РАЗРАБОТКА КЛАССИФИКАЦИИ СОВРЕМЕННЫХ УМНЫХ ОБУВНЫХ СТЕЛЕК

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РАННЕЕ ВЫЯВЛЕНИЕ ОНКОЛОГИЧЕСКИХ ЗАБОЛЕВАНИЙ С ИСПОЛЬЗОВАНИЕМ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В МЕДИЦИНЕ. ЖКМП.-2023.-Т.4.-№4.-С

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Аннотация: Представлен результат классификации современных умных обувных стелек, обеспечивающих комфорт стопе пользователя. Показано, что современные умные обувные стельки для обеспечения комфортности пользователя могут быть вентилирующими, ароматизирующими и обогревающими. Детально рассмотрены стельки, имеющие возможность выделять тепло на основе перевода механического движения, электричества и химических реакций в тепловую энергию.
Ключевые слова: *обувные стельки, интеллектуальные устройства, классификация, разновидности, комфорт стопе пользователя.*

ZAMONAVIY AQLLI POYABZAL TAGLIKLARI TASNIFINI ISHLAB CHIQISH

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Annotatsiya: Foydalanuvchi oyog‘iga qulaylik yaratadigan zamonaviy aqlli poyabzal tagliklarini tasniflash natijasi keltirilgan. Foydalanuvchi qulayligini ta‘minlash uchun zamonaviy aqlli poyabzal tagliklari shamollatuvchi, xushbo‘ylashtiruvchi va isituvchi bo‘lishi mumkinligi ko‘rsatilgan. Mexanik harakat, elektr energiyasi va kimyoviy reaktsiyalarni issiqlik energiyasiga o‘tkazish asosida issiqlik hosil qilish qobiliyatiga ega bo‘lgan ichki tagliklar batafsil ko‘rib chiqiladi.
Kalit so‘zlar: *poyafzal tagliklari, aqlli qurilmalar, tasnifi, navlari, foydalanuvchining oyoq qulayligi.*

DEVELOPMENT OF A CLASSIFICATION OF MODERN SMART SHOE INSOLES

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Annotation: The result of the classification of modern smart shoe insoles that provide comfort to the user's foot is presented. It is shown that modern smart shoe insoles can be ventilated, flavored, and heated to ensure user comfort. Discussed in detail are insoles that have the ability to release heat based on the transfer of mechanical movement, electricity, and chemical reactions into thermal energy.
Keywords: *shoe insoles, smart devices, classification, varieties, user's foot comfort.*

Introduction: Recently, there has been an increasing development and use of smart things in medicine [1,3], which is due to both the need that has arisen in them and the emergence of technical and technological possibilities for their creation.

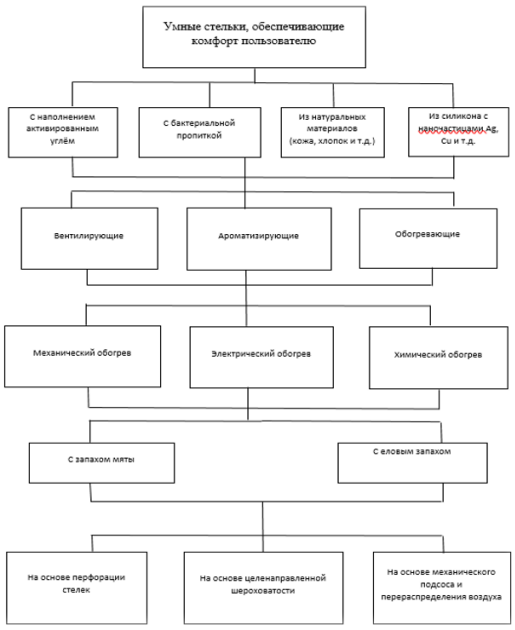
Definition: A smart shoe insole is an intelligent device, often independently (based on the presence of feedback, with analysis and assessment of the situation, as well as the possibility of targeted regulation of its various kindsofparameters-temperature,humidity,etc.)providing an increase in the level of comfort for the user's feet.

Principles of classification traditional ones were taken on the basis of essential features, which were taken to develop a classification of modern smart shoe insoles that provide comfort to the user's foot: a characteristic of the material for the manufacture of such insoles, a

characteristic of the type of comfort, a heating method, a type of flavor and a method of air ventilation. Research results. At present, there is no generally accepted classification of smart shoe insoles, however, they can be conditionally divided into 3 large basic groups (depending on the main functions that they perform), Fig. 1:

- **ventilating;**
- **flavoring;**
- **heating.**

Fig. 1. Classification of smart insoles by providing a level of comfort to the user.



