Methods for forming and transmitting hypermedia images by using modern communication technologies

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Of particular interest is the development of an aromatic image synthesizer that can reproduce a given variety of aromas in the surrounding environment, leading to indirect changes in psychophysiological indicators and behavioral responses of the human body.

Keywords – ***biotechnical, aromatic image; synthesizer; psychophysiological indicators; aromas***

Методи за формиране и предаване на хипермедийни образи с използване на съвременните комуникационни технологии (Венко Т. Кацаров, Анелия В. Станоева, Антон Н. Стоилов, Алексей К. Стефанов, Филип И. Баталов). *Според теорията на комуникацията реципиентите възприемат информацията визуално, аудиално и кинестетически. Кинестетическото възприятие е разделено, от своя страна на три категории: вкус, аромат и тактилно. За човека възприемането на информационните пакети и съобщения, включително предавани по телекомуникационните канали, се осъществява чрез сензорни системи. В масовата комуникация основно внимание се отделя на аудио-визуалните канали за комуникация.. Прието е да се счита, че най-значимата сензорна система е зрителният анализатор. Втората, не по-малко важна сензорна система, е слуховият анализатор. Тези сензорни системи осигуряват дистанционната форма на възприемане на физическите фактори на външната среда. Но поведенческите функции на болшинството живи организми се формират не само при възприемането на зрителната и слуховата информация, но и с участието на обонянието. Възприемането на физико-химичните параметри на околната среда чрез работата на системата на обонянието е присъщо и на човека. Според съвременните схващания това е много мощна сензорна система на възприятие на различни ароматични образи, която е в състояние да образува устойчиви в продължение на дълго време поведенчески стимули. В нормален вид тази система има много общо със зрителните и слухови анализатори. Но в техническо отношение има още много бели петна и нерешени проблеми. По-специално определен интерес представлява създаването на синтезатор - генератор на ароматични образи, който може да възпроизвежда необходими разнообразни аромати в околното пространство, което води до косвена промяна на психофизиологичните показатели и поведенчески реакции на организма на човека. Настоящата статия е посветена на проблемите свързани с класификацията, био-физичните основи на сензитивността на ароматите, а също така на някои аспекти при реализацията на технически системи за формирането на ароматични образи.*

I. Introduction

The sense of smell differs from the perception of taste in that we do not know the primary odors. A single "set" of primary odors may not exist at all. There are many classifications of odors based on introspection and subjective sensations, but the main problem is to distinguish a few basic, primary odors, which, when mixed, form the vast multitude of complex aromas perceived by the human olfactory system.

Since ancient times, attempts have been made to classify odors from scientists belonging to different fields of science. Naturalist Carl Linnaeus, in his work Odores medicamentorum (1756), developed a system

of seven classes (spicy, aromatic, amber-musk, garlic, capry, repellant, fertile); At the same time, physician Albrecht von Haller proposed a much simpler classification into only three categories (pleasant, unpleasant and "intermediate" odors). At the end of the 19th century, the Dutch psychologist Hendrik Zvaardemaker reworked the Linnaean system, adding ethereal and burned aromas (thus obtaining nine categories) and dividing some classes into subclasses:

1. Main flavors (acetone, chloroform).
2. Spicy flavors: Camphor (camphor, needles), Cloves, Anisic (anise, menthol), Citrus fruits (lemon, orange), Almonds (bitter almonds), Others (laurel, cinnamon, lavender);
3. Balsamic: Incense, Jasmine, Lilies (lily), Vanillin (vanilla);
4. Ambromuscus (ambergris, musk);
5. Onion – garlic: Garlic, Arsenic (arsenic), Halogen (bromine);
6. Burnt (toast, tobacco smoke);
7. Capryl or goat (valerian, cheese, sweat, urine, sperm);
8. Repulsive (some varieties of orchids, some insects, bed bugs, belladonna);
9. Fetidia (rotten meat, feces).

