ICT for eHealth: Challenges and Technologies

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Outline

- University of Evry - France, IBISC Lab
- Worldwide Health Situation
- ICT for Healthcare
- Evolution of IT Technologies
- U-Health Smart Home and Tele-Health Perspectives
- Conclusion

Presentation of UEVE

- University of Evry Val d’Essonne (UEVE): One of top university in France in terms of excellence in science.

- 20 Km from Paris
- 35 min from Paris by train

The university has about 106 684 m² surface distributed around 13 sites.

Univ Evry Val D’Essonne

- Membre of the Pole of Excellence (PRES) «UniverSud Paris ».
- 500 permanent research/teaching staff
- 150 in Technology Institutes
- 360 Enginners, Administraths, Techniciens, etc.
- 1300 none permanent teaching staff
- +12000 students (1665 in Institutes of Technology)

- Research:
- 29 Research Laboratories (8 join labs with CNRS, INSERM, INRA, CEA)
- 2 PhD programmes : Site EVRY (Engineering) and Genomics
- International Relationships:
- 60 agreements with foreign institutions, universities, etc (18 in Europe; 12 with non European institutions: Brazil, China, India, etc.)
- 34 European partners in the ERASMUS programme : 200 students from UEVE are abroad, 80 foreigners at UEVE
Genopole®

- Genopole® is France's leading biotech- and biotherapy-dedicated science and business park.
- The Genopole® project was initiated in 1998 in the town of Evry-Corbeil under the impetus of the French government, Ile-de-France Regional Council, Essonne County Council and the French Muscular Dystrophy Association.
- First European science and business park dedicated to genomics, genetics and biotech.
- In addition to constant support from its founding members and other partners, Genopole®'s success is largely based on the novelty of its approach: bringing together public- and private-sector research labs, university teaching facilities and life science start-ups on a single campus in Evry-Corbeil.
- UEVE is a main partner of Genopole.

Main Reasons to Come to Paris!

IBISC Lab Research Areas

110 Full Time Researchers (50 PhD Students)

- ITC& Living
  - Bioinformatics at Bio-System
  - Assisting Living for Disabled, Signal and Image Processing

- ICT & SMART SYSTEMS
  - Autonomous and Intelligent Systems
  - Open and Secure Systems (COSMO)
LRSM Team – COSMO Group

Software for Networks and Multimedia Systems.

- http://www.jisc.ac.uk
- http://www.iii.ac.uk

- Expertises:
  - Open Architecture specification
  - Protocol specification
  - Information Modeling
  - Semantic Web
  - Optimization

- Applications:
  - Network & Service Control and Management
  - Broadband Wireless Networks
  - eHealth
  - Cloud Computing
  - Multimedia Communications
  - Social Networking
  - Semantic TV

How to Support Elderly without ICT?

- ADL Cuff for use with everyday eating utensils for people with hand weakness or paralysis
- The Bate Handle solves the problem of effectively pouring and carrying a large bottle of soda or water
- The Clarity Amplified Big Button Phone – Jumbo keys with tactile characters. Numbers are announced as they are dialled.
- Magnifying Transl Clipper – With UV power magnifier

From http://www.elderlysupport.org

Two-fold paradigm shift

- From Symptom-based to Preventive healthcare.
- From Hospital-centred to Citizen-centred health systems.

Healthcare Situation: Future Projections

If current trends hold, by 2050, Health Care spending will double, claiming 20 – 30% of GDP of many economies

For most countries worldwide, per capita healthcare spending rising faster than PC income.

No country can spend ever-rising share of its output on health care, indefinitely. Spending growth must eventually fall in line with growth in per capita income.


Spending as % of GDP (2007)
Independent Living with ICT Support

=> Cost Reduction

QoL: Quality of Life

Cost: Quality of Health

Independent Living with Efficient Uhealth and Ucare Support.

Why is It Possible Today?

