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Study On Smart And Intelligent Textiles

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Abstract:
Smart textiles are one of the areas that provides added value to textile materials. It is a sector that has been developed with new technologies, new fibers, and textile materials. The production of smart or intelligent textiles cooperate with other branches of science like nanotechnology, materials science, design, electronics, and computer engineering, etc. Smart textiles are classified into three groups as passive smart textiles, active smart textiles and ultra smart textiles according to their performance characteristics. Passive smart textiles are the first generation of smart textiles and sense the external conditions; for instance, UV protecting clothing, conductive fibres, etc. As active smart textiles respond to external conditions, ultra smart textiles sense, react, and adopt themselves to conditions. Shape memory materials, chromic materials, heat storage, and thermo-regulated fabrics are the typical applications of active smart textiles

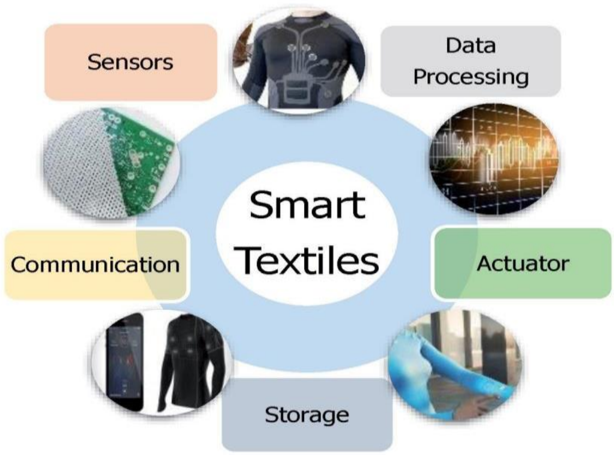
Key words: smart textiles, E-textiles, intelligent textiles, color-changing materials, phase-changingmaterials.

I. Introduction

Textiles, with the basic characteristics of clothing, protection, and aesthetics, are the indispensable part of our lives, but in recent years with the development of technology and the variation of requirements, the demand to smart materials and intelligent textiles grows increasingly all over the world. In other words, technology has also taken control of textile industry. Smart textiles have superior performance and functionalities for the applications ranging from simple to more complicated uses such as military, healthcare, sportswear, etc. Smart or intelligent textiles can also be called as the next-generation textiles.

Many classifications related to smart textiles are available in the literature. In this chapter, the classifications based on the aesthetic and performance functions are mentioned as two categories. Aesthetic smart textiles use the technology for fashion design, because of their ability to light up and

change color. Light-emitting clothes and luminous dresses are the typical and commercial examples for aesthetic smart textiles. As for the performance, smart textiles are classified into three categories as passive smart textiles, active smart textiles, and ultra smart textiles.
Passive smart textiles can only sense the environment, as they are just sensors.
UV protecting clothing, conductive fibers, plasma-treated clothing, and waterproof
fabrics are the typical examples of passive smart textiles. Active smart textiles can sense the stimuli from the environment and also react to them; besides the sensor function, they also have an actuator function. Phase change materials, shape memory materials, and heat sensitive dyes are active smart textile applications.
Classification of smart textiles.
Ultra smart textiles take a step further. Ultra smart textiles are materials that sense, react, monitor, and adopt themselves according to the stimuli or environmen- tal conditions, such as
thermal, mechanical, chemical, magnetic, or other sources.
In the mid-1970s, with the development of personal computers, a technological explosion was recorded in all the areas of human activity for any purposes. In the early 1990s, the benefits of smart textiles became apparent. Many researchers have studied on smart materials and textiles. Chan Vili studied the use of shape memory materials in developing high performance smart textiles, taking into consideration the ways for enhancing the esthetics of woven interior textiles. Dunne et al. pro- vided an overview on textile integration strategies and component attachments.
An ultra smart or intelligent textile essentially consists of a unit which works like a brain, with cognition, reasoning, and activating capacities. For instance, spacesuits, musical jackets, and wearable computers are ultra smart materials



II. Literature Review

Data Process

Data processing is one of the components that is required only when active processing is necessary. According to information theory, it is necessary to process every collected information and data and obtain the desired output.

Therefore, in order to obtain the desired output by processing the parameters col- lected by the sensors, a processor suitable for the relevant purpose is required in smart textiles. The information processing element is only needed when the tex- tile is actively processing information. Textile sensors can provide information to a large extent, but the main problem lies in how the information is evaluated and the processor component comes to the fore. Variation of signals and analysis of signals are main problems for data processors. Furthermore, the energy required for the processor is another problem encountered today. Since the electronic components required for energy
Actuators are the devices designed to perform the necessary action according to signals from the sensor or processor. These devices are also called actuators.

