Biomedical Sensors

Foresight Workshop - fobis

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Outline

- Presentation of CMTF-North
- Examples of biomedical sensor research
- A commercialization case – Bioresonator
- Trends and limitations for the future
- Conclusions
Centre for Biomedical Engineering and Physics – North Sweden

- Umeå University
- Luleå Technical University
- Västerbotten County Council
- Norrbotten County Council

Biomedical Engineering is a rapidly developing field in Science and Industry. The aim is to take a leading part in this field through excellent scientific research and development in North Sweden. The means are co-operation and the goals are products and methods for a better and more safe Health Care.
Companies – Departments

1. Axiom Co. Ltd, Japan
2. Bioresonator AB
3. Bruker Scand, AB
4. Dermaspec Co.
5. Explicit AB
6. GE-Health Care
7. Morgan Electroceramics, U.K.
8. SciBase AB
9. Tauzer Co Ltd, Japan
10. Videoakt AB

1. Computer Science
2. Pharmacology and neurological sciences
3. Public health and clinical medicine
4. Chemistry
5. Surgery
6. Clinical Sciences
7. Mathematics & Mathematical statistics
8. Medical biosciences
9. Social medicine and rehabilitation
10. Radiation sciences
11. Applied Physics and Electronics
12. Computer Science & Electrical Engineering

International scientific cooperation with Japan, USA, Israel, Italy, U.K., Norway, Finland, Germany etc. External funding from EU, Regional, Vinnova, VR and Companies
Results 2000-2005

- New employments: 15
- Technological Platform: -1, CMTF
- New companies: 3, Bioresonator, Videoakt, Dermaspec
- Approved Patents: 6
- Support to companies: >10
- Competens development: - univ courses.
- Networking: -10 ws, 1 int. conf
- Publications: >100

More than 75 persons are today engaged in CMTF
Projects involving sensors

1. Resonance sensors, Applied Physics & Electronics
2. Tactile video, Applied Physics & Electronics
3. Classifying of tissue, Chemistry
4. Surface EMG, Biomedical Eng & Informatics
5. Analysis instrument for Diabetes, Biomedical Eng & Informatics
6. Automatic analysis of radiograph quality, Computer science
7. e-EKG, Applied Physics & Electronics
8. Cardiovascular signal analysis, Biomedical Eng & Informatics
9. Dynamics of the Liquor system, Biomedical Eng & Informatics
10. Signal proc. and image analysis of med. inform., Mathematics
11. EU fp6 Sensor project, Chemistry
Non Invasive Diagnostics
Ass Prof. Britta Sethson

Development of a combination probe for diagnosis and characterisation of:
- Neuropathy
- Erythema
- Malignant Melanoma

Methods:
- NIR spectroscopy, Skin Impedance, Digital Photography, (Laser Doppler Imaging)
- Chemometrics

Development of methods for characterisation of dental materials and disturbances in the oral mucosa
- Titanium
- Cu-Al Alloy

Methods
- Classical Electrochemical Techniques
- Skin Impedance
- Chemometrics

In collaboration with: Northern University Hospital, Deps of Surgery, Oncology and Odontology. SLU Röböcksdalen.
Distance spanning application

Prof. Stefan Karlsson, MTI, NUS

Parameters are selected depending on the patient’s situation. For example, respiration, oxygen saturation, ECG and surface temperature can be measured simultaneously.

Depending on distance and transfer bandwidth different digital radios can be selected, for example DECT or Bluetooth.

Visualization and analysis on an ordinary Windows PC or PDA.

The processed information is sent to hospital over the Internet through a secure VPN tunnel.
Soft or hard?

How to measure stiffness of human tissue?

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Resonance sensors
Prof Olof Lindahl TFE, UmU

- Piezoelectric sensors
- Frequency shift

Eye pressure monitor for diagnosis of glaucoma (5% of population above 70 year.)

Detection of prostate cancer
Clinical Study

Hallberg et al, Physiological measurement, 25, 2004

R=0.92
SD=3.6 mm Hg
n=104
Bioresonator Co, Ltd.

- 1999 Patent application and market analysis via Uminova
- 2000 Finances through NUTEK and LinkMed Co Ltd, formation of company, PCT-application, business plan, market plan, design.
- 2001 Cooperation agreement with researchers, university and county council. Research and "grants".
- 2002-2004 Research/ productification, risc financing via Karolinska Innovation, CE-marking, international patent, partner search, alliances.
- 2005-2006 Keeler Co Ltd
Applications: liver operation/transplant, heart and heart-lung transplant, tele-surgery, and tele-medicine

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Breast cancer checker and its applications

Home and/or office

Clinic, public health care

Personal use

Hospital
Clinic
Doctor
Mammography

Sensor
Light sensor

Displays

PC

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The Embedded Internet Systems Laboratory or EISLAB
Trends for the future

**Mission:**

Fighting Cardio-vascular Diseases by Preventive Lifestyle & Early Diagnosis

**Project Summary:**

Cardio-vascular diseases (CVD) are the leading cause of death in the west. In Europe over 20% of all citizens suffer from a chronic CVD and 45% of all deaths are due to CVD. Europe spends annually hundreds billion Euros on CVD. With the upcoming aging population, it is a challenge for Europe to deliver its citizens healthcare at affordable costs.

It is commonly accepted, that a healthy and preventive lifestyle as well as early diagnosis could systematically fight the origin of CVD and save millions of live-years. The MyHeart mission is to empower citizen to fight cardio-vascular diseases by preventive lifestyle and early diagnosis.

The starting point is to gain knowledge on a citizen\'s actual health status. To gain this info continuous monitoring of vital signs is mandatory. The approach is therefore to integrate system solutions into functional clothes with integrated textile sensors. The combination of functional clothes and integrated electronics and process them on-body, we define as intelligent biomedical clothes. The processing consists of making diagnoses, detecting trends and react on it. Together with feedback devices, able to interact with the user as well as with professional services, the MyHeart system is formed.

This system is suitable for supporting citizens to fight major CVD risk factors and help to avoid heart attack, other acute events by personalized guidelines and giving feedback. It provides the necessary motivation the new life styles. MyHeart will demonstrate technical solutions. The outcome will open up a new mass market for the European industry and it will help prevent the development of CVD, meanwhile reduce the overall EU healthcare costs.
The Pill Camera
Conclusions

- Ambient Assisted Living (AAL) for the Ageing Society EU fp6, including home health care
- Preventive lifestyle and high life quality
- Implantable devices (retinal- and cochlear prosthesis)
- Wireless sensor networks
- Smart sensors with low power consumption
- Distance spanning technology
- Micro- and nano sensors
- Limitations: CE-marking, FDA, Ethical committees, Large costs
- Triple Helix networks