Embedded Systems

ArtistDesign Workshop on Embedded Systems in Healthcare 2009

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Healthcare in 2020: Consequences for Embedded Systems

Abstract

When determining research directions for embedded systems in healthcare it is important to have an idea of what the healthcare field will look like at the time that the research results end up in products, say around the year 2020. Therefore we first present the most relevant trends in society. Then we discuss the strategies that the major players in the healthcare field consider in dealing with these trends. These lead to certain characteristics for the embedded systems that will be deployed in that time-frame. From these, finally we can draw some conclusions for the research directions we might want to follow.







Healthcare in 2020: Consequences for Embedded Systems

Pierre America Piërre van de Laar





World

- Population has aged
 - Elderly people need more healthcare
 - Elderly people want to remain self-supporting
- Many more people with access to healthcare











Health

- Fatal diseases have become chronic
 - More combinations of diseases
- Unhealthy lifestyle continues
 - Unbalanced diet
 - Smoking, drinking, drugs, ...
 - Too little exercise





IDS









- Affordable individual care for all
 - Cost pressure
 - More people covered
- Minimal time between problem detection and solution
- Easy access

 Home versus hospital
- Individual patient preferences
 - Quality of life versus quality of care











Developments in Healthcare (1/2)

- Focus moved from intervention to prevention/compensation
 - Promote healthy way of living
 - Early detection, even before bodily symptoms
- Minimally invasive intervention
 - Guided surgery
 - Guided medicine release (e.g., electronic pill)
 - Towards medical nanobots









Developments in Healthcare (2/2)

- Evidence-based medicine
 - Latest insights from medical research
 - Usage of all available information
 - Linkage to EHRs from family members: hereditary diseases
 - Medical guidelines
 - Highest quality: Adhere to guidelines and prove it
- Personalized medicine
 - Cost of complete DNA sequencing decreases drastically





Healthcare Technology

- Electronic Health Record
 - Central or Personal: At least patient empowered/controlled access
 - Filled by both professionals and patient using sensors in daily objects
- Telehealth

- Easily accessible and convenient for patient
- Cost-effective and efficient for caregivers
- Cost reduction makes medical devices a commodity
 - Ultrasound and X-ray at referring physician
 - Mobile equipment for e.g. paramedics and emergency doctors
- Miniaturization enables more implants
 - Replace "broken" parts
 - New functions
 - monitoring
 - check for and kill pathogens
 - compensation (remove alcohol to prevent liver problems)
 - Part of system: info to physician during intervention
 - Integration of biological/organic and silicon









Embedded Systems (1/2)

- Sensors and emergency detection integrated into daily • objects
 - Intelligent bed
 - · Sensing mobile phone or watch
 - Wireless sensor networks ۲
- Connectivity



- Upstream: Measurement data transferred from sensor to • electronic health record and medical back-office
 - Agreed conceptual models: What is and should be measured
 - Privacy guaranteed, yet usable for treating comparable patients and research
- Downstream: Updated executable medical guidelines in devices



Embedded Systems (2/2)

- Tight integration of medical components
 - All relevant information available to specialist (e.g. surgeon)
 - Clinical decision support
 - Medical assistance: Localize first aiders and send to patient
 - Decision support for patients: When to contact a doctor?







Embedded Systems

INSTITUTE

IDS

IDS

Quality Demands for Embedded Systems

Longevity

Embedded Systems

- Power efficiency (e.g., scavenging)
- Reliability
- Robustness
 - Graceful degradation
- Independent life cycles
- Security
- Usability

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- more domain knowledge
- Cooperation with medical experts, patients, and insurance
- From technology-oriented market, via clinical specialties, towards patient-oriented healthcare
 - E.g., from MRI via cardiac and neurology solutions to patient wellbeing

