Smart Textile Classification

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Smart textiles are fabrics that have been developed through new technologies so that they are able to sense and react to environmental changes. Those environmental changes can be, but are not limited to, mechanical, chemical and biological changes. Smart textiles can also be further defined as passive smart, active smart or very smart. According to Sarah Kettley, in her book *Designing with Smart Textiles,* passive smart textiles have simple reflex actions (Kettley, 2016). They can use mechanical, thermal, chemical, electrical or magnetic states to communicate information to a processor located somewhere else (Kettley, 2016). Passive textiles can also provide a consistent functionality without usage of conductive materials (Kettley, 2016). Active smart textiles, on the other hand, have nerves and muscles, and are capable of displaying behavior (2016). They may or may not require a microprocessor. Very smart textiles are able to learn and adapt because they are aware of their own status (2016). They have the ability to react to multiple contextual information (2016). All three types of these smart textiles are rapidly changing the fashion and textile industry and are projected to create a fourth industrial revolution worth more than $130 billion by 2025 (“Report: Smart Textiles”, 2016).

Passive textiles were the first types of smart textiles developed, otherwise known as the first generation of smart textiles. An example of a passive textile would be Coolibar’s Women's Cannes Tunic Dress (shown in Figure 1). Coolibar is a fashion company which was founded in 2001. The company’s primary goal is “to develop the most innovative, technical and high performing sun protective apparel and accessories” (Coolibar, 2020). All Coolibar fabrics, not just this specific dress, have been approved as an effective UV protectant for covered areas (Coolibar, 2020). The main components of their textiles use a combination of tight weaves, colors, weight and additions of the best active ingredients found in sunscreens (2020). Coolibar

textiles also incorporate millions of the sun-bouncing minerals, titanium dioxide and zinc oxide infused at the fiber or fabric level (2020). Washing and exposure to sweat, chlorine and salt does not change the textile function. Coolibar is also the first clothing company to receive The Skin Cancer Foundation's Seal of Recommendation (Coolibar, 2020). Most of Coolibar's clothes, including this dress, have a UPF of at least 50 plus. UPF is what is used to measure the amount of UV radiation that can pass through textile and reach skin. According to Coolibar's website (2020), "A garment with a UPF of 50 only allows 1/50th of the UV radiation falling on the surface of the garment to pass through it. It blocks 49/50ths or 98% of the UV radiation". This should be categorized as a passive textile because it can only sense environmental conditions or stimuli. According to Kettley (2016), passive textiles react in a predetermined way and have no user control. These textiles also provide the same function regardless of what the environment does (2016). These attributes describe sun protective clothing.

The second generation of smart textiles, active textiles, comprise both sensors and actuators. Functions can include being chameleonic, memorizing shape, regulating temperature, absorbing vapors, repelling water, etc (Mikhalchuk, 2017). This is heavily represented through Ministry of Supply's, a Boston based fashion brand, sweater (Figure 2) which was made available to consumers in 2019. The innovative sweater is able to adjust to your size automatically using only heat (Schwab,2018). The fashion company first starts out by taking your measurements, then an in-store robotic machine uses a heat gun to adjust the sweater to your size (Schwab, 2018). Due to the combination of materials used to make each individual sweater and the structure of the knit, the fabric shrinks when exposed to heat (Schwab, 2018).This technology, which was developed by the Self-Assembly Lab at MIT, provides a

solution to the problem of mass customization (2018).Their sweater is mass-produced in regular sizes and the customization process happens only in store, rather than during the production process (2018). Skylar Tibbits, the founder and co-director of the Self-Assembly Lab, and his team developed the fabric after countless experiments, putting together several materials and then trying out different knitting patterns to see how they would react to each other after being exposed to heat (2018). This textile should be categorized as an active textile because it includes an actuator function, meaning it does something (conform to the wearer's body) as a result of a sensed environment (heat). It is also controlled by an integrated button (the machine used). These are attributes of an active textile according to Kettley (Kettley, 2016).

The third generation of smart textiles, also known as very smart textiles, are much more advanced than both passive and active textiles. Very smart textiles work much like a human brain due to a built-in microcomputer. An example of a very smart textile would be Saint Laurent's Cit-e Backpack (Figure 3). Saint Laurent collarborated with Jacquard by Google to make this tremendously innovative textile. The Saint Laurent brand has been known to modernize fashion since its founding in 1961, while Jacquard by Google thrives to weave new digital experiences into the things people love, wear, and use every day (Jacquard, 2020).There are several components which make up this backpack. The first, the interactive strap. The left strap of the bag is integrated with Jacquard technology to enable the backpack to respond to touch gestures ("Jacquard- Saint Laurent", 2020). There are also light indicators that glow in different colors to alert the wearer of things such as when they have left their phone behind. If the lights are not enough, a tactile nudge can also be used as a reminder. The most important part of the textile is the Jacquard tag which is hidden discreetly into the backpack. It connects with

the Jacquard app to help with the bag's other features such as, taking pictures and summoning Google' s virtual assistant, who can update the wearer on current traffic, weather, and news or simply answer a question. This backpack should be categorized as a very smart textile because it has a wide range of behaviors to respond to and contains a self adapting learning system (Kettley, 2016). This textile senses, reacts, and then adapts itself given stimuli.

As the world evolves technology is constantly developing and advancing. Smart textiles are one element of the many the fashion industry is using to progress and become more beneficial to society. As the many points previously discussed illustrate, the use of these advanced textiles can contribute to protection, safety and everyday life. An important benefit of smart textiles is that they are able to react passively or by more active control mechanisms whenever necessary. If the textile industry continues to keep up such drastic advancements, our clothes will soon be smarter than most people, if they are not already.

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Figure 1:

Women’s Cannes Tunic Dress UPF 50+

https://www.coolibar.com/women/plus-size/dresses/women-s-garden-party-tunic-dress-upf-50.html

Figure 2:

MIT Sweater[Photo: courtesy Self-Assembly Lab/Ministry of Supply]

https://www.fastcompany.com/90281007/ministry-of-supply-will-tailor-this-sweater-to-your-body-in-minutes

Figure 3:

YSL Cit-e Backpack

https://atap.google.com/jacquard/collaborations/ysl/

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