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THE ADVANTAGES OF SMART TEXTILES IN MODERN TEXTILE TECHNOLOGIES

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Abstract. Currently, the development of smart textile technologies is widely used not only in the textile industry, but also in various aspects of daily life. This article discusses the main advantages of smart textiles, their role in medicine, sports, fashion, safety and environmental protection. Smart fabrics are important not only for monitoring human health, but also for controlling their temperature, providing bio-assistance and creating more interactive designs. The article also provides information on the future prospects of smart textile technologies, their importance in science and industry, as well as their economic and environmental benefits.

Keywords: smart textiles, nanotechnology, sensors, bio-monitoring, medicine, sports, fashion, safety, environment, innovative technologies, environmental safety.

Introduction. Serious changes and innovations are taking place in the field of modern textile technologies, because technological progress is creating new opportunities. These technologies not only help to increase the efficiency of production, but also help to reduce the impact on the environment and to create high-quality products. Let us examine some basic modern technologies:

In the modern textile industry, machines are becoming more automated and "smart." They work with the help of special programs and sensors, which automatically optimize the production process. For example, weaving machines or sewing robots provide maximum efficiency, reduce production time and errors.

Methods.

In the Methods section, you should explain the methodology used to conduct your research. You may have used one or a combination of the following methods:

Experimental method. If you conducted experiments in real-world conditions to study the effectiveness of smart textile technologies, you may have used this method.

Theoretical analysis. You may have conducted a scientific theoretical analysis to explain the benefits of modern textile technologies and smart textile systems.

Statistical analysis. If you measured the effectiveness of technologies or materials, you may have analyzed the results using statistical methods (e.g., t-test, regression analysis).

Results.

Nanotechnologies make it possible to create new methods in the textile industry. Nanoparticulate materials can add high quality and new functions (for example, water resistance, killing bacteria, or protection from UV rays) to textiles. Fabrics produced with the help of nanotechnologies can be light, durable, and at the same time environmentally safe [1].

3D printing technology is also finding its place in the textile industry. With the help of this technology, it is possible to create special fabrics and stitches. This technology allows for layer-by-layer printing of materials, which helps in creating complex shapes and designs.
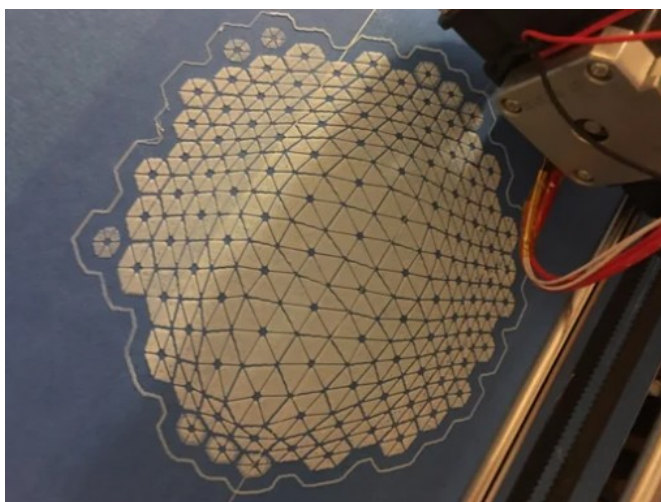

Figure 1. The process of fabric weaving on a 3D printer.

Nowadays, technologies aimed at protecting the environment, reducing waste, and increasing energy efficiency are developing. "Green" technologies, such as environmentally friendly dyeing methods, water-saving, and recycling processes, are rapidly developing in the textile industry.

Modern fabrics can have not only visual, but also interactive features. Digital fabrics, for example, can be equipped with LED lights or sensor technologies, which helps in creating new, innovative designs.

This technology is also popular in the fashion industry, allowing for the creation of more interactive and personalized clothing.

Smart clothing is one of the newest developments in the textile industry. These clothes not only have an external appearance, but also perform internal functions. For example, clothes are being developed that can measure body temperature, monitor heart rate, or even generate electrical energy. These technologies are of great importance in sports, healthcare, and the military industry [2].

Smart fabrics, also known as electronic textiles and intelligent textiles, are digitally enhanced fabrics that use light and battery technologies. These fabrics have environmental sensing technology. Smart textiles work through signals received from a central control unit. An electric processor embedded in the fabric analyzes the signals. The entire function of smart textiles operates with the help of nanotechnologies.

Some general uses of smart textiles include: healthcare (using telemedicine and biomedical clothing), safety belt (a transabdominal wearable device), rescue vest (continuously monitors and reads heart rate and blood pressure), military defense (detects toxic gases and prevents injuries), sportswear (monitoring, performance and recovery support). Also, environmental monitoring and the smart bra (measures auditory frequency through sensors) [3].

Figure 2. The use of sensor-based clothing in smart textiles to detect human body health indicators.

Modern textile technologies not only help improve quality, but also contribute to making the entire industry more sustainable and innovative. With new

technologies, production can become faster, more accurate, and environmentally friendly.

In healthcare and bio-monitoring, smart textile fabrics are of great importance in the field of medicine. With their help, it is possible to monitor people's physical condition in real time. For example, biological indicators such as heart rate, blood pressure, or body temperature are measured using sensors. This technology significantly facilitates long-term health monitoring in medicine [4].

In the fields of sports and fitness, smart sportswear helps athletes improve their performance. It allows athletes to control temperature, measure energy expenditure, and monitor body condition. At the same time, through smart fabrics, athletes in specific conditions (for example, body pain, fatigue) can be quickly identified and provided with the necessary assistance.

In the fields of fashion and design, smart fabrics are also bringing major changes to the fashion industry. Clothing is not only beautiful and aesthetically appealing, but also possesses interactive features. Fabrics that change color, those that react to body temperature, or clothes with integrated LED displays are being developed. These innovations combine design and interactivity, forming new directions in fashion.

In the field of security, smart fabrics have also found their place. For example, fabrics designed for military uniforms or security personnel monitor body temperature and condition, which helps increase safety. However, these fabrics are important not only for high-level safety but also for protecting personal privacy [5].

In the field of environmental safety, smart fabrics help to develop environmentally friendly technologies. It is possible to create fabrics with features such as water conservation, recycling of waste, and increasing energy efficiency. At the same time, the use of nanotechnologies and biomaterials helps to reduce the ecological footprint and preserve natural resources.

Discussion.

The prospects for the development of smart textile technologies indicate wider application in the future. They will elevate not only design and aesthetic aspects but also functionality to a higher level. There is potential to apply smart fabrics in the automotive industry, aerospace technologies, and other advanced fields. In addition, these technologies contribute to the social and economic development of society [6].

In this section, you can evaluate the benefits of smart textile technologies based on your results. For example, analyze how smart fabrics react to heat, moisture, or mechanical forces. If your research includes measurements that show,

for example, the perfection and long-term performance of fabrics, cite these results.

You can talk about the advantages created by modern technologies, for example, sensor systems used in fabrics or the self-cleaning properties of materials. At the same time, you can evaluate the role of smart textile technologies in optimizing production processes using automatic control and sensors.

Conclusion. The development of smart textile technologies is taking the textile industry to a new level. These technologies create opportunities to add additional functions to fabrics, making people's lives more comfortable and safer. Smart fabrics are especially important in areas such as medicine, sports, fashion, and security, offering innovative solutions for monitoring health, managing temperature, providing bio-assistance, and preventing harm to the environment.

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