Later, an attempt was made to build a system for the calculation of fragrances not in two-dimensional, but in a three-dimensional perspective. According to the plan of Hans Henning (1916), each aroma must find its well-defined place inside the so-called "perfume prism", at the tops of which are the main, primary aromas.

One of the most developed and used classification systems is the H. Zvaardemaker system, which appeared in its first version in 1895 and in its final form in 1914. It divided all aromatic substances into 9 classes. [17]

And some species are subdivided into subclasses.

1. Aromatic: comfort, spicy, anise, lemon, almonds;
2. Balsamic: floral, lilac, vanilla.

The classification was criticized and, in 1926, was proposed and further developed in the classification of fragrances by Crocker and Henderson, according to which the fragrances were divided into four "psychologically basic" fragrances (aromatic (pleasant), acidic, burning, capricious) [18,19]. All other flavors, in nature, according to the authors of this classification are mixtures of basic in different proportions. They suggest assigning each scent value of 1 to 8 on a special scale. Thus, using this system, up to 8888 different flavors can theoretically be described.

According to Crocker and Henderson, each fragrance can be expressed by a four-digit number, whose individual numbers characterize the intensity of each of the basic fragrances. The degree of intensity of the main aromas is expressed from 1 to 8. Table 1 lists the codes of certain aromatics substances according to the Crocker and Henderson classification.

Table 1

Characteristic numbers of some substances

Substance	Fragrance code	Intensity of perception of base aromas			
		Floral	Sour	Burned	Caprylene
Rose oil	6423	6	4	2	3
Vanillin	6021	6	0	2	1
Freshly brewed coffee beans	7683	7	6	8	3
Ethyl alcohol	5414	5	4	1	4
Acetic acid	3803	3	8	0	3

As can be seen from Table 1, according to Crocker and Henderson's classification, there is no substance in nature that has only one basic aroma. The aroma of vanillin is closest to the pure floral, but the aroma of vanillin is denoted by the number 6021, i. In addition to the floral aroma of sufficiently high intensity, vanillin has two other types of aroma, the intensity of which is sufficiently low. Acetic acid has the most pronounced acid odor - code aroma 3803.

The acidic aroma and the chemical concept of "acid" are not identical. The acid aroma is characteristic of acetic acid, formic acid, acetone, camphor. However, hydrochloric acid has a relatively low intensity of acidic aroma.

Roasted coffee beans and furfural can serve as a standard for the aroma of burning.

The Caprylic (goat) odor of quite high intensity is found in fusel oils, kerosene, gasoline, fading fats.

Crocker and Henderson's fragrance classification system uses the term Degree of Aroma Intensity. A degree of olfactory intensity means an amount that causes a clear perception of the aroma even for people who are not trained to perceive it.

In the 1960s, as noted above, the American scientist J. Amour, within his stereochemical theory of aromas, reverted to the classification of the seven basic (ether, camphor, musk, floral, peppermint, caustic and putrefactive).

In 1965, J. Davis offers a classification identifying 10 main flavors: musk, amber, cedar, pepper, floral, almond, camphor, ether-fruity, fruity, alcohol-fruity.

All other aromas found in food, J. Davis considers a combination of these ten flavors. However, it should be noted that the classification of J. Davis does not reflect the unpleasant aromas that occur in foodstuffs when oxidation or decay occurs (acidic, moldy, rotting) [20].

There is also a known attempt to classify fragrances, presenting fragrances in the form of a geometric figure - the so-called aromatic or Hanning prism [21].

The Hanning prism is a hollow triangular prism, the six corners of which correspond to six primary aromas: floral, putrid, Heteren (fruity), spicy, as well as the smells of burning and rubber. According to the author, all the fragrances that are "placed" on the sides connecting two corners and are similar to the primary fragrances "arranged" on the corners. Intermediate aromas resulting from the mixing of several primary fragrances "lie" on the surface of the prism.

Recently, a classification based on primary aromas has been proposed in an attempt to establish a direct link between certain chemical properties of compounds and the perception of their aromas [21].

