Electronic Textiles

Subjects: Others
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Electronic textiles belong to the broader range of smart (or “intelligent”) textiles. Their “smartness” is enabled by embedded or added electronics and allows the sensing of defined parameters of their environment as well as actuating according to these sensor data. For this purpose, different sensors (e.g., temperature, strain, light sensors) and actuators (e.g., LEDs or mechanical actuators) are embedded and connected with a power supply, a data processor, and internal/external communication.

Keywords: smart textiles ; electronic textiles ; e-textiles ; sensors ; actuators ; conductive yarn ; body functions ; textile batteries ; textile circuits ; single-board microcontroller (SBM)

While textiles have been used by humans since thousands of years, smart textiles have only been developed during the last decades [1]. Usually, textiles are defined as “smart” when they can respond to changes of environmental parameters, e.g., by changing their color due to UV irradiation or by measuring vital signs and sending them to a smartphone to enable the investigation of one’s fitness level. In many cases, such “smart” functionalities are based on electronic components, defining them as electronic textiles or e-textiles.

Such e-textiles usually contain sensors, actuators, internal/external communication, a power source, and finally a data processor [2]. Many of these parts were only made available during the last decades by inventions such as conductive polymers [3] or transistors, often based on one or two fine metal wires coated by an organic semiconductor [4][5][6]. Other parts, such as the data processor, cannot be transferred into textile structures, but due to steady miniaturization are more and more able to be integrated into textile structures [7]. Many other electronic parts made their way from being added to textiles by sewing, to integration on the fabric level and more recently even on the yarn or fiber level [8]. Nowadays, diverse levels of textile integration can be found in e-textiles, from wearable computers with openly visible electronics, using textiles only to make the electronics wearable [9][10], to fully integrated electronic functionalities [11][12].

With higher grades of integration of electronics into textiles, new challenges arise. On the one hand, textiles are flexible and often even stretchable, which causes strong mechanical influences on integrated electronics [13][14]; on the other hand, electronics which cannot be removed need to be washable [15]. Other challenges are related to the integration of batteries, power-packs, or solar cells which are usually either flexible or elastic or have a high capacity and maximum current, but normally do not combine both these properties [16][17][18].

Besides these technical challenges, sometimes problems occur due to high prices or due to low acceptance by the target group [19], especially when designing e-textiles measuring vital data to enable elderly people to live alone as long as possible, with the security that in case of a medical emergency the e-textile will detect the dangerous situation and call for help in time. In this situation, where an e-textile would be an ideal solution to support vulnerable people, privacy protection is of the utmost importance to increase the acceptance of the target group.

Thinking about the measurements of vital signs, such as pulse or full ECG, breathing frequency, or skin temperature, such parameters are not only important for people who may experience medical emergency situations, but also for rehabilitation and for athletes or people with physically strenuous jobs such as firefighters on duty [20][21][22].

In this entry, we concentrate on new technological approaches and give an overview of some recent applications of electronic textiles.

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