[UCI-Calit2] SURF-IoT Call for UCI Faculty Project Proposals 2015

Proposing Faculty Member:

Prof. John Billimek

Project Title:

Health360 – Comprehensive, Intuitive and Interactive view of health aspects to drive self-healthcare and social well-being

Project Description:

US has the highest health care cost inflation among leading developed nations.[1] Between 2006 and 2010, the healthcare costs in US increased by a staggering 19%.[2] Even more importantly, the overspending in healthcare in USA due to overutilization is estimated to be $750 billion. [3] It is deeply perplexing to see such statistics for a nation whose talented healthcare providers and technology are among the world's best. One of the most promising solutions is patient-centered healthcare. But for that to succeed, patient has to play the most critical role, by taking ownership of one's health, which would include educating oneself about one's medical conditions, proactively following prescribed medication, continuously monitoring health metrics, regular wellness activities, and more. Patients are eager to play that role, after all it's all about their health; however, the biggest impediment is the lack of data as well as technology to make that data highly intuitive and actionable.

Internet of Things (IoT) provides a great opportunity to fix this problem through interconnected devices, continuous data collection and reporting, which can enable seamless automated health insights delivered anytime, anywhere, on any device.

In the last few years we have seen a proliferation of portable health sensors, many of which are already available in market at affordable prices. However, the true value of the data collected from such sensors lies in integrating the data from all sensors, combining it with patient's medical history, providing doctors the ability to monitor the changes in patient's health metrics with regards to on-going medication, and making a patient more aware of the impact of his/her casual decisions pertaining to healthcare (such as not adhering to the timely consumption of prescribed medicines).

Health360 solves this problem through using the Internet of Things (IoT) technology based devices, along with human-computer interaction and information technology to deliver a simple, customizable dashboard providing comprehensive view of user's health aspects. Health360 not just informs its users, but also educates them and assists them in carefully following their medication as well as pursuing wellness goals. A simple, yet powerful design will enable users to manage their health through Health360, without getting lost in the details or complexity of the medical terminology. Besides individual health, social well-

being is also promoted by Health360 through features such as Wellness Challenger and Voice of Patient which enable social interaction, while maintaining privacy when required. The following picture depicts a primitive design which we are currently working towards:
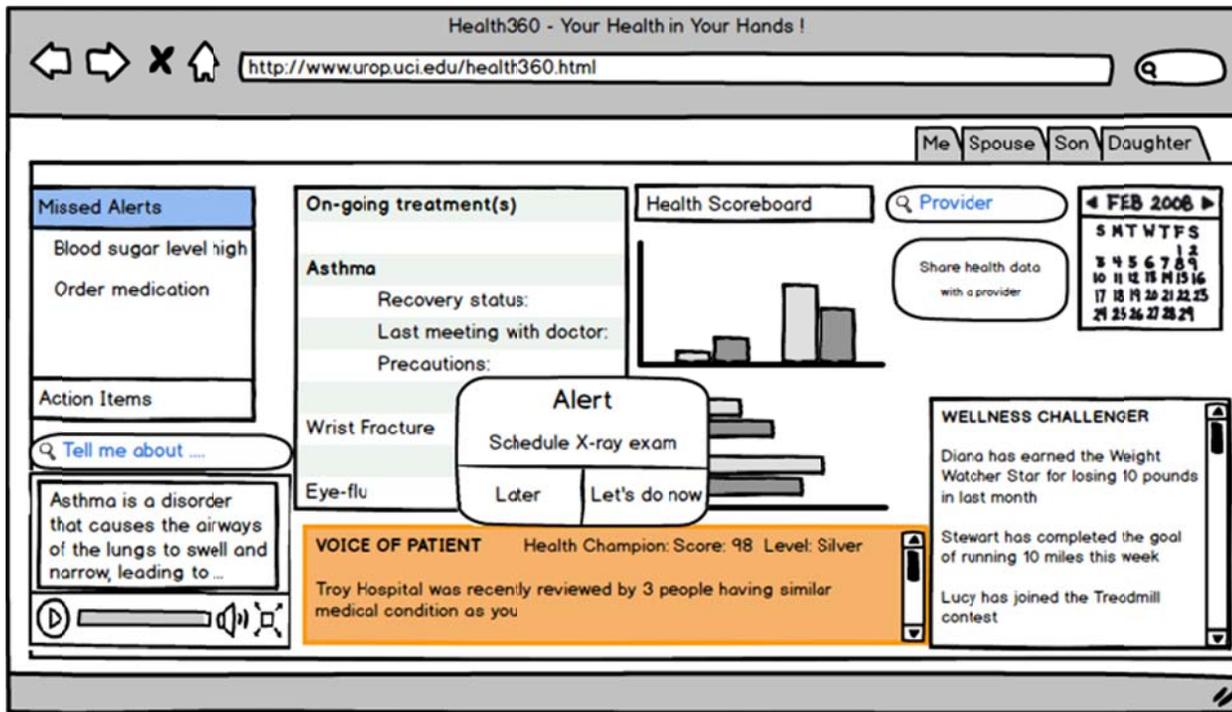
Source:
1. Wikipedia (http://en.wikipedia.org/wiki/Health_care_finance_in_the_United_States)
2. Health Care Transparency 101 - White Paper, Castlight Health
3. Institute of Medicine of the National Academies, "Best Care at Lower Cost: The Path to Continuously Learning Health Care in America," September 2012

