

Research and Innovation Staff Exchange (RISE) project: E-TexWeld - Welding of e-textiles for interactive clothing

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The project E-TexWeld (Welding of e-textile for interactive clothing) is supported by the EU Framework Programme for Research and Innovation Commission, Marie Skłodowska-Curie actions - Research and Innovation Staff Exchange (RISE) join together the partners from the academic and private sector: Slovenia, Turkey, France, Greece, United Kingdom, Hong Kong and Taiwan. The interdisciplinary project work is the combination of welding, textiles, electronics and informatics technologies that aims to develop novel e-textile structures including transmission lines, sensors, actuators, microprocessors, personalized algorithms, on-body computing and user feedbacks in order to make a towards development of interactive clothing and footwear. The project is divided in: (i) designing of transmission lines of e-textile structures; (ii) integration of electronic elements (different sensors, actuators, microprocessors, data transmission and power supply systems) to textile structures and (iii) design and development of whole e-textile system for protective clothing applications including interactive protective garments and shoes.

The paper presents the dissemination the results of intensive research work among the partners after one year and half of running the project. The project activities are running and aligning with the approved research project schedule. The strengths and weaknesses will be also discussed.

Key words: e-textile, protective clothing, welding technologies, E-TexWeld

1. Marie Skłodowska-Curie Actions

The Marie Skłodowska-Curie Actions aim to support the career development and training of researchers – with a focus on innovation skills – in all scientific disciplines through international and intersectional mobility (Guide of applications Marie Curie skladoska, 2014)

The Marie Skłodowska-Curie Actions are expected to finance around 65,000 researchers between 2014 and 2020, including 25,000 doctoral candidates. The Actions address several objectives of the Europe 2020 strategy, including the Innovation Union flagship initiative. The latter states that the EU is needed at least one million new research jobs if it is to reach the target of spending 3% of EU GDP on research and development by 2020 (Guide of applications Marie Curie Skladowska, 2014).

By funding excellent research and offering attractive working conditions, the Marie Skłodowska-Curie Actions offer high quality professional opportunities open to researchers of any age, nationality or discipline.

The 2014 Marie Skłodowska-Curie Actions are:

- Innovative Training Networks (ITN), Innovative doctoral-level training providing a range of skills in order to maximise employability;
- Individual Fellowships (IF); Support for experienced researchers undertaking mobility between countries, possibly to the non-academic sector;
- Research and Innovation Staff Exchange (RISE); International and intersectoral collaboration through the exchange of research and innovation staff;
- Co-funding of regional, national and international programmes (COFUND); Co-financing high-quality fellowship or doctoral programmes with transnational mobility.

1.1 Research and Innovation Staff Exchange (RISE)

The joint research and innovation project is designed to exploit the complementary expertise of the participants and to create synergies between them. In addition to advancing research and/or innovation knowledge in a particular area, RISE projects are also expected to create additional benefits for the participants in terms of cross-sectoral transfer of knowledge and enhancing skills and expertise of the staff seconded. Each secondment is expected to provide benefit to both the seconded staff member - who would acquire new knowledge - and the host organization, which would gain new knowledge and experience.

Within the framework of the joint research and innovation project, the partnership is expected to support the successful implementation of the project by planning secondment, organizing/taking part in training, workshops, seminars, conferences etc. aimed at sharing knowledge, acquiring new skills and developing career for the staff members involved.

2. E-TexWeld -Welding of e-textiles for interactive clothing

This project is the combination of welding, textiles, electronics and informatics technologies that aims to develop novel e-textile structures including transmission lines, sensors, actuators, microprocessors, personalized algorithms, on-body computing and user feedbacks in order to make a breakthrough towards development of interactive clothing.

In the frame of the project, prototypes of e-textile structures that include electronics integrated into textiles will be developed and compared with standard sensors when tested onto simulators besides, the existing techniques (weaving, knitting, embroidery, sewing) used for designing e-textile transmission lines including conductive yarns will be compared with newly proposed welding technologies. The wearability and comfort of the whole e-textile system designed for protective clothing applications will also be assessed.

2.1 Members of project

The list of 12 participants within the project Welding of e-textiles for interactive clothing, E-TexWeld is presented in Table 1. The coordinator of the project is The Faculty of Textile Technologies and Design, Istanbul technical University.

Table 1. Participants table

Participant number	Legal Entity Short Name	Academic (Y/N)	Country
1	The Faculty of Textile Technologies and Design, Istanbul technical University	Y	Turkey
2	Kivanc Kimya Sanayi ve Ticaret A.S.	N	Turkey
4	Inlas d.o.o.	N	Slovenia
5	Technological Education Institute of Piraeus, Department of Electronics Engineering	Y	Greece
6	Ecole Nationale Supérieure des Arts et Industries Textiles	Y	France
7	TMET	N	Greece
8	University of Manchester	Y	United Kingdom
9	Institute of Textiles & Clothing- The Hong Kong Polytechnic University	Y	China
10	United medical Inovation Ltd.	N	United Kingdom
11	Taiwan Textile Research Institute	N	Taiwan
12	Kings Metal Fiber	N	Taiwan

All the partners are in an excellent position to meet objectives of the project. The expertise of the partners are given as follows:

The Faculty of Textile Technologies and Design, Istanbul technical University, Turkey comes first among the top textile engineering Faculty in Turkey. It is leading prestigious and preferred educational and research institution at national and international levels by providing an international and well-qualified education and research facilities within the fields of textile science, technology, and design.

