Patient and Baby Biosensor System for Health Monitoring

BiGC2

October 17, 2014

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1. Problem Definition and Background Information

Busy lives of individuals force them to fall apart from their beloved ones. These mandatory distances become a huge problem for people especially who has relatives or patients which are elders, babies, disabled people and others that have difficulties or seizures may prevent them from expressing themselves clearly. In majority of cases, these people doesn't need to be hospitalized but observed. Unfortunately constant observation may not be an option. Classical approach to solve this problem is monitoring via caretakers. But caretaker is a human and can't be awake and qualified to make the right judgment all the time.

Moreover, vast set of regular people that don't match with descriptions above also need medical monitoring in variety of circumstances, anyone whose health conditions are subjected to be observed by any caretaker.

Continuously monitoring health data of people, in case of emergency or in significant situations predefined contacts desire to be notified. Also, these data can be analyzed for use of medical staff and other relevant people in the long run. A fully-featured, reliable and efficient system is demanded in order to satisfy these requirements.

Although some solutions are developed addressing these issues, subject is suffering from lack of a complete system. Such a solution can be seen as a Cloud Doctor.

The purpose of the project is to develop a health monitoring system so that, designed physiological sensing system can provide reliable vital signs measurements and incorporating real-time decision support.

A wearable embedded biosensor system that is attached to person will measure various vital information including body temperature, heartbeat, hit or fall, panic button. (Type of sensors can be limited by their availability). Results will be constantly transferred to central cloud for a good analysis. The system will generate alerts and notifications for caretakers of the patient or baby to the mobile system and web platform. Mobile system will collect information and push on web for future analysis and web access. Visualization of system can be found in appendix 1.

There are currently no affordable out-of-the-box solutions that includes all parts for a complete system. There is a research that is focused at optimized transmission of the data captured by health sensors. The research emphasizes the size, arrival time and priority of the sensor data and

provides a scheduling technique. This research is not product, therefore it is not a rival, but it would be greatly useful during development of our project. It has been conducted by Grid Computing & Distributed Systems Laboratory, Department of Computer Science, University of the Western Cape. [1] There are also number of tracking devices such as "FitBit" especially for sports and fitness, but it does not have required sensors for a complete health monitoring.

2. Significance of the Problem and Motivation

Biosensors are firmly established for application in clinical chemical analysis. Biosensors for measurement of blood metabolites such as glucose, lactate, urea and creatinine, using both electrochemical and optical modes of transduction, are commercially developed and used routinely in the laboratory, in point-of-care settings and, in the case of glucose, for self-testing. [2]

The design and development of wearable biosensor systems for health monitoring has gained lots of attention in the scientific community and the industry in the past. Mainly motivated by increasing healthcare costs and propelled by recent technological advances in miniature bio sensing devices, microelectronics, and wireless communications, the continuous advance of wearable sensor-based systems will potentially transform the future of healthcare by enabling proactive personal health management and simultaneously monitoring of a patient's health condition.

Yet, market is lacking existing system that offers complete set of required features for personal healthcare without compromising on efficiency, reliability and security. Most of the nanotechnology-based products have only been demonstrated in the research settings and are devoid of extensive validation and trials in industries and healthcare. [3]

Medical applications such as diagnosis, symptom detection and monitoring can be developed and they generate useful data for medical staff, relatives and people who is being concerned. Real-time decision support for early detection of symptoms or context awareness such as sudden death, serious injuries of people, cardiovascular disease (CVD) and other health issues which measurements are applicable shall be provided within the scope of solution.

Immediate awareness in emergent situations is a critical aspect regarding to any possible solution for this problem. Within this scope, system shall provide a reliable interpretation and transmission of health data between subsystems. Solution shall include display, configuration and examination of health data for the authorized people. Due to concerns about the ease of use, mobility shall be provided.

Goal trying to be accomplished is minimizing health care cost and providing most recent health care technology at a time for people. With the aid of this solution, a solid positive impact on health care industry will be developed and this improved care means better quality of life for individuals.

Project has a potential of going into production in commercial business with some planning in the near future. Steps that will be taken for the production will most probably include