So, for example, a shoe insole is known (received the status of a patent of the Russian Federation for the invention N 2603444), consisting of one or more layers (the total thickness of the product is from 2 to 8 mm), each of which has a woven structure formed from hydrophobic fibers of a round section (made on the basis of polymer or rubber), the surface of which is equipped with a pile of different diameters, which serves to prevent the accumulation of excess moisture in the shoe, due to improved air transmission. In addition to it, an insole for shoes is known (also received the status of a patent of the Russian Federation for the invention N 2401024), which has ventilation channels in its structure, used to increase comfort for the user's foot, achieved by pumping and distributing air in the shoe, carried out on the basis of variable pressure feet on such an insole, which ensures the pumping, movement along the insole and the subsequent release of air from it.

A modern breathable smart insole, as a rule, does not release toxic substances into the free space of worn shoes prevents the appearance of foreign odors, and is also responsible for the microclimate in the shoe, the cleanliness of its inside and a certain freshness [10]. In addition, it often has pronounced antistatic and hypoallergenic properties.

Reusable smart shoe insoles with sweat odor prevention functions differ in their material of manufacture, the number of layers [9], and the device. One of the common options for such insoles is liners with activated carbon, which intensively absorb the sweat emitted by the user's skin when walking or running and prevent microbes from multiplying (inhibiting the microbiome) and spreading. Well, absorb moisture and linen reusable insoles. In addition, the perforated cotton upper wicks moisture away to the bottom layer of the insole, keeping the wearer's feet dry. Elastic latex foam cushions well when walking, while relieving the shock load from the ankle joints, providing daily comfort to the user's feet. Also, in smart shoe insoles (between two layers), it is advisable to use a special inorganic porous material (Fig. 2), which works as a microconditioner that regulates both the moisture level and temperature values.

Fig. 2. Porous micro-conditioner for smart insoles.

The work of such an innovative material is due to the fact that it is equivalent to an energy storage device: absorbing energy in a heated state and releasing it in cold weather. In addition, an active component has been developed that is able to retain the natural heat of the user's foot, called Thinsulate [9]. With active movement, this substance not only retains heat, but also generates additional. There are smart shoe insoles with bactericidal impregnation, the main task of which is to protect the user's foot from various pathogenic microbes. For ergonomics, these insoles are usually made from latex foam.

Aromatic mint-scented breathable insoles are usually impregnated with an antibacterial agent, and thanks to this, these insoles fight the odor not only by covering it with another smell but also by destroying the very cause of its occurrence. The perforated surface of such smart insoles allows the user's foot to "breathe" better and thus further prevents various bacteria from multiplying. Natural material (for example, leather or cotton), due to its natural properties, has proven itself in the fight against unpleasant odors as well as possible.

Tarrago Aromat is scented two-layer insoles for shoes, the spruce aroma of which provides the necessary freshness in the shoe cavity for quite a long time and at the same time eliminates unpleasant odors that appear overtime. Thus, special deodorizing smart insoles for shoes are quite convenient and effective in combating discomfort due to the sweat emitted by the user's body and the subsequent smell. However, insoles with antibacterial impregnation will help the user, but only if the shoes are properly cared for, otherwise they will be useless (especially if a person suffers from hyperhidrosis of the legs). So, they need to be aired every day and dried thoroughly, otherwise, there will be quite a little benefit from them. One of the types of temperature-controlled smart shoe insoles is called Climfeet. They have two main features [7]: a two-sided design and a non-standard principle of operation.

Climfeet smart insoles usually consist of silicone and copper nanoparticles [2,4], which together provide them with a fairly high degree of flexibility and effective thermoregulation. They also have special air cells-capsules (Fig.3).

Fig. 3. The insoles have mini-capsules that are involved in the thermoregulatory process [7].

The design of such smart shoe insoles is two-sided [7]: when it's hot, the user can put them with the cooling side up, and when it's cold, turn them and swap them (in this case, a warming effect will be felt). During the movement (walking) of the user, the air inside the Climfeet insoles cyclically contracts and expands, then gathering into soft and bubble-like mini-capsules, then leaves them. This process triggers the thermoregulatory effect. What exactly the user will feel (heat or cooling) depends on the side of the insole [7]: the red side will warm the feet by 4o C, and the blue side will cool them by 3.5o C.In addition to the natural passage of air, such insoles create effective shock absorption, saving the user's foot from possible impacts when walking or running, and thereby increasing overall comfort for the ankles. Solecooler's insoles also do not need electric batteries. they use the mechanical energy of their owner's steps. In particular, when a user places their foot on a repulsing surface while walking, an electrical energy of 10 watts is generated, which is more than enough to operate the thermoregulatory mechanism of such insoles.