KIVANÇ, Turkey is dealing with production of personal protective clothing according to last issued EN standards. It has own manufacturing facility, which is also capable of making customization/modification of its products. Company is the first producer of several certificated Personnel Protective Clothing in Turkey, especially for fire fighter suit, heat and flame resistant protective clothing, protective clothing against electric arc and sudden flash fire, protective welder clothing and chainsaw protective clothing for forest worker.

INLAS d.o.o., Slovenia, is providing the technical assistance in obtaining rights in the field of industrial property, in particular in the field of patent, model and of trademarks protection. Within its activities, Inlas works with Slovenian Intellectual Property Office (SIPO), World Intellectual Property Organization (WIPO), and Office for Harmonization in the Internal Market (OHIM).

Technological Education Institute of Piraeus, Department of Electronics Engineering PIRAEUS, Greece includes the research on the multifunctional textile materials as one of its priority research areas. In the last decade there is a continuous research activity very often in cooperation with other universities or industrial companies in the field of the wearable electronics, electrically conductive textiles, e-textiles etc.

TMET, Greece is the first spin-off company of the Institute of Microelectronics. The company is focused on the design and manufacturing of optical metrology tools for the characterization of thin and thick films, the FR-Series. The company is able to design and manufacture a wide range of turn-key optoelectronic characterization tools and holistic solutions for a wide spectrum of diverse applications, such as: semiconductors, organic electronics, polymers, paints and coatings, photovoltaic, bio-sensing, chemical sensing.

Ecole Nationale Supérieure des Arts et Industries Textiles, France, with its scientific laboratory GEMTEX, has research activities mainly focused on Human Centered Design (denoted HCD), Multifunctional Textiles and Processes (denoted MTP), and Mechanics Textile Composites (denoted MTC). ENSAIT is well known an internationally oriented textile engineering school and it has many partnerships with industrials sectors in Europe.

Institute of Textiles & Clothing- The Hong Kong Polytechnic University, China is leading a centre of excellence in research, development and technology transfer in fashion and textile technologies. The Institute works closely with the industry for the continual development of technologies for the textile and apparel industry and to enhance competitiveness in the global marketplace. ITC offers an extraordinary environment for students, with a close-knit community within one of the world's leading universities in the fashion and textile sciences.

Taiwan Textile Research Institute, Taiwan, is the integrator of technology and leadership of the Taiwan textile industry. It demonstrated its core R&D technologies by undertaking a crucial assisting role in establishing marketing and business development strategies of Taiwan textile industry. TTRI provides a variety of services including technology transfer, research commercialization, process integration, and project management in textile researches. It has many R&D achievements from fiber to textile products as well as many publications in scientific journals, books, conferences.

King's, Taiwan, as being stainless steel producer, provides the high-quality conductive filaments for wearable electronics, and it is becoming renowned worldwide as a leading provider of wearable electronic components.

The School of Materials in the University of Manchester, United Kingdom has world class top scientists, including the winners of 2010 Nobel Prize for Physics for their pioneering work on graphene.

United Medical Innovations Ltd (UMI), United Kingdom is a private company registered in England, UK. The company was established 2010 and it is fully involved in the research, development, marketing and trade of fibrous wound dressings including alginate, chitosan, CMC, and antimicrobial fibrous dressing since its foundation, and has been working with many leading wound care companies across the world for various fibrous wound dressing projects.

2.2 Originality of the project

Comprehensive investigation on the development of e-textiles through welding technologies with respect to sensing performance and preserving textile aspects is expected to provide a new scientific way for design and development of interactive clothing. Since the use of welding technology is expected to be convenient technique for construction of reliable and durable transmission lines as well as for fully integration of electronic components to textile structures, it may represent a great challenge and significant contribution to the sensor and actuator integration knowledge to textile structure. By this way, the aims of this research are:

- Different type of conductive yarns with different basic fabric type will be tested to design transmission lines of e-textile structures using welding techniques.
- Different types of sensors, actuators, data transmission and power supply systems will be tried to be embedded to textile structures via welding techniques.
- Welding parameters will be tried to be optimized for development of e-textile structures.
- Specific interactive protective clothing garment and shoes including e-textile structures will be developed using welding techniques.

2.3 Research methodology

The research methodology according to the work plan for whole four years is presented in Table 2.