1) Evolutions in Networking Technologies
2) Evolutions in the Home Media Technologies
3) Evolutions in Electronic and Sensor Technologies
4) Evolutions in dual technologies
5) Evolution of M2M Technologies

Innovative eHealth Services To The Home

Evolution in Network Technologies

(Triple & Quadruple Play)

Evolution in Processing Technologies

(Cloud Computing)
Existing Sensors with Wireless Communication Capabilities

<table>
<thead>
<tr>
<th>Properties</th>
<th>Measuring</th>
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<tbody>
<tr>
<td>Physical Properties</td>
<td>Pressure, temperature, humidity, flow</td>
</tr>
<tr>
<td>Motion Properties</td>
<td>Position, Velocity, Angular, Acceleration</td>
</tr>
<tr>
<td>Contact Properties</td>
<td>Strain, Force, Temp, Slip, Vibration</td>
</tr>
<tr>
<td>Presence Properties</td>
<td>Tactile, Contact, Proximity, Distance/Range, motion</td>
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</tbody>
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Evolution in Ultra Low Power Communication Technologies

- PAN: 802.15.1/2/3/3b/4/4a/4b/4c/4d/5
  - Personal Area Network: BT/ZigBee/irDA
  - 802.15.1 BT
  - 802.15.2: Co-existence WLAN/WPAN
  - 802.15.3: high-rate (20Mbit/s or greater)
    - 802.15.3b: Improve implementation and interoperability of the MAC
    - 802.15.4: a low data rate solution/Very low consumption (Sensors, RFID)
      - 802.15.4a: Low Rate Alternative: high precision ranging / location capability
      - 802.15.4b: resolving ambiguities; reducing unnecessary complexity, Security...
      - 802.15.4c: Address the Chinese regulatory changes in the 3x2x1800 MHz bands
    - 802.15.4d: Address the Japanese regulatory changes in the 9x MHz
  - 802.15.5: PHY and MAC layers of WPANs

WSN for Healthcare

- A report by ON World, "WSN for Healthcare" estimates that wireless sensor networks can reduce annual health care costs by US $25 billion.
- Much of that savings is derived by reducing hospitalizations and extending independent living for seniors.
- Standard for connecting low power consumer products to the next generation of mobile phones and mobile Tabs enabling smart energy devices within the home.
- Application on smartphones and smartcommunication devices will be a key issue of the success of medical WSN.

Nano Bio Sensors Networks


Silicon nanowire-based bio-FET.
Nano Bio Sensors Networks

Ubiquitous Healthcare Smart Home

Need for Ubiquitous Medical Devices

Cheap, Convenient and Rapid and Continuous Diagnosis to improve the prevention of chronic diseases

Rapid diagnosis reduces the intensity of symptoms in acute diseases

Take benefit from the advancement in low-power electronics, sensor technologies and wireless communication technologies, decision-making systems.

Ubiquitous Healthcare Smart Home for AAL

Communications are multi-faceted (e.g., Rx@RFID, Relay@BAN & Tx@Bluetooth)

U-health-biosensors

Sensors everywhere

Emi-sensors

Nano-router

6LoWPAN: IPv6 over Low power Wireless Personal Area Network

http://www.ietf.org/dyn/wg/charter/6lowpan-charter.html
Autonomic eHealth Management System

Value chain?

What is the Business Value chain?

On-going Research Activities related to eHealth

- Intelligent Context-Aware eHealth Management
- eHealth Cloud Services and Infrastructure
- Advanced Self-organised Medical WSN

Intelligent Context-Aware Management System

- Medical Home
- Beehive

eHealth SaaS and IaaS

- All information about patients will be stored in the cloud (static and dynamic): EHR, medical sensed data, images, etc.
- Doctors and health providers can accessed this information from anywhere/anytime using Internet connection to provide their expertise.
- Intelligent data-mining and diagnosis applications can be also deployed in the cloud and take benefit of its huge processing capacity.
Advanced Self-Organised Medical WSN (IoT)

  - Collaboration with Libyan University in Tripoli
- High-Performance Multisensor Gateway Supporting the Cloud-Sensor System Based Data Fusion:
  - Collaboration with Tsinghua University
- Enabling Communication and Cooperation in Bio NanoSensors Networks:
  - Collaboration with Prof M. Meyyapan (AMES)
- New Energy Efficient WSN for Critical Infrastructure Monitoring

Collaborations

- What?
- Who?
- Why?
- How ($$$$)
  - Need to sustain the collaboration via instruments:
    - France-Germany Collaboration Programs
    - EU AAL Program
    - ERANET EU Program (CHISTERA, CHISTERA 2)
    - EUREKA Program
    - Next H2020 Program
    - Others?

Thank you for your attention!

Any Questions?