![ITEA3 logo]

Project Results

eWatch

Integrated sensors and wearables for the next generation of telehealth

EXECUTIVE SUMMARY

By integrating data from various sensors and wearable devices into one dashboard, the ITEA project eWatch intends to streamline health monitoring and treatment. This will expand the telehealth domain, improving patient quality of life by providing care within their homes.

PROJECT ORIGINS

All health systems face the same challenge: how can the needs of citizens be met while controlling costs? Worldwide, over four million deaths are caused by cardiac diseases per year, with treatment costs of around USD 650 billion. Additionally, the complexity of such diseases requires the involvement of many professionals throughout the diagnosis, treatment and follow-up process. To minimise costs and enhance quality of life, remote methods of health monitoring and feedback must become commonplace.

The eWatch (Extensive personal monitoring & watch platform) project has focused on the integration of various sensors and wearable device solutions into one platform. This uses physiological data to manage chronic diseases and monitor post-hospitalisation recuperation and targets several areas: pulse oximetry, wound/skin imaging, indoor and outdoor localisation, cardiological monitoring and behavioural metrics such as stress detection. Data is made available in a unified dashboard which allows doctors to access reports on a patient's overall status, thereby reducing the complexity of treatment.

TECHNOLOGY APPLIED

eWatch's added value lies primarily in its integration of diverse technological solutions, as shown through a number of demonstrators:

- Barco has created a solution for real-time wireless and secure exchange of high-resolution wound images taken by nurses when patients are unable to leave their homes. These images
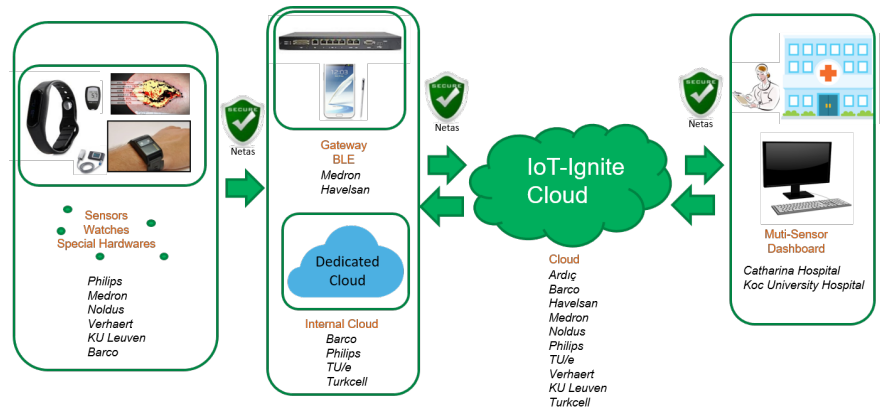
eWatch platform

are processed and stored in the cloud, enabling doctors to examine the wounds.
- Verhaert has produced algorithms for measuring blood pressure from the fingertip or wrist, removing the stress that cuffs induce in patients.
- Philips, Catharina Hospital and Eindhoven University of Technology have worked on an outpatient monitoring study kit for continuous cardiac monitoring, enabling sensor results to be collected by the Philips Healthband and sent to the cloud for cardiologic disease detection. Philips also offers a hub which can be connected to external devices at home to collect additional data.
- Noldus' object identification platform analyses data relating to patient behaviour, activity and condition, allowing the measurement of their workload and stress level.

- The Medron watch uses a PPG sensor to collect oxygen saturation, heart rate and activity, sending this data to the cloud through gateways at home using Bluetooth Low Energy.
- Havelsan's indoor localisation system can be used to track patients across large areas such as hospitals. Their algorithm is executed within Turkcell's cloud, which collects PPG raw data from wearables and uses another algorithm to also detect Atrial Fibrillation (AF).
- Integration has been provided by Ardic's IoT-Ignite cloud, which gathers data from the previously described solutions and presents it in a multi-sensor dashboard. This provides an overview of a patient's status to each health professional involved in their treatment.
- For security, Netas has carried out penetration tests on the clouds and gateways to generate vulnerability scores. Netas determines whether

cloud data is public or private and encrypts it accordingly.

MAKING THE DIFFERENCE

eWatch's main result is the proof-of-concept that companies of different sizes can integrate their work to create mutual opportunities. One example is Philips, which has improved its embedded software library with a new AF metric which it will license to other manufacturers for their own wearables. Its ambulatory monitoring study kit is now being used for joint investigations into the value of cardiac monitoring in clinical research and practice. Havelsan, meanwhile, has combined pre-existing localisation technologies (fingerprinting and RSSI) into one method which has an accuracy of within one metre (versus the previous state-of-the-art of four metres). They have also extended the seven state-of-the-art motion classifications to remote areas which were previously unable to benefit from these technologies.

Commercialisation is just beginning but has already led to the recruitment of 15 employees across the consortium. In terms of new markets, Turkcell is a success story: through collaboration with academia on PPG data collection and AF detection modelling,

they intend to expand beyond digital telecom operations into ehealth services. Verhaert also plans to extend its reach in the smart health and smart sport markets, in which it predicts respective revenues of EUR 10.55 million and 4.26 million over six years. Ardic, meanwhile, has introduced its IoT cloud system and is already working with 185,000 devices – a figure set to increase through the eWatch platform and dashboard. By providing different MQTT/REST APIs for partners to connect to the dashboard, Ardic has gained crucial experience needed to access the smart health domain.

Telehealth is more important than ever before. eWatch is therefore disseminating its results beyond the consortia, including in three journal papers and three international conferences. This will allow researchers to construct new models and algorithms which can be connected to the platform and expand its offerings into additional health domains. In turn, this will allow an increasing number of patients to receive treatment from the comfort of their homes, streamline the treatment process for health professionals and push down the costs of treatment for society as a whole – a truly integrated result.

MAJOR PROJECT OUTCOMES

Dissemination
- More than 5 publications (e.g. IEEE Journal of Biomedical & Health Informatics) and more than 7 presentations at conferences/fairs (e.g. Intl. Conference on Computing in Cardiology 2019, Measuring Behavior Conference 2018 & 2020)

Exploitation (so far)
New products:
- Patient Monitoring Dashboard and IoT Platform with graphical representation of sensor data
- Medron Device Gateway: simple installation and simultaneous Bluetooth/Wifi/Ethernet support
- Clinically relevant wearable medical device: continuous cardiology, respiratory, sleep monitoring
- Ambulatory monitoring study kit: supports clinical studies around prescribed monitoring at home

New systems:
- Hybrid Indoor Localisation Algorithm with e.g. location of users and individual mobility metrics
- Security Framework: compatible with mobile application frameworks and IoT gateways, providing a faster encryption/decryption process than existing libraries
- Activity Tracking System: real-time activity classification suitable for indoor localisation systems
- Cloud based wound imaging system

New services:
- Atrial Fibrillation detection algorithms and behavioral detection algorithms
- Embedded software library for metric extraction from PPG & ACC for integration in smart watches
- PPG2BP IP: model to estimate blood pressure from PPG sensor
- Clinical trial investigation support for vital signs based technology
- Opensource IoT-Ignite MQTT Client for C#: easy to develop for medical and generic type devices

Patents
- 1 patent application filed: Hybrid Solution for Indoor Localisation System

Partners

Belgium
Barco
KU Leuven
Verhaert New Products & Services

The Netherlands
Catharina Hospital
Eindhoven University of Technology
Noldus Information Technology
Philips

Turkey
ARDIC
Havelsan
Koc University
Medron Medikal Teknolojiler
NETAS Telekomunikasyon
Turkcell Teknoloji

Project start
September 2016

Project end
April 2020

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