a VLSI after a year of development phase. It is a necessity because size of the embedded device must be reduced and must be comfortably wearable.
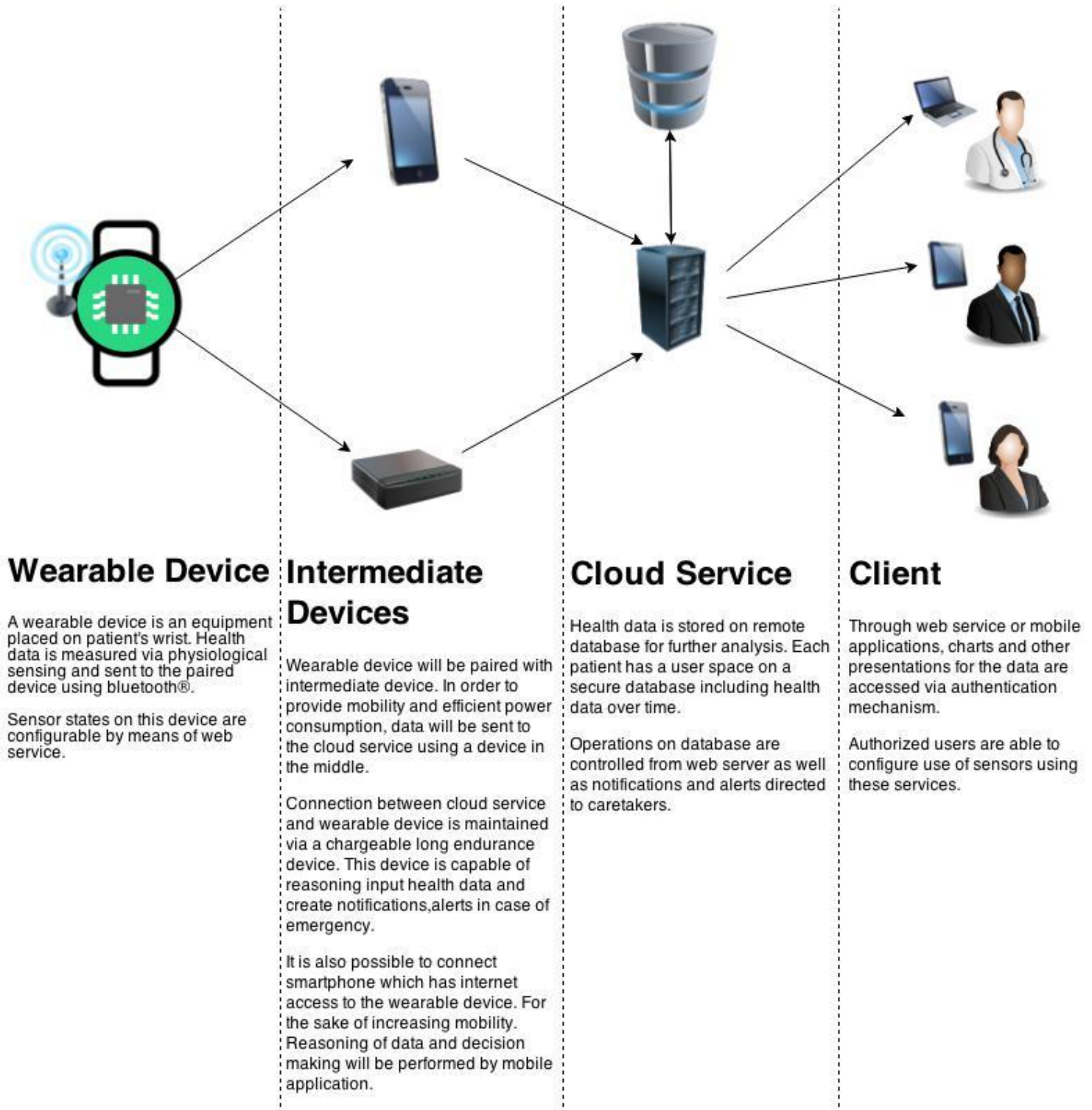
3. User Story

As a/an (Type) User	I want to	so that … (optional)
Patient	Have an authorization system	I can decide who has privileges(doctors, nurses, caretaker etc.) to display my health data and configurations
Patient	Display specific my health data	I can manually observe my own sensor data
Patient/ Authorized	Have a configurable notification and alerting system on	Patient or monitoring users can be notified on pre-defined changes of medical condition of the patient
Patient/ Authorized	Have smart and robust transmission	Health data can be observed and transmitted all the time without losses according to my configurations
Patient	Have a compact device	I can move freely while I have equipment on me
Authorized	Be able to observe the patient's data through mobile application	I can be notified directly from the application
Authorized	Be able to access the patient's data with a web browser through a web application	I can view and download the data in a more detailed way

4. Support

Dr. Onur Tolga Şegitoğlu and Dr. Attila Özgit lend our project team some development hardware for a period time. Besides of those, no agreement on the intellectual property rights of the end-products was made.

5. Appendices

Wearable Device

A wearable device is an equipment placed on patient's wrist. Health data is measured via physiological sensing and sent to the paired device using bluetooth®.

Sensor states on this device are configurable by means of web service.

Intermediate Devices

Wearable device will be paired with intermediate device. In order to provide mobility and efficient power consumption, data will be sent to the cloud service using a device in the middle.

Connection between cloud service and wearable device is maintained via a chargeable long endurance device. This device is capable of reasoning input health data and create notifications,alerts in case of emergency.

It is also possible to connect smartphone which has internet access to the wearable device. For the sake of increasing mobility. Reasoning of data and decision making will be performed by mobile application.

Cloud Service

Health data is stored on remote database for further analysis. Each patient has a user space on a secure database including health data over time.

Operations on database are controlled from web server as well as notifications and alerts directed to caretakers.

Client

Through web service or mobile applications, charts and other presentations for the data are accessed via authentication mechanism.

Authorized users are able to configure use of sensors using these services.

6. References

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[2] Cibele Gouvea (2011). Biosensors for health applications, Biosensors for Health, Environment and Biosecurity, Prof. Pier Andrea Serra (Ed.), ISBN: 978-953-307-443-6, InTech, Available from: http://www.intechopen.com/books/biosensors-for-health-environment-and-biosecurity/biosensors-for-health-applications

[3] Nanotechnology-Based Biosensors and Diagnostics: Technology Push versus Industrial/Healthcare Requirements
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