![ITEA 3 logo]

Project Results

DEMWatch

Assistive technology for the elderly

EXECUTIVE SUMMARY

The goal of the ITEA 2 project DEMWatch was to assist people with slight and moderate memory disorders by creating assistive indoor and outdoor technology to support everyday living and enable increased independent living and inclusion.

PROJECT ORIGINS

The maturity of satellite-based outdoor positioning systems encourages indoor positioning research to focus on radio technologies. However, localisation devices designed for outdoor use are inefficient indoors most of the time, so research in the indoor context tends to focus on wireless technologies not commonly used outdoors. The transition between outdoors and indoors requires a truly global positioning system that should be efficient in those different environments. DEMWatch set out to close this 'gap' and demonstrate the benefits of sensor-fusion technology in the health domain, particularly for the elderly.

TECHNOLOGY APPLIED

Since radio-based techniques can already cover outdoor areas and are implemented in the hardware of many mobile devices, the radio indoor approach might have seemed a relevant candidate to address a wide variety of environments. However, infrastructure issues limit the deployment of indoor radio technologies. So a fusion of INS (Inertial Navigation System) and radio was adopted to highlight the obvious complementarities: radio technique provides absolute positioning and provides long-term reliability while INS is autonomous, independent of changes in the environment. The indoor localisation requirements, use cases and demo scenarios were defined, and included aspects such as accuracy/measurement uncertainty,

the coverage area and limitations to certain environments, the required infrastructure, output data, privacy parameters, interfaces, system integrity, robustness and availability/scalability.

The design of a wearable belt-mounted tracking activities device was based on a real-time Linux board connected to off-the-shelf Inertial Measurement Unit (IMU) sensors and the integration and configuration of Bluetooth low-energy components for communication with the gateway of Eeleo. An important innovation came in the shape of the "jerk" concept for forward-move evaluation and drift mitigation while the development of a simple sensor fusion approach improved the overall accuracy of the indoor localisation device. The 'proof of the pudding' was demonstrated in a 'City of Marseille' pilot initiated by Telemedicine Technologies (TTSA) involving 1400 patients that revealed how an integrated platform operated in real-life conditions and in a health domain ecosystem through an incremental maintenance and deployment process with regular user feedback.

MAKING THE DIFFERENCE

Among the various achievements in the project were a simple sensor fusion approach that provides higher accuracy of indoor localisation and new algorithms for improved fall detection along with the development of a DEMWatch platform and professional services. Eeleo

DEMWatch context

used its gateway to connect to devices with standardised or proprietary interfaces and developed a communications framework including indoor/outdoor localisation and cloud services plus an end user application for demonstration. CEA developed a wearable device (belt-mounted tracking activities device) prototype for indoor localisation, although the device does not yet fulfil the requirements for autonomous operation of at least 1 week (the batteries currently need to be recharged after six hours). An architecture based on I-Beacons was implemented, with first-class I-Beacons used to detect the room and second-class I-Beacons placed strategically around the room. Actimage developed several approaches to provide fall detection based on signal processing and machine learning as well as an application to demonstrate the

different fall detections algorithms. Actimage benefited from the innovative way to enhance sensor data and the integration of the machine learning framework directly on the device to predict without the need for mobile network access or cloud. This has improved the company's expertise in smart mobile applications and in data science, machine learning and predictive models, especially for projects related to e-health. Bor Software developed two mobile applications (a caregiver application and patient device simulator) and a user portal for hospitals/clinics to care for a group of patients.

The SR4HC (Shared Record for Health Care) developed by TTSA enables patient-centred electronic medico-social record processing, including an international standard for multidimensional assessment. TTSA bases its work on its close relationship with key stakeholders in the home care domain and its technical knowledge in the development and operation of collaborative e-health environments, so the DEMWatch project enabled TTSA to identify a generic architecture for such collaborative solutions. In addition, TTSA acquired invaluable experience in the integration of real-time data monitoring and the integration of such data in collaborative e-health solutions, enabling the company to enter into subsequent R&D partnerships and reinforce its expertise and know-how in dealing with large amounts of data and the smart management of such data. TTSA also made a considerable dissemination effort towards key stakeholders, both national and regional authorities as well as assistance and repatriation companies affiliated to the insurance system, and academic and hospital institutions.

MAJOR PROJECT OUTCOMES

Dissemination
- Participation to industrial and healthcare profesionals workshop 'Centre Gérontologique Départemental' in Marseille, initiated by Telemedecine
- Participation in ITEA 2 Co-summit on 10 and 11 March 2015 in Berlin. Presentation of DEMwatch project and the main results
- Participation in 'The EIT Health, an opportunity to work with actors across Europe' Informal presentation of project objectives, results and prospects
- Presentation of DEMWatch project during the day 'project emergence MUSPAC' Multitechnological Stroke Patient Care
- Participation to 'Eureka Innovation week' on 27 to 28 april 2016 in Stockholm

Exploitation (so far)
New Services:
- TELEMEDICINE is clearly positioned towards the creation of new d-CAS product for the home care and real life clinical studies markets

New systems:
- CEA has developed a reliable device for indoor localisation issues
- Eeleo has upgraded its eeleoCare platform in the framework of the DEMWatch project by adding location data indoor & outdoor
- TELEMEDICINE was clearly positionned towards the creation of new products for the home care and real life clinical studies markets (this one appeared in the course of the project)
- Internal Actihome product, dedicated to elderly people has been updated with posture detection algorithm

Standardisation
- Implementing the RAI standardized instruments into the d-CAS has been a first in France and has been endorsed by the CNSA and ASIP following an international call for tender published 23/10/2015 under nb. AO-1545-2674

Patents
- Method for indoor and outdoor positioning and portable device implementing such a method, USPTO Applicaton #: #20160238395

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Partners

France
Actimage
CEA
Eeleo
Telemedicine Technologies

Turkey
Ankira
ARDIC
Bor Software
Turkcell Teknoloji

Project start
February 2014

Project end
August 2016

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Project website
https://itea3.org/project/demwatch.html