Types of Sensors

- Contact sensors (accelerometers, ECG, EMG, EEG, Pulse oximeters, glucose level, etc.)

- Non Contact Sensors (video analysis of movement (Kinect), heart rate and breath rate (VitalSign), IR, Bio-radar, audio)

- Two Types of Implantable sensors –
  - With battery
  - Without battery (RFID (NFC),
Activity monitoring in elderly people

PARTNERS

<table>
<thead>
<tr>
<th>Institution</th>
<th>Type</th>
<th>Country</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFKI</td>
<td>R&amp;D, Coordinator</td>
<td>Germany</td>
<td><a href="http://www.dfki.de">http://www.dfki.de</a></td>
</tr>
<tr>
<td>University of Compiegne</td>
<td>R&amp;D</td>
<td>France</td>
<td><a href="http://www.utc.fr/">http://www.utc.fr/</a></td>
</tr>
<tr>
<td>TRIVISIO Prototyping GmbH</td>
<td>SME</td>
<td>Germany</td>
<td><a href="http://www.trivisio.com/">http://www.trivisio.com/</a></td>
</tr>
<tr>
<td>Centre Hospitalier Universitaire de Rennes</td>
<td>End user</td>
<td>France</td>
<td><a href="http://www.chu-rennes.fr/">http://www.chu-rennes.fr/</a></td>
</tr>
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</table>

**Name of the project:**
PAMAP / Physical Activity Monitoring for Aging People

**Coordinator:** Prof. Dr. Didier Stricker

**Duration:** 36 months

**Starting date:** 01 July 2009

**Total budget:** 2,771,929 €

**Public contribution:** 1,987,369 €

**Contact:**
Prof. Dr. Didier Stricker
Phone: (+49) 631-20575-3500/3510
Email: Didier.Stricker@dfki.de

Technical Coordinator:
Dr. Gabriele Bleser
Phone: (+49) 631-20575-3560
Email: Gabriele.Bleser@dfki.de

**Website:** http://www.pamap.org
The project emphasizes the role of the home as care environment, by providing real-time support to patients. IS-ACTIVE proposes a combined technological solution, which uses intelligent miniaturized inertial sensing used for ambulatory human movement analysis, and wireless communication.

The IS-ACTIVE sensor-based system is meant to provide the patients:
- An effective sensing system for daily use, which analyzes in real-time their physical activity and condition;
- An easy-to-use interface and a natural feedback, so that they become easily aware about the importance of self-management.

Field trials will be conducted in different locations and their results are expected to provide qualitative and quantitative indications on the system accuracy, robustness, reliability and usability, together with assessing the user experience regarding the motivation in self-managing the chronic condition.
## PARTNERS

<table>
<thead>
<tr>
<th>Partner</th>
<th>Type(s)</th>
<th>Country</th>
<th>Website</th>
</tr>
</thead>
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<tr>
<td>University of Twente</td>
<td>R&amp;D</td>
<td>The Netherlands</td>
<td><a href="http://www.utwente.nl">www.utwente.nl</a></td>
</tr>
<tr>
<td>Roessingh Research &amp; Development</td>
<td>R&amp;D, SME, End-users</td>
<td>The Netherlands</td>
<td><a href="http://www.rrd.nl">www.rrd.nl</a></td>
</tr>
<tr>
<td>Inertia Technology</td>
<td>R&amp;D, SME</td>
<td>The Netherlands</td>
<td><a href="http://www.inertia-technology.com">www.inertia-technology.com</a></td>
</tr>
<tr>
<td>Norwegian Centre for Integrated Care and Telemedicine</td>
<td>R&amp;D, End-user</td>
<td>Norway</td>
<td><a href="http://www.telemmed.no">www.telemmed.no</a></td>
</tr>
<tr>
<td>NORUT Northern Research Institute</td>
<td>R&amp;D</td>
<td>Norway</td>
<td><a href="http://www.norut.no">www.norut.no</a></td>
</tr>
<tr>
<td>University Hospital Elias</td>
<td>R&amp;D, End-user</td>
<td>Romania</td>
<td><a href="http://www.spitalul-ilies.ro">www.spitalul-ilies.ro</a></td>
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<tr>
<td>PROSYS PC</td>
<td>R&amp;D, SME</td>
<td>Romania</td>
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### Name of the project:
IS-ACTIVE / Inertial Sensing Systems for Advanced Chronic Condition Monitoring and Risk Prevention

### Coordinator:
Prof. Dr. Paul Havinga, University of Twente

### Duration:
36 months

### Starting date:
1 April 2009

### Total budget:
1,814,812 €

### Public contribution:
1,394,777 €

### Contact:
Dr. Raluca Marin-Perianu
raluca.marinperianu@utwente.nl
+31 53 489 3633
Pervasive Systems Group, Department of Computer Science
Zilverling Building
PO-Box 217
7500 AE Enschede
The Netherlands

### Website:
www.is-active.eu
11. Do you think this AAL solution is easy to use / userfriendly?

1) Very simple

2) I would need some training

3) Too complicated
12. Would you buy/rent/subscribe to this AAL solution when it is on the market (for a reasonable price)?

