

Vital-Jacket®: A wearable wireless vital signs monitor for patients' mobility in Cardiology and Sports

João P. Silva Cunha, Bernardo Cunha, António Sousa Pereira
IEETA/Dep. Electronics, Telecomm. and Informatics
University of Aveiro
Aveiro, Portugal
{jcunha,mbc,asp}@ieeta.pt

William Xavier, Nuno Ferreira, Luis Meireles
Biodevices S.A.
Aveiro, Portugal
{luis.meireles,nuno.ferreira,william}@biodevices.pt

Abstract—The Vital Jacket® (VJ) is a wearable vital signs monitoring system that joins textiles with microelectronics. After several years of development within the university lab, it has been licensed to a start-up company. Its evolutions have focused on cardiology and sports and scaled down from a jacket to a single T-shirt. The VJ manufacturing process has recently been certified to comply with the standards ISO9001 and ISO13485 and the cardiology version was approved as a Medical Device for the European market compliant with the MDD directive 42/93/CE, holding the CE1011 mark. The authors intend to wear VJs during the days of the congress to demonstrate its usefulness in first hand and will exemplify the different scenarios of use of this innovative wearable intelligent garment.

Keywords- *wearable electronics; cardiology; sports; MDD 42/93/CE certified.*

I. INTRODUCTION

The Vital Jacket® is a wearable vital signs monitoring system that joins textiles with microelectronics. It was designed and developed to be a usable practical approach for different

clinical scenarios, in hospitals, home or on the move, that need continuous or frequent high quality vital signs monitoring from its wearer.

The concept was designed and specified based on the long tradition on biomedical instrumentation and telemedicine of the IEETA institute of the University of Aveiro, Portugal (www.ieeta.pt). This R&D non-profitable organization further developed all the microelectronics, informatics and mobile communications and sub-contracted the textile development to the CITEVE – Technological Centre for the Textile and Clothing Industries of Portugal, a non-profitable association of 600 partners from the Portuguese textile industry.

In 2007, this development has been licensed to a small biomedical engineering spin-off company called Biodevices, S.A. that has further evolved the first prototypes and focused the wearable platform on Cardiology and high performance sports, scaling it down into a simple and comfortable T-shirt with the design and textile development support of Petrutex S.A.