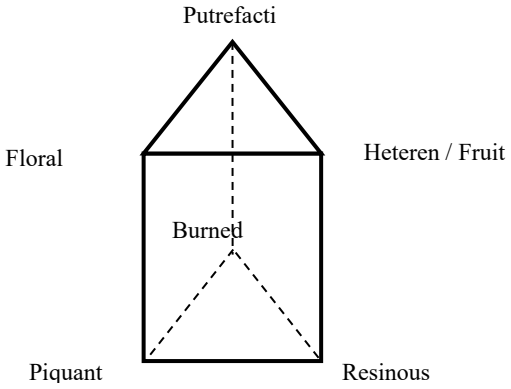

Fig. 1. The prism of Henning's scents.

As we can see, the classifications are mostly based on primary aromas, but none of them escapes criticism and their value is doubtful enough. The main difficulty that arises when trying to create a classification based on several primary fragrances is that it is difficult enough for most of the aromatics to be associated with one or more primary fragrances. On the other hand, the classification based on a large number of flavor categories may be too broad and not adapted to define the primary flavors and therefore cannot cope with the task assigned to it, namely to identify specific primary flavors.

Furthermore, the use of preset flavors of such names or labels as "floral", "putrid" or "spicy" limits people's ability to evaluate and define their own olfactory sensations. If one is to compare one's own assessment of smell with all known categories, one's description of a specific olfactory sense is limited to those categories.

It should be noted that the classification, which is based on seven primary aromas, is based on and is closest to the stereochemical theory of aroma.

II. Technical, making implementation

In the biotechnical environment, in which one is part of a complex system for the formation, perception and analysis of information flows, the reproduction of aromatic images requires the creation of special technical and technological devices. The process of forming aromatic images by technical means has a definite focus. Based on the method of expert evaluation of the aroma, a list of simple fragrances can be obtained that does not change over time. Using heuristic rules for the construction of aromatic compositions based on various ingredients and aromatic substances, unlimited aromas can be reproduced, which in their nuances of perception are not inferior to the natural aromatic images and at the same time change over time. The static or dynamic nature of the aromatic image reproduced in the surrounding space is largely determined by the nature of the source of the aroma itself. For natural sources of aromas, static aromatic images are typical.

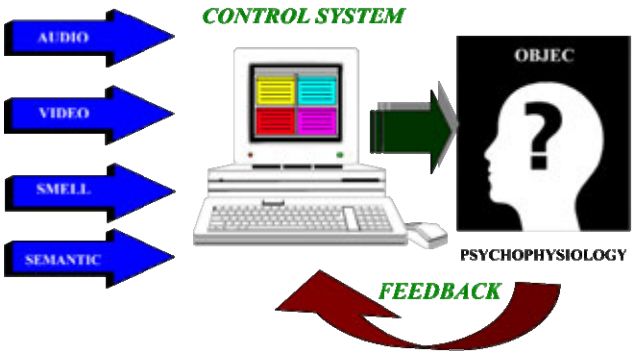

Fig.2. Block diagram of the technical creation of hypermedia images.

The fragrance synthesizer is a technical device, suggesting the possibility of forming a large number of aromatic images, the verbal characteristics of which are not constant over time and may in practice not depend on the external environmental conditions. Such a device, connected to a data channel oriented to the perception of visual and auditory information, is able to significantly expand the traffic of the generated message packets. In the usual sense, the creation of an aromatic image seems like a procedure

for the perception of specific compounds [1, 3]. For each typical odor, there is a certain set of chemicals that cannot be altered in the process of human perception. Given the huge amount of fragrances from different sites, it is difficult to imagine the possibility of their rapid reproduction. This task can only be solved by creating an aroma synthesizer - an aromatic image generator.