Health360 will be developed entirely based on Open Source software and utilities, in order to encourage collaboration from other universities as well as to offer this service to end users for free (by avoiding any licensing or subscription costs).

NOTE: Project Health360 has already received seed funding (from MDP 2014-15 program) and is currently operational. It has an enthusiastic team comprising of faculty members and students (undergraduate and graduate). We are just looking for an undergraduate researcher to help us with specific aspects of the project as outlined in the below section.

Student's Involvement and Expected Outcomes:

Student Activities:

- Write code snippets to collect and integrate the data from different health sensor devices (IoT enabled). This will include some preprocessing and transformations such as data normalization, using standard metrics, etc.
- Design and build a multi-platform seamless experience for users, through which users can access Health360 seamlessly over computer, tablets and smartphones.

(This will be done in phases. Initially the focus would be to deliver a minimum viable product for the web interface only i.e. computer access)
- Perform comprehensive usability assessment of the interface's features through focus groups and rigorous A/B testing (the scope for this activity will depend on how much time is left after the above two tasks)
- Design creative elements for the interface to enable the delivery of integrated healthcare information from IoT devices in an intuitive and engaging way.

Expected Outcomes:

- Data collection and reporting from multiple IoT health sensor devices
- An intuitive, actionable interface for providers as well as patients based on health metrics monitoring data
- Innovative features that will engage users towards greater health awareness leading to self-healthcare and patient-centric healthcare system

Specific Skills that Students will Develop:

- Hands-on technical IoT experience (across a variety of popular devices)
- Basic data engineering (data collection, data transformation, data integration, etc.)
- Wed design and development
- Basic understanding of healthcare
- Applying technological innovation to meet patients' needs

Student Eligibility:

We are ideally looking for Computer Science or Information Technology students with a good experience of web development and programming. The student must have taken courses and/or developed projects that involved building websites and solving problems through programming. The most important capability we are seeking is for the candidate to be a fast learner, as this project might require one to quickly learn new programming languages and start using them for development.

Healthcare experience or background is preferred, however, it is not mandatory at all.

Recommended Readings:

Jara, Antonio J., Miguel A. Zamora, and Antonio F. Skarmeta. "An internet of things---based personal device for diabetes therapy management in ambient assisted living (AAL)." Personal and Ubiquitous Computing 15.4 (2011): 431-440.

Pang, Zhibo, et al. "Design of a terminal solution for integration of in-home health care devices and services towards the Internet-of-Things." Enterprise Information Systems 9.1 (2015): 86-116.

Li, Xu, et al. "Smart community: an internet of things application."Communications Magazine, IEEE 49.11 (2011): 68-75.

Rohokale, Vandana Milind, Neeli Rashmi Prasad, and Ramjee Prasad. "A cooperative Internet of Things (IoT) for rural healthcare monitoring and control."Wireless Communication, Vehicular Technology, Information Theory and Aerospace & Electronic Systems Technology (Wireless VITAE), 2011 2nd International Conference on. IEEE, 2011.

Pae, YoungWoo, et al. "Using Mashup Technology to Integrate Medical Data for Patient Centric Healthcare." Future Information Technology. Springer Berlin Heidelberg, 2014. 71-76.

Viswanathan, Hariharasudhan, Baozhi Chen, and Dario Pompili. "Research challenges in computation, communication, and context awareness for ubiquitous healthcare." Communications Magazine, IEEE 50.5 (2012): 92-99.

Murphy, Judy. "Patient as center of the health care universe: A closer look at patient-centered care." Nursing Economics 29.1 (2011): 35-37.

Buchanan, William J., et al. "Patient centric health care: an integrated and secure, cloud-based, e-Health platform." (2012).

Maizes, Victoria, David Rakel, and Catherine Niemiec. "Integrative medicine and patient-centered care." Explore: The Journal of Science and Healing 5.5 (2009): 277-289.

Demiris, George, et al. "Patient-centered applications: use of information technology to promote disease management and wellness. A white paper by the AMIA knowledge in motion working group." Journal of the American Medical Informatics Association 15.1 (2008): 8-13.

Chawla, Nitesh V., and Darcy A. Davis. "Bringing big data to personalized healthcare: a patient-centered framework." Journal of general internal medicine28.3 (2013): 660-665.