A project to improve awareness for cyber security in smart textile applications

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Abstract. The textile and clothing industry is facing structural changes and will enter into the interdisciplinary market of Smart Textiles. This market has a high market potential, but there is also plenty new challenges. That is why our project systematically investigates the integration and IT security of electronic communication systems in textile products. The main objectives are the scientific investigation of the area of IT security of smart textile products, the transfer of existing security concepts as well as the development of secure innovative prototypes. Based on the knowledge gained, guidelines for further action are deduced and courses for the textile and clothing industry will be created, ensuring an intensive multidisciplinary and cross-industry know-how transfer. This challenge is to be solved by an interdisciplinary team of scientists and companies from the fields of textile and clothing as well as information technology.

1. Introduction
The textile industry is one of the oldest industries in the world. In addition to the automation of the loom, the development of synthetic fibers was one of the greatest revolutions in the industry. Synthetic fibers have opened up a multitude of new possibilities in addition to classic clothing. The field of technical textiles has been on the advance in the last decades and has opened up a multitude of industries with product innovations. From underwear to interior fittings and lightweight construction which makes e-mobility possible, to the rotors of wind power edges which support the energy revolution, textiles make an important contribution in our lives and are often hidden despite everything. Electronic components are integrated into textiles and trigger the next revolution in textile and clothing technology. These textile products with extended functionalities are summarized under the term Smart Textiles. Although the development of Smart Textiles has been going on for decades, their use in everyday life is still in its infancy and there are numerous definitions. In the following, Smart Textiles are defined as textile products that interact with their environment and can thus actively support the user. The terminology used in this paper is divided into intelligent textiles, so-called I-textiles, and textiles with integrated electronic components, so-called e-textiles. For this research work we concentrate exclusively on the field of e-textiles and divide them into adaptable, integrated and modified integration levels. Adapted means that the electronic components are located in a closed housing and the textile is the carrier. On
the next level, the connections of an electronic circuit with textiles are realized, for example with conductive yarn. At the highest level, modified, electronic components such as batteries and temperatures are realized directly as textiles.

1.1. Market evolution
From automated communication with a washing machine and intelligent anti-theft protection to vital-signal monitoring – technology has the ability to make textile products more intelligent and this way “smarter”. Notably, textiles and clothing are one of the oldest industries and are essential to our everyday life. Whilst our ancestors used garments to protect themselves against environmental impacts, thereby facilitating the highly developed human civilization; textiles and clothing also paved the way for globalization in the shape of the Silk Road, connecting different societies across different continents. In addition, the field of technical textiles has been on the rise in recent decades and is opening up a wide variety of industries with product innovations; here Germany is regarded as an innovation engine and world market leader [1][2]. The market for Smart Textiles products is a young and dynamic area. The Centre for European Economic Research (ZEW) expects the global market volume to have increased thirtyfold by 2030. According to the study, the greatest growth is expected in the medical, industrial, military and fashion sectors [3]. This trend can also be deduced from some megatrends such as connectivity, new work, health and individualization [4].

1.2. Cybersecurity
The report “The situation of IT security in Germany 2018” by the German Federal Office for Information Security (BSI) states that the threat situation for IT attacks has intensified and the focus of attacks is clearly spreading. The Smart Home and IoT areas are now also among the targets for attacks (see Figure 1). Smart Textiles are assigned to the Internet of Things category and are therefore also a potential target for attackers. However, IT security in this area has not yet been systematically researched [5].

![Figure 1. Focus of attacks broadening [5].](image)

2. The project SEKT
Therefore, the interdisciplinary research project SEKT of the Faculties of Engineering and Computer Science at the Albstadt-Sigmaringen University takes up this approach and intensively combines the fields of textile and clothing technology and IT security. The SEKT project systematically investigates the integration and IT security of electronic communication systems in smart textile products and develops practical security concepts and smart demonstrators. This challenge is to be met by an interdisciplinary team of scientists and companies from the fields of textile and clothing technology and IT security between December 2018 and November 2021. In addition to three professors a team of three employees and twelve project partners – ranging from Start-Ups to associations to large cooperations –
will be involved. The core objective is the scientific investigation of the area of IT security of smart textile products and the transfer of existing security concepts as well as the development of secure, innovative prototypes. Recommendations for action are derived from the knowledge gained and courses for the textile and clothing industry are created, thus ensuring intensive interdisciplinary and cross-sector know-how transfer.

The project is divided into the following five phases:

1. Investigation of current system solutions via survey and analysis of the latest product developments
2. Examination of specific systems with which the integration of the electronic components into the textile products is evaluated as well as the safety concepts used are investigated.
3. Development and adaptation of practice-relevant IT security concepts to smart textiles products
4. Development, design and manufacture of three selected smart demonstrators
5. Knowledge and technology transfer by means of guidelines and a teaching module in the blended learning process [6].

2.1. Use of communication technologies in Smart Textiles products

The main focus in the analysis of the systems was on the wireless communication technologies used. When a transmission of data takes place, this is relevant for IT security. Since an attacker does not have to have direct access to the product, this is also the most likely attack scenario. The following Figure 2 shows the distribution of different technologies in different categories.

![Figure 2](image)

**Figure 2.** The four most common wireless communication technologies in the three main areas.

The next steps will include a deeper analysis of these communication technologies. Performing this, we will use well established methods as e.g. penetration testing in general and communication capturing followed by deciphering and replay attacks in particular. We will develop functional prototypes fulfilling...
as well a reasonable functionality as a good IT security.

This will result in a recommendation as to which protocols should be used for safeguarding the individual technologies. An important part of this will be how the compliance with the requirements of textile companies that have purchased these components can be systematically checked.

3. Conclusions

The textile industry is and will remain an innovative industry dedicated to progress in all sectors; an enormous development is predicted in the near future, especially in the Smart Textiles sector. As an interdisciplinary project, SEKT combines these two innovative areas of textiles and clothing and information technology and thus creates the basis for future innovative product development. It has been shown that wireless transmission methods are the most important core points for IT security. Effective protocols exist for all technologies to secure communication. However, these must also be activated or used. Therefore, checking the mechanisms used is one of the most important factors.

Acknowledgement

The Federal Ministry of Education and Research (BMBF) funds interdisciplinary research and development projects in the disciplines of engineering, natural sciences and economics, in which universities of applied sciences cooperate with partners from industry and science. The current research project SEKT (funding code FKZ:13FH180PX6) is the first research team to focus on evaluating the cyber security of electronic communication systems in smart textile products. The project started in December 2018 and will last until November 2021. The project team works with well-known brands with backgrounds in textiles from different areas such as fashion, sports, military or medicine and cooperates with various partners from the IT sector. In addition, the group cooperates with various associations and the universities of Erlangen-Nuremberg and Hamburg – a consortium of 12 partners is involved. The SEKT project is funded by the FHprofUnt2016 initiative with approx. 500,000 Euros.

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