1) YES
   - 9.8%

2) Perhaps
   - 34.1%

3) NO
   - 56.1%
Heart rate monitors

"People who are really serious about software should make their own hardware." - Steve Jobs quotes Alan Kay at the MacWorld 2007.

Blatand offers a worldwide unique chest strap for heart rate monitoring. The chest strap communicates via Bluetooth short distance radio with your mobile phone or other end devices, e.g., the Bluetooth access point at a gym, a home computer or the rehab staff's PDA.

It is convenient, persistent, interference-proof, tap-proof and less expensive than conventional products.
(см. Рис. 1)

(см. Рис. 2)
ECG monitor developed at the University of Kuopio, Finland
Garmin with GPS receiver and heart rate monitor
Круг3 - 10:55:41

0.5 km, 153 bpm
NuMetrex Heart Rate Monitor Clothing
http://www.numetrex.com/
Introduction

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and a high number of aged citizens suffer from this disease (prevalence of 5-15% at the age of 80 years). AF gives a highly increased risk of other clinical events, especially stroke. However, this increased risk can be lowered with proven antithrombotic therapy. It is therefore crucial to diagnose these patients timely and initiate treatment. The diagnosis can, however, be impeded if the disease is silent or only happens in temporary episodes. It is therefore desirable to be able to perform long term recordings and screening for AF, especially in the elderly population. To do this, it is important to develop a small, wireless electrocardiogram (ECG) recording device that can automatically analyze the ECG signal and detect episodes of AF. DELTA has designed such a recording device, and the next step is to design automatic mathematical methods algorithms to detect the AF events. The first step in this, is to create an algorithm that can automatically find each heartbeat (QRS complex), and the design of such an algorithm is the focus in this study.

The DELTA ePatch Technology

The device electrode is able to record 2 ECG leads:

Some of the advantages of the device are:
- Wear and longer design
- Easy to use
- High user comfort
- Wireless, only one patch is needed to record the ECG signal
- Potential for very long-term recordings

Data

The algorithm was designed and optimized for ECG signals recorded with the ePatch electrode:
- 30-minute ECG recordings from 15 different patients
- The database was monitored and reference data was used to create reference data
- Database contains a total of more than 22,000 beats with up to 100 beats per patient (250-300 beats per 5000 beats) and 30-40 beat per 10,000 beats

Automatic QRS Complex Detection

The designed algorithm can automatically detect each heartbeat from the ECG signal and it consists of several steps:

The algorithm uses information from each ECG leads:

Results

The detection sensitivity and positive predictivity on the ePatch database is provided below:

<table>
<thead>
<tr>
<th>Patient ID</th>
<th>Number of Beats</th>
<th>Sensitivity</th>
<th>Positive Predictivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1456</td>
<td>96.50 %</td>
<td>96.50 %</td>
</tr>
<tr>
<td>2</td>
<td>1167</td>
<td>95.00 %</td>
<td>95.00 %</td>
</tr>
<tr>
<td>3</td>
<td>610</td>
<td>90.00 %</td>
<td>90.00 %</td>
</tr>
<tr>
<td>4</td>
<td>501</td>
<td>85.00 %</td>
<td>85.00 %</td>
</tr>
<tr>
<td>5</td>
<td>376</td>
<td>80.00 %</td>
<td>80.00 %</td>
</tr>
<tr>
<td>6</td>
<td>311</td>
<td>75.00 %</td>
<td>75.00 %</td>
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<tr>
<td>7</td>
<td>286</td>
<td>70.00 %</td>
<td>70.00 %</td>
</tr>
<tr>
<td>8</td>
<td>248</td>
<td>65.00 %</td>
<td>65.00 %</td>
</tr>
<tr>
<td>9</td>
<td>206</td>
<td>60.00 %</td>
<td>60.00 %</td>
</tr>
<tr>
<td>10</td>
<td>164</td>
<td>55.00 %</td>
<td>55.00 %</td>
</tr>
<tr>
<td>11</td>
<td>125</td>
<td>50.00 %</td>
<td>50.00 %</td>
</tr>
<tr>
<td>12</td>
<td>90</td>
<td>45.00 %</td>
<td>45.00 %</td>
</tr>
<tr>
<td>13</td>
<td>55</td>
<td>40.00 %</td>
<td>40.00 %</td>
</tr>
<tr>
<td>14</td>
<td>30</td>
<td>35.00 %</td>
<td>35.00 %</td>
</tr>
<tr>
<td>15</td>
<td>20</td>
<td>30.00 %</td>
<td>30.00 %</td>
</tr>
</tbody>
</table>

The algorithm was also tested on datasets containing 100,000 beats.

