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AN E-LEARNING COURSE ON SMART TEXTILES ENABLED BY TRITEX

Carla Hertleer, Johanna Louwagie
Dept. of Textiles, Ghent University, Technologiepark 907, 9052 Zwijnaarde, Belgium
carla.hertleer@ugent.be, johanna.louwagie@ugent.be

Cédric Cochrane, Marilyne Rochery
Université Lille Nord de France, F-59000 Lille, France
ENSAIT, GEMTEX, F-59100 Roubaix,
cedric.cochrane@ensait.fr

***Abstract**: In the framework of an interregional project TRITex between Flanders, Belgium and the North of France, an e-learning course on Smart Textiles was developed. The course comprises two modules: Functional and Smart Textile materials and Smart Textile Systems. Because of the cross-border cooperation it is available in two languages: English and French. The course gives the trainee a profound insight in the materials and working principle used to develop smart textiles. It is available 24/7 on the UGent Zephyr platform.*

***Keywords:** e-learning, functional textile materials, smart textile materials, smart textile systems*

I. INTRODUCTION

The TRITex project (Transfer of Research and Innovations in Textiles) [1] frames in the Interreg IV programme which stimulates cross-regional cooperation between France, the Walloon provinces and Flanders. The TRITex partners are GEMTEX laboratory of ENSAIT, France and the Department of Textiles of Ghent University in Flanders, Belgium. The two entities collaborate to promote the use of communication and information technologies for teaching, in order to diffuse knowledge in the field of smart textiles.

The main goal of the TRITex project is to develop an e-learning course which is remotely available. The course consists of two modules, the first one on *Functional and Smart Textile Materials*, and the second one, building on the knowledge acquired in the first module, *on Smart Textile Systems*. The entire course gives the trainee a profound insight in the working principals of smart textiles and is completed with examples of prototypes and commercially available products. Throughout the course, online interaction with the teachers of the course is possible. At the end of each module, the acquired information is tested through an extensive assessment with multiple choice answers. To our knowledge, there is no equivalent resource available on the net in this research area, while there is a need to it because of the continuous emergence of smart textiles. The target group for this e-learning course is people working in the textile industry wanting to sharpen their knowledge on new and advanced technologies.

The first module has been officially launched in December 2012, while the second module is to be launched in spring 2013.

II. METHODOLOGY

2.1 Access to the e-learning course

The aim of this e-learning course is to give a permanent access to multi-media numerical resources in the field of the smart textiles for an industrial public or students, as soon as they have an internet connection. These resources are hosted on a digital platform ZEPHYR from UGent [2], on which they are able to login with a password from everywhere on a 24 hour/7 days basis. The topic of smart textiles in which ENSAIT via its research laboratory GEnie des Matériaux TEXtiles (GEMTEX) [3] and the Department of Textiles of UGent [4] are strongly implied with international recognition, calls in fact upon multi-field concepts combining knowledge from chemistry, physicochemistry of polymers, physics and mechanics to understand the concerned phenomena.

2.2 Presentation support of the e-learning course

Questions were being raised about the form in which the content of this remote training could be presented opposing quality to cost. The "Podcast" solution was considered to be too complicated and not really interactive. The "Powerpoint" presentation, even when improved by including audio/video animation and comments, was abandoned because it required an additional investment of the authors. The solution of mediatisation by private companies appeared to be too expensive and was quickly eliminated. Therefore, SEMM (Service Teaching and Multi-Media) of the University Lille 1 was approached [5]. This group is specialized in multi-media teaching engineering and brings together all project-related expertise: web development, computer graphics, web integration, video creation with teaching goal. Furthermore, SEMM has more than 10 years of experience in the mediatisation of scientific contents. In addition, SEMM has invested for more than five years in the advanced use of the open source application "Scenari" with the academic models (Quadra and thereafter OpaleSup) and in creating its own models.

III. CONTENT

3.1 Structure of the e-learning course

The course is conceived of two modules, the first one being a pre-requisite to approach the second one. Module 2 is an advanced module including the process from design to the final use of smart textiles.

CONTENT OF THE MODULES

Module 1-Chapter 1 Functional textile materials	Module 1-Chapter 2 Smart textile materials	Module 2 Smart textile systems
1.1. Electroconductive materials	2.1. Chromic materials	1. Definitions
1.2. Optical Fibres	2.2. Phase change materials	2. Electrodes and sensors
1.3. Microencapsulation	2.3. Shape memory materials	3. Actuators
1.4. Photoluminescence	2.4. Hydrogels and superabsorbents	4. Data processing
1.5. Biomimetic textiles	2.5. Auxetic materials	5. Energy supply
	2.6. Shock absorbing materials	6. Interconnections
	2.7. Piezoelectric materials	7. Data communication system
Self-assessment	Self-assessment	Self-assessment

Table 1 gives the content of the modules, which is based on the classification proposed in the Technical Report written by the CEN Technical Committee 248 Working Group 31 that is dealing

with the standardization of smart textiles [6]. Module 1 is composed of two independent chapters (Functional textile materials and Smart textile materials). It refers to fundamental physics and chemistry concepts with an intermediate level of knowledge. The subdivision of the two chapters was done to give independent sequences which can be covered in any order. This enables the students to complement their knowledge with a variable degree of complexity according to their pre-requisites and their needs. Module 2 deals with the textile sensors and actuators, data processing, communicating textiles and textiles for the production and storage of energy.

