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MSc Thesis Project

Embedded Systems

Intro
Every year, over €15 Billion is spent on the treatment of pressure ulcers ('doorligwonden') in the EU. These wounds are very painful to patients and occur especially in elderly patients. The best way to prevent them is keeping the patients mobile, by repositioning the patient. However, often the mobility of the patient is not known, and there is no accurate way of knowing which patients need to be repositioned at what time.
By using pressure sensors beneath the mattress in combination with an algorithm that distinguishes different types of movement, patient mobility can be monitored. By analyzing the movements, an estimation can be made when the patient should be turned. Smart reminders can be sent out to caregivers.

Project description
The system consists of embedded devices (with sensors, beneath mattresses) that connect to a central server (locally at the healthcare institution, or on a remote server). The algorithms to interpret the sensor data can be implemented on multiple levels: on an embedded level, on a local server, or on a remote server. There is a tradeoff here between (embedded) hardware complexity, load on the wireless network, data storage, cyber security aspects, power consumption, maintenance, and cost of implementation. Investigating this trade-off forms the basis of the project.

Goals
- Minimize complexity and cost (financial) of embedded hardware;
- Build a prototype of the embedded device that connects to the analog front-end and communicates wirelessly with the central server;
- Implement an algorithm based on the sensor data that can distinguish:
    - Small patient movements (e.g. moving a limb)
    - Large patient movements (e.g. turning around)
    - Bed entry / Bed exit
    - Bonus: Breathing rhythm
    - Accuracy: verify with test-bed environment (will be provided)
- It is the choice of the student in what system part to implement the algorithm, based on a 20-bed situation in a care institution.

Skills involved
- Embedded hardware development (PCB design, integrate with the analog front-end)
- Embedded software development (C, Python, etc)
- Implement wireless connectivity (Wifi/IoT)
- Design and implement algorithms
- Bonus: implement security measures

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