Conclusion

The DELTA device was able to record ECG signals with sufficient quality for automatic QRS complex detection. The developed algorithm performed very well, especially with shorter and shorter data records. The results showed that the device can automatically detect AF and help improve diagnosis and treatment of AF. Early diagnosis might increase the overall risk, and help keep more patients alive within their normal daily activities.
Mobile Cardiac Monitoring
Bluetooth® ECG and Activity Monitor

Applications
- Cardiac Rehab
- Cardiovascular Screening
- Home Monitoring
- Disease Management
- Atrial Fibrillation Screening
- Mobile Telemedicine
- Activity Monitoring
- Falls Monitoring
- Fitness Monitoring
- Sports Training
AliveCor iPhone ECG
Nonin Onyx 2 9560 Bluetooth Wireless Finger Pulse Oximeter with FREE case!!

The first wireless fingertip pulse oximeter

Oximetry Unplugged — Revolutionizing Disease Management. With the increased need for remote disease management, there is an opportunity to provide oximetry monitoring solutions to simplify the exchange of secure information.
Glucometer with BlueTooth (Germany)
Reach Out And Prick Someone

Amy at DiabetesMine brings us the story on the GlucoPhone -- once considered vaporware, it's been quietly introduced by HealthPia:
Medtronic Unveils iPro 2 Professional CGM

by GENE OSTROVSKY on Jun 9, 2010 - 12:00 am
iPro2 Professional CGM is easy for clinicians and patients to use. It includes a disposable glucose sensor and a small data recorder, which automatically record glucose information. This next-generation product is simple to start and significantly reduces the amount of clinical staff time needed to implement the therapy. There is no computer required for setup, patients do not interact with the device, and minimum patient training is required. Patients wear the small, lightweight and watertight device while going about their normal daily activities before returning it to their physicians' office for evaluation.
Bathtub ECG (2)

Room light

Limb Lead #1

Limb Lead #2

Chest Lead #1

Chest Lead #2

Limb Lead #3

Preamps

Pre-filtering

Amplifiers

A/D

Digital filter

Neutral electrode
Shower ECG (1)

Negative electrode

Neutral electrode

Positive electrode

Equivalent Circuit

Ls

Rs

Zn

shower

body
Stool ECG (1)

Neutral electrode

Positive electrode

Negative electrode

Auto-recording Pressure Switch

Time (s)
Bedroom Monitoring

- Respiration
- ECG, heart rate
- Body weight
- Body temperature
- Body movement
- Perspiration

Auto-recording Pressure Switch
Method

- System Configuration -

Pattern Light Projector

70cm

95cm

Image of multiple-slit-pattern light
Radar for remote measurement of breath and a heart activity

**Characteristics**
- Duration of a pulse: 200 ps;
- Average power: $< 0.04 \mu W$;
- Range of action: 0.02 - 5 m;
- Density of a flow emission power: less than 0.1 mW/cm$^2$. 

![Radar device image]
Output signal of radar during breath and when breath is stopped

Signals of heart and breath

Only heart's signals
Average Heart rate
72/minute

Measurement result:
Your heart rate is: 72/minute.

Average Breathing rate
15/minute

Measurement result:
Tell your friends about your results!
SpiroSmart

Contact: Hannah Hickey  
hickeyh@uw.edu  
206-543-2580  
University of Washington

Using SpiroSmart

Caption: This shows the SpiroSmart phone.  
Credit: S. Patel, Univ. of Washington
RF-Sensors on / in body

- Functions:
  - Measure pressure/load
  - Measure bacterial activity
  - Measure temperature
  - Drug delivery
  - RF-powerless (Senstenna)
  - Flat, reading outside body (frequency up to 400 MHz)
Implantable RFID-based sensors

The CardioMEMS Interrogator cart contains a 15” touchscreen monitor and lightweight, ergonomically designed Antenna. During the EVAR procedure, the cart’s Antenna transmits RF energy to the sensor. The circuit inside the sensor is charged by the RF energy. The sensor returns a resonant frequency signal back to the Antenna, which is translated by the electronics to a pressure measurement.
TELLTALE HEART MONITORING: This small sealed sensor keeps tabs on artery pressure in heart failure patients, transmitting information wirelessly to doctors.

