

Passive Smart, Active Smart, and Very Smart Textile Classification.

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Introduction

The fashion industry has been improving in the past few years with great technological innovations and great developments of new forms of textiles. Smart textiles are described as textiles which communicate with their environment. Smart textiles are essentially referred to as those textiles that are capable of responding and adapting to an environmental stimulus. The origin and response of the stimulus may be from either an electrical, thermal, chemical, or magnetic source. Those three categories of smart textiles are passive smart, active smart, and very smart.

The First Generation: Passive Smart Textile

The first generations of smart textiles are passive smart textiles, which can only sense the conditions of the environment. Passive smart textiles are only able to perceive environmental conditions or stimulus data. Such textile forms only contain sensors. “The examples are UV protective clothing, plasma-treated clothing, fabric with optical sensors, etc” (Teslasuit, 2020). The passive smart textile can be used in more ways such as UV protective and antimicrobial.

Passive smart textiles are mostly used in activewear apparel. For example, “a cooling fabric can help to regulate your temperature, but it does not actively provide coolness. It simply helps you to evaporate liquid more quickly due to the construction of the textile. The same goes for apparel and other goods with UV protective, anti-microbial, and anti-static properties” (Loomia, 2019). As shown in figure 1, the men’s training t-shirt is loose, light, and keeps you cool. It is made of UA tech fabric that quickly dries up, it’s ultra-soft, has a more natural feeling. It’s also anti-odor technology that prevents the growth of odor-causing microbes and the sweat

dries fast. The fitting is great too, it's a streamlined fit, comes in multiple colors, and shaped hem. Passive smart textiles are also used in medical wearables, outdoor apparel, accessories, and automotive interiors.



Figure 1: Men's UA Tech™ 2.0 Short Sleeve

URL: <https://www.underarmour.com/en-us/p/tops/mens-ua-tech-2.0-short-sleeve/1326413.html>

The Second Generation: Active Smart Textile

The second generation that has both actuators and sensors is an active smart textile. The actuators operate either directly or from a central control unit upon the detected signal. Shape memory, water-resistant, chameleonic, and vapor permeable heat storage, thermo-regulated, vapor absorbing, and fabric that evolves heat are active smart textiles. “Active smart fabrics can memorize the shape, keep the chameleon effect, regulate temperature, resist water, absorb

vapors, heat fabric of the suit, and store it” (Teslasuit, 2020). Active smart textiles are used in thermoregulation, seat sensing, and heating.

Active smart textiles are mostly used in outerwear apparel. For example, “active textiles generally utilize electricity, which can support actuators and sensors. These actuators and sensors allow the smart fabric to sense touch and temperature, as well as process and interpret a myriad of information about the external environment (Loomia, 2019). As shown in figure 2, the women’s self- heating jacket offers unique comfort and protection against the elements without restricting movement or compromising breathability, with polyester fleece lining and an improved carbon fiber heating system. It is soft and breathable, made with ultra-soft and breathable fleece material, and elastic hems seal in the heat without restricting the range of motion. “3 carbon fiber heating elements generate heat across core body areas (left & right chest, mid-back); Adjust 3 heating settings (High, medium, low) with just a simple press of the button” (Supsn, 2020). The jacket heats up in seconds and can stay up to 10- hours fully charged. It also provides a USB-A port for charging any smartphone devices. Active smart textiles are also used in any occasions such as alpine mountains to the concrete jungle or can be used as a mid-layer on chilly days or a stand-alone jacket in mild weather.



Figure 1: Women's Heated Fleece Jacket

URL: <https://supsn.com/products/women-heated-fleece-jacket>

The Third Generation: Very Smart Textile

The third generation of very smart textiles are capable of sensing, responding, and adapting to environmental conditions and it is known as a very smart textile. A very smart textile consists of a device that deals with cognition, reasoning, and triggering capacities like the brain. “The examples of this clothing type are spacesuits, I-wear, sports jackets, musical jackets, wearable computers, and so on” (Teslasuit, 2020). Not only can they sense various data types, but without preliminary adjustment, they can also make predictions and match external conditions. Due to a built-in microcomputer, certain kinds of textiles work like the brain.

Very or ultra-smart textiles are mostly used in everyday-wear garments that could be worn in monitoring people who are ill, either at home or in the hospital, as well as athletes or astronauts. For example, “These are customizable, so we can make garments for anyone who needs to have some physical data from their body like temperature, respiration rate, and so forth” (Tectales, 2020). As shown in figure 3, a comfortable garment ensures robust sensor-to-skin contact while keeping the clothing comfortable. There is a detachable wireless module that allows you to easily charge and wash the garment. The electronic sensors are made of long, flexible epoxy-coated strips that are then woven into narrow channels in the fabric. These channels have tiny openings that make it possible to expose the sensors to the skin. The researchers developed a prototype shirt for this study with 30 temperature sensors and an accelerometer that can calculate the motion, heart rate, and breathing rate of the wearer. The

garment will then relay this information to a smartphone wirelessly. The researchers chose a polyester fabric for its moisture-wicking properties and it conforms to the skin. The shirt can be perfect for any different sizes to fit an array of age and any body types. This could be great for telemedicine to allow the doctors to monitor their patients while the patients stay at home.



Figure 3: *Sensors woven into a shirt can monitor vital signs*

URL: <https://tectales.com/wearables-sensors/sensors-woven-into-a-shirt-can-monitor-vital-signs.html>

Conclusion

Smart garments, however, have made great strides. Different kinds of garments emerged. Smart insoles or a scarf may also be bought. In general, the variety of ordinary clothing is followed by smart garments. These three passive, active, and very smart textile classification have created many unique garments that could be very helpful to many consumers, companies, and businesses. Smart textiles can be defined as textiles that are capable of sensing, reacting to,

and adapting to environmental stimuli through the integration of functionalities in the textile structure.

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