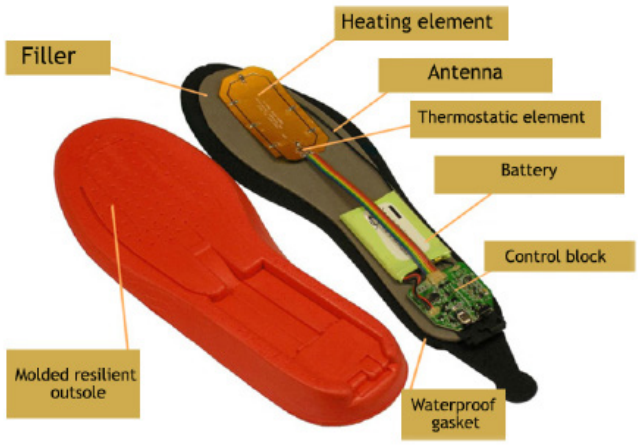
Heated insoles maintain (through heating elements or due to the operation of the chemical composition) a comfortable temperature of the feet for 4-7 hours [6]. The operation of the first option is usually provided by a power supply unit with batteries or an electric power accumulator (Fig.4).

Fig. 4. The design of insoles with a battery [5].

The optimum temperature of such insoles is 400 C. Often there is a mode of targeted regulation of the heating value of the insoles by a remote control (RC), as well as through the use of various mobile applications. It should be noted that insoles with a complex device can be additionally equipped with an antenna. For the heating element, manufacturers use [8]: carbon fiber, infrared plates, carbon fiber and many other high-tech materials.

The heating element is distributed over the entire area of \u200b\u200bthe product or only in its front part. The main criterion is the flexibility of such a material and resistance to deformation under various types of mechanical load. Wireless insoles with a built-in electric battery (often lithium-ion, with the ability to recharge up to 500 cycles) maintain the temperature inside the shoe at 40-510 C [6]. These electrically heated insoles are also controlled by the remote control. New models such as Dr. Warm are controlled by a smartphone. To avoid possible overheating of the electric battery, such smart shoe insoles heat up, as a rule, cyclically, with some temporary interruptions. The time of uninterrupted operation of such models is 4-8 hours. The blocks are charged using a telephone charger from the network, Power bank, USB cable, batteries, and other alternative sources [8]. Wired smart shoe insoles also provide heating up to temperatures equal to 40-510 C, and the change in their modes is carried out using the remote control [6]. The period of continuous operation of such insoles is usually 4-7 hours. The thickness of the wire inserts is similar to conventional insoles (2-8 mm), which is not felt by the user when walking. Such insoles are constantly heated. Temperature conditions are usually accompanied by their visual indication on the remote control. The device of smart shoe insoles with electric heating is quite simple (Fig. 5): an electric power accumulator and heating elements are placed in their hollow part. At the same time, the perforated structure of the front part of the liner quickly warms the fingers, and the design of the insole ensures that the heat will be evenly distributed throughout the user's foot.

Fig. 5. Electric heated insoles [6].



In addition, remote control systems for a smart heated shoe insole are known (patent Ru N 2597584), containing an on / off switch, an electric battery, an electronic circuit, a control signal receiver, a microprocessor (electrically interconnected by wires), as well as connectors (made with the ability to connection with the charging device), which serve to create comfortable positive temperatures in the user's shoes during operation in the winter. At the same time, Mimeng insoles look like ordinary shoe inserts, but inside they have a battery, heating elements, and a Bluetooth module. They work quite simply [11]: after charging, the user needs to insert such insoles into their shoes, and set the quantitative level of heating in a special application on the smartphone, and you can go outside in winter. These insoles heat up to 500 C, but they also have an intelligent mode that will adjust the temperature of such a smart shoe insole to the weather.

The built-in battery lasts for 6 hours at an average heating temperature, and at the maximum temperature, such insoles will work for 3.5 hours. They try to save the electric charge of the battery and automatically turn off if the user's shoes are removed from the user's foot. To recharge them, there is a special wireless platform that can be placed near the entrance to the apartment and on which shoes are placed for charging. The size of smart shoe insoles adjusts to any foot - you just need to cut off the excess material yourself according to the size and shape of the user's foot. A pair of Mimeng smart shoe insoles and wireless charging costs $166.

The high level of safety of wired insoles allows the user to not only walk, but also run or even jump, as well as get their feet wet. It usually takes 3 hours to fully charge an electric battery. At the same time, its service life is at least 3 years. Chemical smart shoe insoles (Fig. 6) often create uncontrolled and unpredictable heating (therefore, sharp differences between imperceptible and burning temperatures are possible in them) in the range of 30-700 C [6]. Models of such insoles are usually disposable and they work for 3-7 hours. Initially, salt insoles are not felt in the shoes, but then they harden, which reduces the level of comfort for the user's foot. At the same time, such insoles provide constant heating of the user's foot, but there is absolutely no possibility

to turn off or change the temperature regimes in them. It should be noted that the use of low-quality chemical insoles threatens the user with a thermal burn.

Fig. 6. Chemical smart shoe insoles [5].

Conclusion. This article presents the results of research that serve as the basis for the subsequent development of smart medical insoles. It presents the results of the first phase of the study, characterizing various smart shoe insoles that provide an increase in a certain comfort to the user.

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