Interactive animated sequences are available for better understanding the mechanisms and for overcoming the teacher's absence. For example, Figure 1 gives to the student the opportunity to move the cursor and to see how a strain sensor works. That implies a larger participation of the student with thus a better integration of this concept.

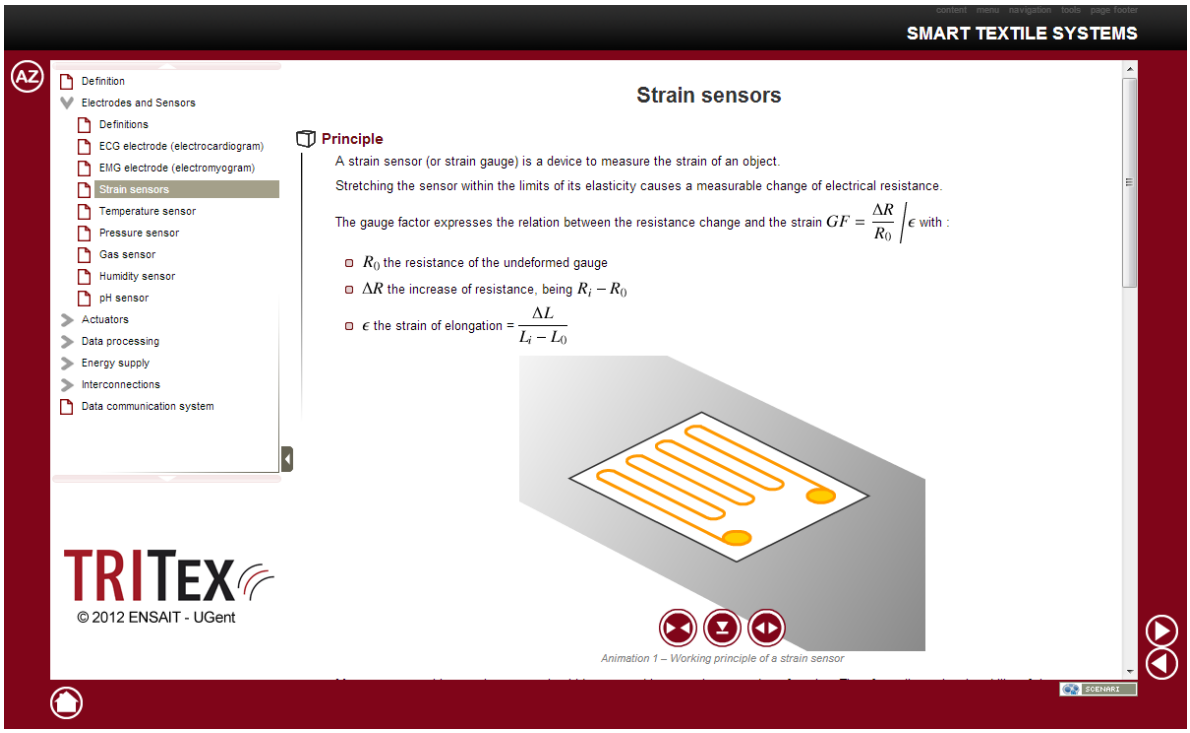

Figure 1. Interactive animated sequence of the e-learning course

3.2 Monitoring the students

At the beginning of each learning session an instructor (expert teacher) is designated for the student. The digital platform where the e-learning module is hosted gives the opportunity to exchange information with other students via the forum of discussion also with the other learners. The instructor is also able to follow the pedagogical progress through a learning pathway.

At the end of each chapter, students can assess themselves with a 20 question test in the form of multiple choice answers. They can determine their progress according to the obtained score. The number of tests is limited. The history of the scores will be consulted by the instructor. In case of failure after three tests, the instructor will contact the student in order to understand with him the reasons of his difficulties to answer correctly. He will guide him in his learning before opening the test again.

We consider a different way of monitoring for the academic students and for the industrial students. For the academic students learning sessions will be programmed in their timetable in the place of the usual lectures in classroom, even if they can adapt their working slots at times different

from those indicated. Sessions of practical exercises will be inserted between each self-learning session and allow a direct exchange with the expert and the whole students in order to answer the points which need clarification or require further information. Meetings of practical work in classroom on concrete examples of intelligent textile solutions will also be organized to supplement this formation. The validation of the module will be conditional on the success rate of the usual examinations.

In the case of industrial public, the device will offer a personalized assistance to the students. This one will be ensured by the expert with a mainly asynchronous tutorial, i.e. with exchanges by email and/or discussion forums via the digital platform hosting the module. Considering the lack of flexibility to bring industrialists together, due to their geographical spread and professional constraints, the sessions of synchronous contact will be limited. However, to encourage face-to-face contact, workshop will be organized to handle prototypes. The presence of experts at these meetings enables the exchange of information in relation to precise innovation needs in their company. Furthermore, each module we will offer the industrial student the possibility to participate to a seminar in the field of innovative textiles. After successful completion of the test and participation in the workshop, a certificate can be obtained.

IV. CONCLUSIONS

This trans-border project TRITex between ENSAIT and the Department of Textiles of Ghent University allowed implementing a first e-learning module on functional and smart textile materials and systems. An e-learning course enables the students to deal as effectively as possible with studying the content, since they can work independently once connected to the internet. The access is protected but the course is accessible 24/7. The teaching methods which were established are different according to the public concerned (academic students or industrialists). The pedagogical support had to be adapted compared to the courses taught in a traditional way. This e-learning module has been tested on a small number of students and has provided a feedback about the benefits of this new teaching approach.

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