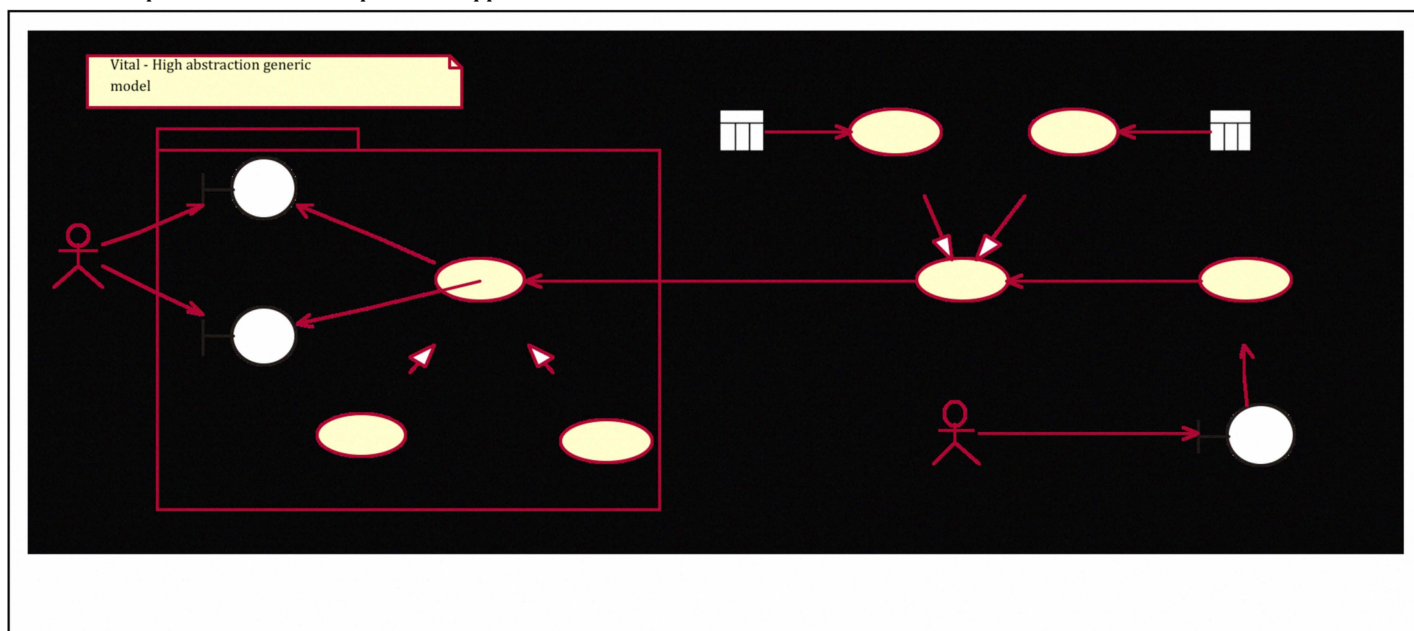


Figure 1. Vital concept architecture

This work was supported by PRAI-Centro funding program and is being further supported by FCT/FEDER through CMU-Portugal (grant CMU-Pt/CPS/0046/2008) and MIT-Portugal (grant MIT-Pt/TS-ITS/0059/2008) programs and IEETA.

II. PRODUCT CONCEPT

The Vital Jacket® is the wearable part of the “Vital” wider concept of future health and wellbeing integrated systems for home, hospitals or mobile scenarios under development at the University of Aveiro, Portugal and based on previous R&D for bed-side monitors [1,2]. The “architecture” of this concept is presented in Fig. 1 using UML notation [3]. Depending on the specific needs of the user, the wearable system can be setup to acquire different vital signs (ECG, temperature, respiration, movement/fall, posture, actigraphy, oxygen saturation, etc.) and psycho-social variables (panic button, medication delivery, activity habits, location, etc.) through wearable or bed-side sensors. Furthermore, this garment is washable, easy to wear by using disposable electrodes and large number of these wearable monitors can be connected to its IT infrastructure. All vital variables are transmitted through wireless channels, stored and processed to generate alarms, trends, and result charts that are presented to health professionals or care givers through web-based IT infrastructure.

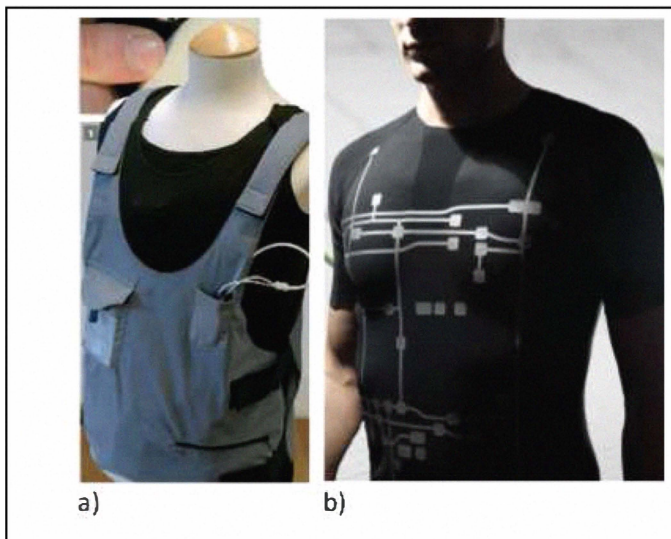


Figure 2. Vital Jacket prototype (a) and sports commercial version (b)

III. FROM PROTOTYPES TO PRODUCTS

The wearable part of the previous concept has evolved to a pre-product version that we named Vital Jacket® and later to a line of products focused in specific niches, namely in high performance sports and cardiology. The first version was composed of two parts, a seamless shirt with elastic properties where sensors are embedded and a jacket where the microelectronics were inserted (Fig 2a) while its sports evolution version is only composed of a simple T-shirt with textile embedded electronics (Fig. 2b).

