ITEA 2

INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

INNOVATION REPORT

Improving the quality of everyday life through wearable computers

EUREKA

Karel Slavicek, Masaryk University

The need for users of technology to interact on a daily basis with a host of electronic devices is often hindered by the bulkiness and complexity of the interfaces of these devices, including mobile phones. Moreover, as technology evolves, users are introduced to new platforms, devices and services enabling them to access improved underlying structures. This requires a more interactive environment, especially for mobile applications. The answer: wearable computers that not only offer new possibilities and ways of interaction but are also more mobilised, adapted and natural. The ITEA 2 LIFEWEAR project took up the challenge to develop a new platform based on the results of previous EU research projects whereby wearable electronics work in conjunction with mobile computers to enhance the mobile lifestyle of users and create new market opportunities.

Attributes for wearable devices

LIFEWEAR examined various technologies, such as wearable computers and sensors, new ways of human-machine (HMI) and human-computer (HCI) interaction, machine learning and ubiquitous computing focusing on personalisation, privacy and seamless interaction. The key to wearable devices is that they need to be:

- unmonopolising: interaction with the wearable equipment should be a secondary activity rather than a primary focus of attention;
- unrestrictive: wearable equipment should be designed for everyday mobility such as walking and jogging;
- observable: equipment should be responsive using different media such as displays, sounds and movements;
- attentive: sensors should enable wearables to be aware of their surroundings; and
- communicative: wearable equipment should enable users to connect and communicate with other users as well as with surrounding objects and the worldwide web.

Furthermore, wearable equipment has to be always ready and available, or be able to ‘wake up’ manually (pressing a button) or automatically (sensor response) and, importantly, be personal – equipment should act as natural extensions of body and user experience, and be private in all applications.

Monitoring body functions

A major goal of wearable equipment is the online physiological monitoring of human body functions in different natural and safety-critical environments. For example, tracking the blood pressure, pulse or temperature of a patient for whom these functions are life-critical and transmitting the data to medical staff to enable the appropriate treatment to be constantly controlled. Such data can be used in very different application areas, such as monitoring motorcyclist or car driver exhaustion and state of alertness, observing workers in critical situations that demand a high state of alertness or following sports training to optimise level or performance.

LIFEWEAR Application area

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Using ambient intelligence

This project explored a number of innovations that are central to the acceptance of wearable devices, among which is the whole issue of user requirements of professionals such as doctors and firemen as well as other vulnerable groups like the disabled and the elderly. New algorithms, based on learning and reasoning gestures, were developed. These are central to both the need for WSN (wireless sensor network) gesture-based ambient intelligence applications and for the adaptive user interfaces in human-computer and human-machine interaction as well as machine learning systems able to recognise existing gesture patterns or learn new ones.

In all LIFEWEAR scenarios, ambient intelligence is used to capture data from various sensors and understand the environment of the user whereby all the data are combined, processed and used to take decisions enabling the user to use an easy-to-understand interface. In a parallel ITEA 2 project, ViCoMo, advanced video-interpretation algorithms are being developed to enhance images acquired with multiple camera systems so that the intelligence of visual systems is significantly improved and the behaviour of persons, objects and events in a 3D view recognised.

Real time

The use of body posture detection sensors to detect whether the user is exercising or performing sport correctly can be compared with other data acquired by LIFEWEAR middleware and merged to provide useful information to the user. By combining location and other technologies, distance, calories consumed and average speed can all be calculated. The real innovation here is location in real time and suggestions to optimise exercise and sports performance. In the field of eHealth, too, an app from Mobilera, a consortium partner, enabled LIFEWEAR to work on chronic disease management whereby the user and doctor receive real-time information about the user's health status. With the third generation mobile devices able to connect sensors and other devices as well as infinitely develop assistance, alert programs and security APPs, LIFEWEAR aims to supplement a mobile service, specifically geared to monitoring sleep in humans and to suggest sporting exercise versus diet.

In case of fire ... innovate

In the fire-fighting area, an innovative solution is the development of a wearable device, like a polo shirt, with sensors to collect all the vital signs. The sensor data of the wearable device and from other sources (cameras, etc.) is monitored by a human operator who is alerted whenever the data exceeds normal limits. In this way, all the vital parameters of the fireman engaged in a situation are constantly monitored, so allowing timely intervention before potentially lethal parameters are reached, with an audio or vibration warning. Several prototypes were developed and tested, and even reused for other applications like heavy industry. The project partners are planning to exploit the prototypes for commercial production.

The RO-LIFEWEAR web platform that came out of this specific research integrates all the available data sources for analysis and decision-making and serves as a portal for the supervision of fire situations. The architecture is based on the Liferay open-source content management system and the MySQL database server. RO-LIFEWEAR has been designed as a standalone system, which can function without an internet connection. Nevertheless, the approach taken allows the easy migration of the application and the written code to a centralised platform available via internet. In fact, LIFEWEAR has the ability to join several middlewares which are specialised in different fields in a unique platform so that 'wearable' services foster component re-use and decrease the number of errors required to implement a new application. While the solution is just a prototype, preliminary experiments have proved the validity of the proposed platform: low-power consumption, reduced complexity, high compatibility and extendibility. In addition to confirming the validity of the data-processing methods, currently performed in a non-specific environment, the project developed a predictive model to assess the hazards a fireman may actually face.

Leapfrog effect

LIFEWEAR aimed to create a leapfrog effect on the everyday acceptance of wearable computers, as well as the technologies behind them, with results demonstrated across Europe by universities and research institutes. The exploitation of the outcomes in future technological products will have a great impact on the standardisation of wearable equipment as well as new HMI and HCI methods that can be applied to a great variety of devices such as mobile phones, medical equipments and domotics. The successful implementation and validation of the application scenarios based ubiquitous computing and the 'Internet of things', virtual learning environments, healthcare and community applications and services against the business and user requirements of the project as well as the user experience provided by the LIFEWEAR ecosystem will help create new business models and integrated applications. In turn, these will boost the position of European technology in the new generation wearable solutions in the global arena and, as importantly, improve the quality of life for users and bring happiness to industry and the community.