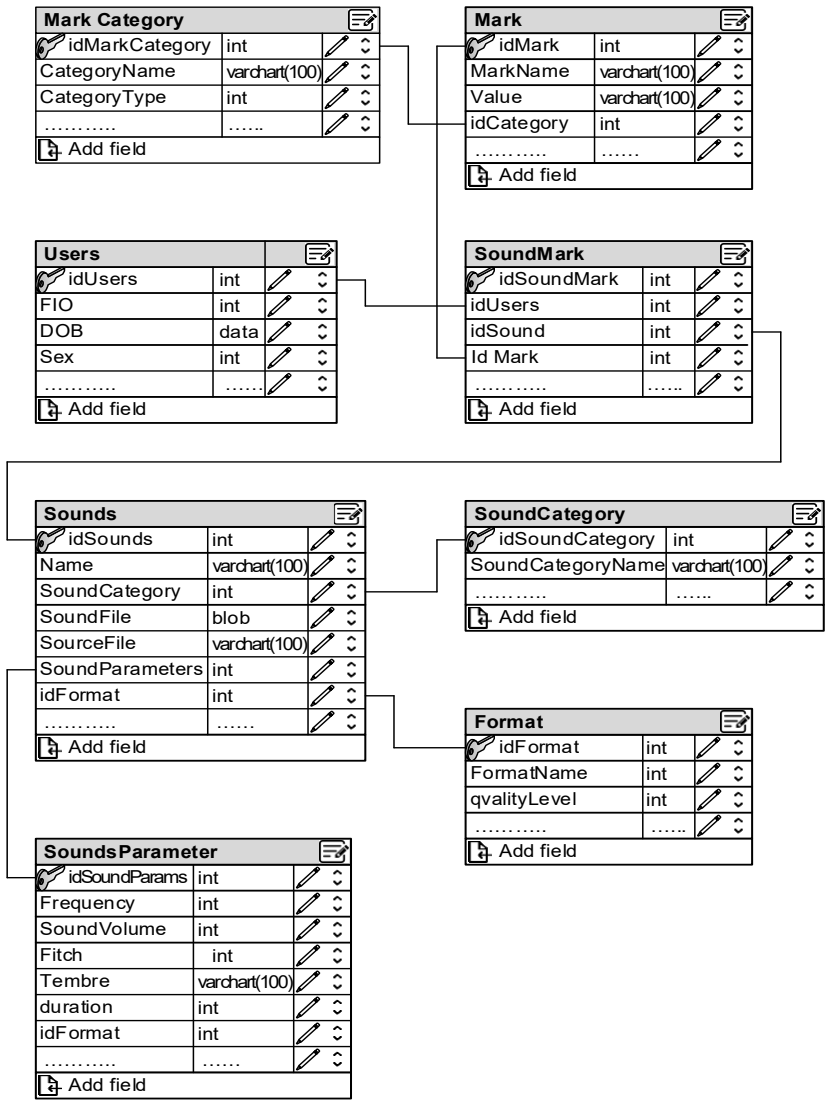

Fig. 1. Physical model of the database

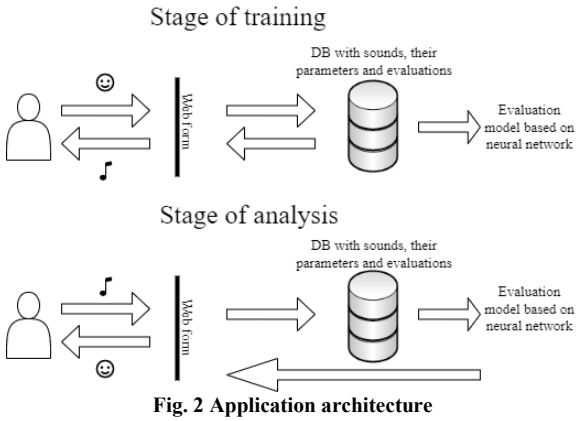

Fig. 2 Application architecture

Conclusions

This article presents approaches to the emotional evaluation of sounds. Describes the emotional model based on the discrete theory of emotions, specified categories of emotions for further use in the experiment for emotional evaluation of sounds. The structure of the relational database and the relationship between tables for storing sounds with their parameters and emotional evaluation of the user are presented. The architecture of the developed application is also illustrated, on the basis of which the proposed model will be studied. In particular, the possibilities of managing the emotional behavior of people in different sound environments.

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