The sports Vital Jacket is intended to be a “heart wave monitor”. When used in the gym, it can send clinical quality ECG and heart rate data through Bluetooth wireless connection to the PDA of a personal trainer. At the same time, all data is collected into an SD memory card that can be used for offline analysis. Furthermore, in the cardiology evolution version, the

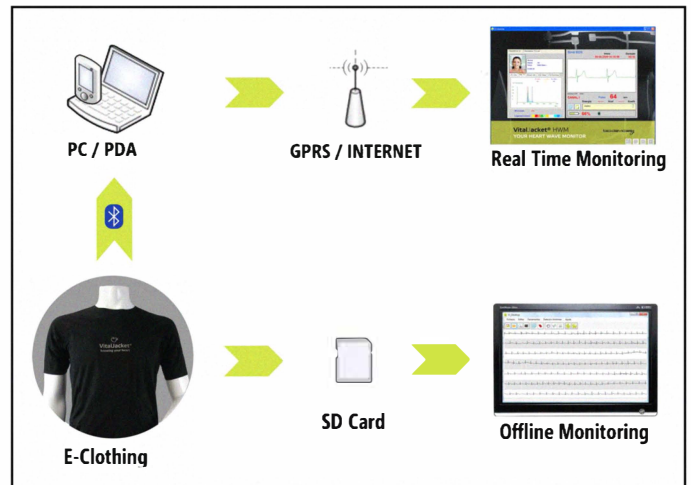


Figure 3. Vital Jacket online wireless connections and offline SD card based data analysis

Vital Jacket Cardio has 1, 3 or 5 ECG leads and a 3 axis accelerometer. All this information can be relayed in real time, not only to a PDA or a PC, but also to a cardiology information system through wireless LAN, GPRS or UMTS mobile data networks (Fig. 3). Due to intellectual property (IP) protection, the scientific work on this project was silent for several years. This IP was licensed in 2007 to Biodevices S.A. that has successfully concluded the certification process according to the standards ISO9001 and ISO13485 and the approval of Vital Jacket® as a medical “Ambulatory ECG device” according to the MDD directive 42/93/CE that regulates medical devices in Europe. Vital Jacket has been granted with the CE1011 mark. To our knowledge, this is the first truly wearable cardiology long-term monitor to hold such certification worldwide.

IV. VITAL JACKET PRESENTATION

In our presentation we will demonstrate the different scenarios of use of Vital Jacket with real live devices that the presenters will wear during the days of the congress. More information on Vital Jacket is available from the website www.vitaljacket.com.

ACKNOWLEDGMENT

The authors would like to thank all the team members of SIAS lab of IEETA, Biodevices SA and Petrutex SA that have contributed to the different Vital Jackets versions developed through the years and to all the fun we had doing them.

REFERENCES

- [1] A. Trigo, J. P. S. Cunha, M. B. Cunha, W. Xavier, and N. S. Ferreira, "Wireless bedside vital signs monitoring unit," in *Med-e-Tel 2004*, Luxembourg, 2004
- [2] J. Capucho and J. P. S. Cunha, "A New Paradigm in Bed-side Vital Signs Monitoring Based on Low-cost Telemonitoring Units," in *BioEng 2001 - Sixth Portuguese Conference on Biomedical Engineering*, Faro, Portugal, 2001
- [3] M. Fowler with K. Scott, *UML Distilled: Applying the Standard Object Modeling Language*, Addison-Wesely, 1997.