Table 2. Work Plan of project

Num.	Work plan	Months							
		6	12	18	24	30	36	42	48
	Work packages								
1	Selection of materials	X							
2	Design and manufacturing of electronic circuits and electrical interfaces		X	X					
3	Design and production of e-textile circuits and e-textile transmission lines			X	X	X			
4	Integration of electronics to fabric structures				X	X	X		
5	Design and production of interactive protective clothing						X	X	X
6	Dissemination & exploitation of results	X	X	X	X	X	X	X	X

2.4 Project organization and management structure

The organizational and management structure of the project including the work flow within project duration is depicted in the diagram below, Figure 1.

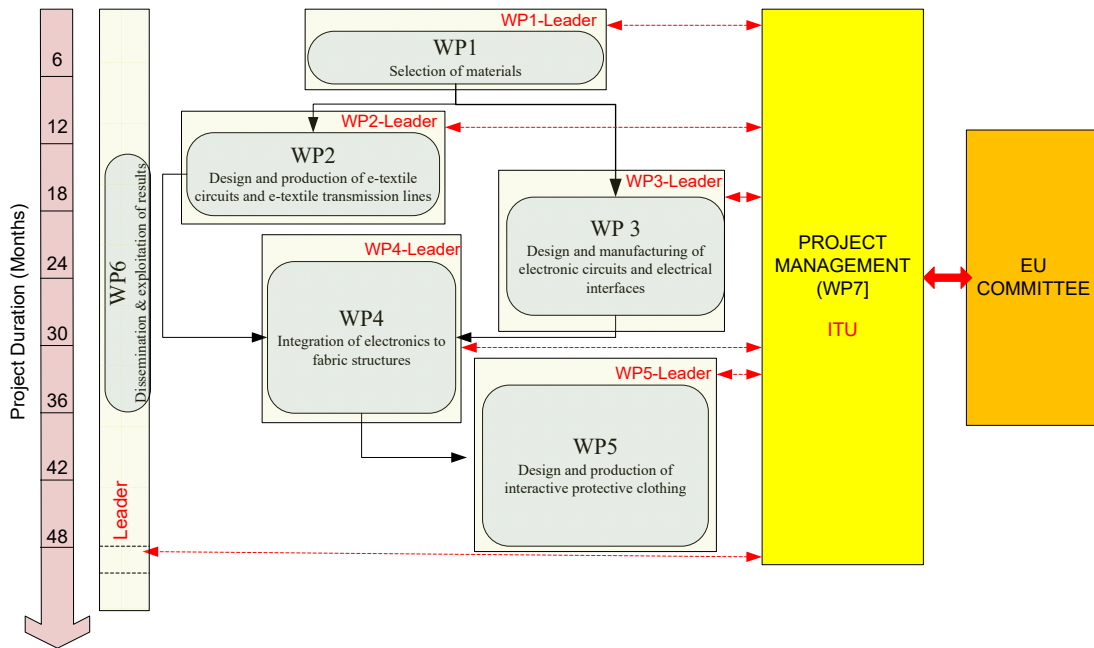


Figure 1. Organizational and management structure of the project E-TexWeld

2.5. Role of Intellectual property rights

Within the project will be developed the following element of industrial property:

- patents,
- designs and
- trademarks designs for the new e-textile products, interactive clothing and footwear.

The company INLAS Ltd. also a member of a project consortium that engaged professionally in the protection of intellectual property is ensuring the protection of project intellectual property right. Participants are collectively reflected the best strategy to protect the results of the proposed research both for further researches and in the development of commercial products, processes or services. The intellectually property created under the project will be protected in National offices for intellectual property of participate countries or WIPO-World Intellectual Property Organization or OHIM (Office for Harmonization in the Internal Market depend on agreement of consortium members).

During the submission of any application of intellectual property the consortium members are careful leading attention that required condition for patents (Novelty, Inventive Step and Industrial applicability) and for designs, Novelty (no identical design disclosed to the public earlier and Individual character). The project consortium is going to take care on time priority deadlines that the project intellectual property rights will not loss (6 months for designs and trademarks; 12 months for patents). The Inlas d.o.o. main task is also take attention on dissemination the project results.

3. Dissemination of project results for 1st research year

Patent

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6. S. A. Mitilineos, S. G. Vassiliadis, P. Grimanis, K. Rizopoulos, S. P. Savvaidis, N. A. Stathopoulos, S. Kursun, O. Atalay, F. Kalaoğlu, Design of A Textile Linear Spiral Antenna for Medical Imaging, *5th International Istanbul Textile Congress 2015: Innovative Technologies "Inspire to Innovate"* September 11th -12th 2015 Istanbul, Turkey

4. Conclusion

To conclude, this project is a key scientific and technological interest of global textile industry since it addresses the fundamental development of e-textile structures for interactive clothing systems. The results have important impacts both at a theoretical and expert levels. The project offer excellent opportunity for exchanges the knowledge between the academic and private sectors. Common work between the academic researchers and expert from private company is leading to develop high quality interactive protective clothing with the integrated electronics using the welding technologies.

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