*Image: OSU MEDICAL CENTER/CARDIOMEMS*
Alere Health & Wellness solutions for point of care

Day Link Monitor for managing long-term conditions

INRatio®2 PT/INR monitoring system for anti-coagulation

Triage® System for diagnosis and management of heart failure

epoc for blood gas analysis

Heart Check System® Patient Self Testing BNP for HF Monitoring

LDX® System for health checks and cholesterol testing

Interoperable devices roadmap into a ‘common enterprise wide’ platform

Alere with an installed base of Telehealth monitoring systems in some 65,000 homes
Report Finds a Heavy Toll From Medication Errors

By GARDINER HARRIS
Published: July 21, 2006

WASHINGTON, July 20

Hospital drug errors far from uncommon

By Rong-Gong Lin II and Teresa Watanabe, Los Angeles Times Staff Writers
November 22, 2007

The case of actor Dennis Quaid’s newborn twins, who were reportedly given 1,000 times the intended dosage of a blood thinner at Cedars-Sinai Medical Center, underscores one of the biggest problems facing the healthcare industry: medication errors.

At least 1.5 million Americans a year are injured after receiving the wrong medication or the incorrect dose, according to the Institute of Medicine, part of the National Academies of Science. Such incidents have more than doubled in the last decade.
Standard solution for medication monitoring

Configuration and self-test
Configuration is done by software which is programmed into the chip using the RFID capabilities of the CPK082. Customization may be done either during manufacture and/or prior to use by a pharmacist or care provider.

The module provides a self-test capability that may be used in manufacturing and in the market to ensure that it is functioning correctly.

RoHs
The CEM083 is RoHs compliant.

Applications
Figure 1. Edible sensor for electronically confirming adherence to oral medications. (a) A closer view of an edible sensor; (b) Edible sensor attached directly to a tablet. (c) Edible sensor co-encapsulated with a drug product using a sensor-enabled capsule carrier.
Figure 3. A block diagram showing medication adherence and physiologic data collection, integration, and sharing using a networked wellness system.
Drugs Dispenser use decreases number of errors

<table>
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<tr>
<th>Published</th>
<th>Medication errors according to the drug dispensing system</th>
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<tbody>
<tr>
<td></td>
<td>Traditional*</td>
<td>Unit Dose</td>
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<tr>
<td>Barker, 1969</td>
<td>31.2%</td>
<td>13.4%</td>
</tr>
<tr>
<td>Crawley, 1971</td>
<td>26.0%</td>
<td>2%</td>
</tr>
<tr>
<td>Barker, 1984</td>
<td>1 error/patient/day</td>
<td>1 error/patient/week</td>
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</table>

* Collective, Individualized

MEDICATION ERRORS AND DRUG-DISPENSING SYSTEMS IN A HOSPITAL PHARMACY
CLINICS 2005;60(4):325-32
Research Article

Use of a Smartphone for Improved Self-Management of Pulmonary Rehabilitation

A. Marshall,¹ O. Medvedev,² and A. Antonov²

¹ School of Computing, University of Leeds, Leeds LS2 9JT, UK
² Faculty of Basic Medicine, Lomonosov Moscow State University

<table>
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<tr>
<th>Status</th>
<th>Screen shot</th>
<th>Other details</th>
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<tr>
<td>Exercise 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35 s</td>
<td>- Heart rate shown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Time remaining in seconds shown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Green background</td>
</tr>
<tr>
<td>Normal physiological conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate within acceptable range specified by clinical professional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13 s</td>
<td>- Heart rate shown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Time remaining in seconds shown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Amber background</td>
</tr>
<tr>
<td>Normal physiological conditions, but near acceptable limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate higher or lower than normal, but still within acceptable range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 s</td>
<td>- LOUD AUDIBLE WARNING SIGNAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Heart rate shown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Red background</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- STOP displayed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Display freezes and remains in this state until the Stop button is pressed</td>
</tr>
<tr>
<td>Dangerous physiological conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate excessively high or low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise should cease now</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
IDT i-Hub Wireless Protocols

- Built-in Bluetooth
- Built-in WiFi-WCPL
- GSM-M2M

IDT Wireless Devices

Mid Range 2.4GHz up to 30 meters
Short Range 2.4GHz up to 10 meters
Long Range 868/915 MHz up to 800 meters

Expansions:
- ANT+
- BlueRobin

IDT i-Health Hub

Power Device ON Connected
Necessity to use International Standards