Actuators act by an effect sent from the sensor and possibly by first passing this effect through an information processor to perform objects such as moving objects, releasing materials, and making noise. Shape memory materials are the best examples in this field. Shape memory alloys can be formed in the form of lattice

Storage is another component of smart textiles. Although not a fundamental goal, smart suits are expected to need a storage capacity to operate on their own. While the information to be stored in smart textiles is usually information or energy, examples such as textiles that inject or emit drugs or odors indicate that this storage unit will also serve different areas. Detection, computing, actuators, and communication units generally require energy, especially electrical energy. Efficient energy management is achieved by combining the energy source and storage in an appropriate manner. Examples of the energy sources that can be used in clothing are body temperature, mechanical movement (the energy generated by movement resulting from the elasticity of fabrics or kinetic energy from body movement), radiation (solar energy), and so on. The energy source required for the operation.

Communication

One of the components of smart textiles is the communication component, which is shaped according to the type and need of communication. There are many types of communication within smart textiles. Some of the basic situations in which smart textiles are contacted are as follows: in one element of the garment itself; can be mounted between two different elements of the garment; and in order to command the garment by the wearer, contact is made to inform the wearer or his surroundings. In today’s prototypes, communication within the garment is provided by optical fibers or by conductive fine wires. They are naturally woven and can be placed in textiles without the use of stitches. A specific communication protocol is followed to communicate with the wearer. The outlines of this protocol can be provided by the technologies described below. Optical fibers are used in the creation of optical screens, and France Telecom has managed to produce several prototypes by produc- ing a sweater and a backpack. On the other hand, since it requires more than

Shape memory textiles: Materials capable of remembering the original shape are called shape memory materials. Materials are shaped out of its original shape as the temperature change returns to its original shape with a chemical, mechanical, magnetic, or electrical external effect. There are many classes of shape memory materials such as alloys, polymers, gels, and ceramics. Shape memory alloys and shape memory polymers are the types of shape memory materials with applications in textiles. The impor- tant point in these applications is that the material used exhibits the shape memory effect at temperatures close to body temperature.

Phase-changing textiles: Phase change materials, with a textile substrate, are basicly thermo regulating materials. When the melting temperature of the material is reached during the heating process, the transition from solid state to liquid, that is, a phase change occurs, during which the phase change material absorbs and stores a large amount of heat. The temperature of the phase-changing material remains virtually constant during the entire phase change. During cooling of the same material, the stored heat is transferred to the medium and the transition from liquid to solid state takes place. Again, the temperature of the material remains constant throughout the phase change process. If the temperature change continues except for phase change, the temperature of the material also changes.

Wearable smart electronic textiles: Wearable smart electronic textiles make lifes more reliable, healthy and com- fortable in many areas. Wearable smart electronic textiles; temperature change, light, moisture, such as environmental stimuli can detect, react to these stimuli, can change itself according to external conditions, store data, these data are used to produce information and communication purposes. In this sense, they are perceived as intelligent technologies that will have the qualities to support the vital activities of human beings such as sensation, movement, communication, taking action, and adapting to environmental conditions.

Laser-printed waterproof and stretchable e-textiles

The next generation of waterproof smart fabrics will be laser printed and made in minutes. That is the future imagined by the researchers behind new e-textile technology. Scientists from RMIT University in Melbourne, Australia, have developed a cost-efficient and scalable method for rapidly fabricating textiles that are embedded with energy storage devices. In just 3 min, the method can produce a 10 × 10 cm smart textile patch that is waterproof, stretchable, and readily integrated with energy harvesting technologies. The technology enables graphene supercapacitors—powerful and long-lasting energy storage devices that are easily combined with solar or other sources of power—to be laser printed directly onto textiles Conductive metals such as silver, titanium, gold, nickel, and carbon are utilized by the textile. Conductive textiles inhabit the property that it can conduct electric- ity and thus is used in several applications by different end-use industries. The primary function of the conductive textile is controlling the static electricity and protecting from the electromagnetic interference. Based on type, the woven textile segment has significant growth during the forecast period. Woven textiles are widely utilized by various end-use industries such as military and defense, health- care, and sports and fitness. As these textiles offer high standard performance in bshielding and conductivity, they are considered to be the preferred type of conductive textiles utilized across the globe, thereby boosting the growth of the woven textile segment.

III.Conclusion

Current developments in textile technologies, new materials, nanotechnology and miniature electronics, and wearable makes systems more convenient, but the most important parameter for users to accept wearable devices is comfort is sufficient. This is recognized as a challenging environment for the human body and the environment, mechanics resistance, and durability. In addition, the circuit design of the development of intelligent textiles, the knowledge of intelligent materials, microelectronics, and chemistry is basically integrated with a deep understanding of textile production. It requires a multidisciplinary approach.

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