In the process of knowledge of the world, seven primary colors of a radiant flux are noted. Through various empirical experiments, the presence of seven basic sounds has been established, and subsequently confirmed in music practice. The synthesis of color shades or basic sounds envisages the creation of a large number of works of art and illustrations. The creation of such a flavor synthesizer will greatly enhance the range of information packages generated by modern technical means. The creation of such an aromatic image synthesizer based on computer technology will have the ability to easily reproduce software programs for managing the fragrance generator. With the help of the biophysical bases of the perception of the smell of man, the principles of construction of an aromatic image generator and then a working model of the apparatus were formulated. Structurally, this construction is a generator with a set of emitters attached to it (seven emitters and the corresponding number of chemical odor - cartridge carriers), a communication interface for connecting to a computer. By using special software, the user himself determines the parameters and the mode of reproduction of the necessary aromatic image.

The following areas have been selected as the main areas of the work program for the system construction:

- Transmission and reproduction of fragrances in telecommunications networks;
- Formation of psychophysiological factors for the perception of information messages.

The problem of creating a synthesizer or aroma generator is of interest in terms of a wide range of practical problems:

- Creation of comfortable psycho-physiological conditions for rest, as well as places for long stay of a large number of people (planes, trains, cinemas, etc.);
- Creating an atmosphere of information perception at exhibitions, presentations, promotions and other marketing and art. events;
- In medical practice (treatment and prevention of a number of diseases, anesthesia);
- Equipping with such systems - aroma synthesizer for air conditioning units for refreshing and recirculating the air in residential and office buildings.

Currently, the concept of "aromatic image" is formed on the basis of subjective sensations. And often what pleases one does not like the other. As shown in the present study, it is not yet possible to objectively evaluate and express the aroma of a substance. Today it is customary to speak of "typical flavors".

The term Aroma is generally understood to be a pleasant-smelling organic substance. It is unlikely that anyone would say so about chlorine or mercaptan, although they also have their own distinctive and typical odor. When referring to substances with a particular odor in general, the term odorant is often used.

In terms of technology and physico-chemistry, there is no difference between aromatic and odoriferous substances.

After what has been said here, the purpose of the project can be specified: *Transmission and reproduction of aromatic images through the use of telecommunication networks to create comfortable psychophysiological conditions for humans.*

The implementation of such a project should be carried out in several stages:

1. Design and development of a fully functional laboratory model of the apparatus;
2. Preparation of specialized software for the synthesis of aromatic images;
3. Preparation of typical sets of cartridges for forming aromatic images of the respective groups.
4. A plan for the development of design and technological documentation has been prepared.

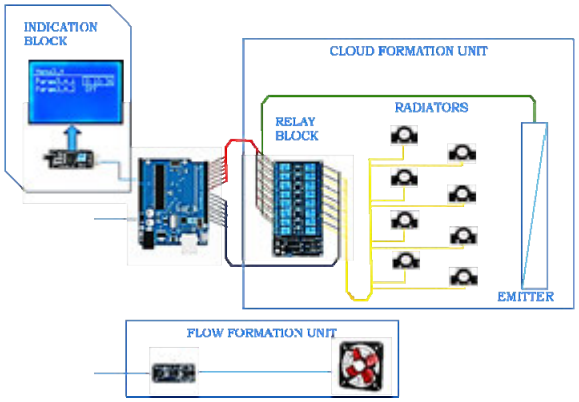

Fig. 3. Block diagram of the layout of the aromatic image synthesizer on the Arduino platform.

III. Conclusion

Research relating to the reproduction of aromatic images in telecommunications networks may include the following contributing elements:

- The practical possibility of creating technical apparatus for reproducing dynamic aromatic images is justified.
- A technological scheme for the construction of technical systems for reproducing aromatic images in telecommunications networks has been proposed [3].
- A working model based on the formulated principles and with the following technical parameters has been created: The number of channels for the reproduction of fragrance components - from 1 to 8; Continuous operation time (without changing cartridges) - 4 hours; Minimum injection duration (ambient dispersal) - 10 s; With an injection duration of about 2 minutes, a permanent aromatic image is created in a room of 60 m^3; Intensity of injection - from 0.02 to 0.4 ml/s.

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