Events-of-interest Capture Using Novel Body-worn Fully-passive Wireless sensors for S&CC

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Project Synopsis

Patients with chronic illness require frequent and avoidable hospital visits. This project aims to develop a new class of battery-less, low-cost, disposable, wireless electronic patch sensors to monitor a variety of physiological signals and a custom smartphone app to monitor their health status and to elect to share their anonymized events-of-interest with their community towards a smart and connected community (S&CC). This will empower users, permit the community stakeholders to assess population health status, reduce the need for frequent hospital visits, and help identify potential individual and community actions to achieve improvement in health status. The project also involves the training of undergraduate and graduate students in interdisciplinary research activities on emerging technologies, and is expected to impact public and private sector efforts to improve healthcare.

Challenges and Research Objectives

- In spite for advanced in mHealth, Memphis has a high incidence of chronic disease, particularly among African Americans, and high rates of unnecessary or avoidable hospital visits.

- Smartphones are becoming ubiquitous, but they have limited integrated sensors and significant gaps in ability to collect clinically important physiological signals.

- There lies a tremendous opportunity to utilize the high computational power of smartphones to empower users for self-monitoring and improve community health, while be cognizant of privacy.

- In this project, we propose to:

1. Deliver wireless, battery free body-worn WRAP sensors (Fig. 1) to allow multi-modal clinically relevant data capture.

2. Develop an open-source framework for Events of Interest (EoI) classifiers via a smart phone app for self-monitoring and secure knowledge sharing with S&CC.

3. Deploy the sensor platform in a "Living Lab" pilot study. Data will be collected and classified in real-time to generate EoIs for multiple health conditions (Fig. 1).
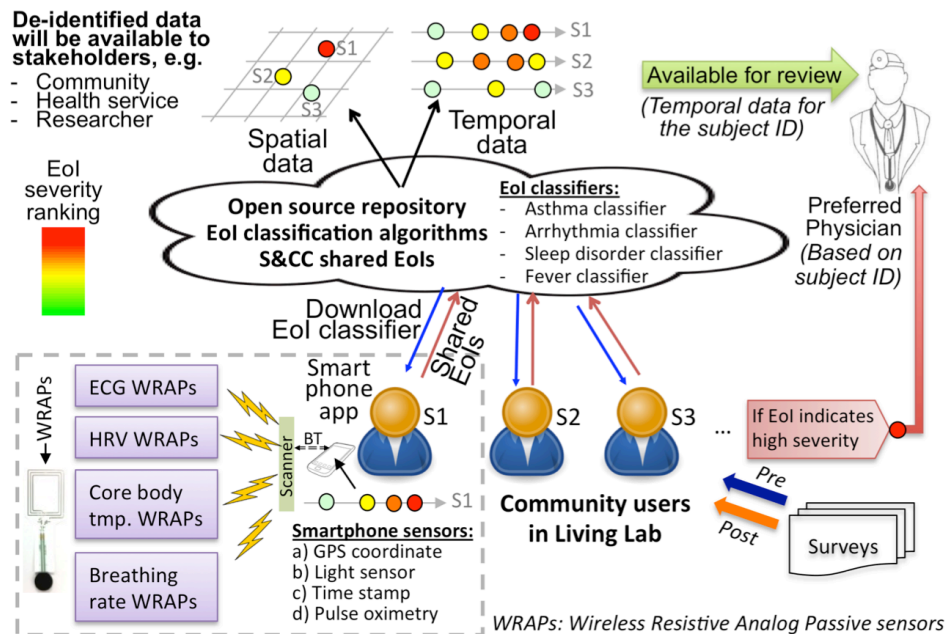

Fig. 1. Graphical representation of the overall project concept.

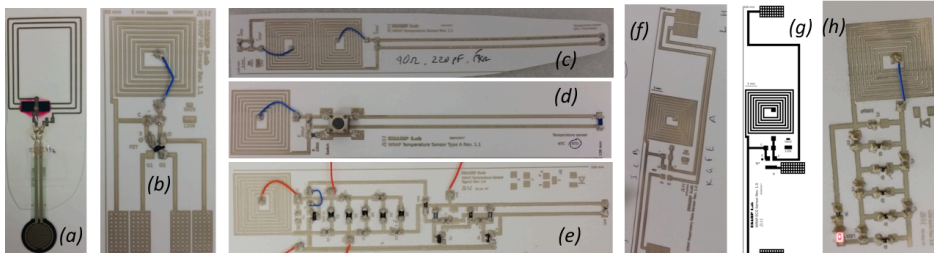## Research Activity 1: Development of Inkjet Printed WRAP Sensors on Paper

Fig. 2. (a) WRAP heart rate sensor using a pressure transducer. (b) WRAP heart rate sensor using Impedance Phlebography. (c) WRAP temperature sensor with a reference coil. (d) WRAP temperature sensor with manual calibration. (e) WRAP temperature sensor with automated calibration. (f) WRAP respiration sensor layout. (g) WRAP ECG sensor design. (h) Partial circuit for WRAP pulse oximetry sensor.

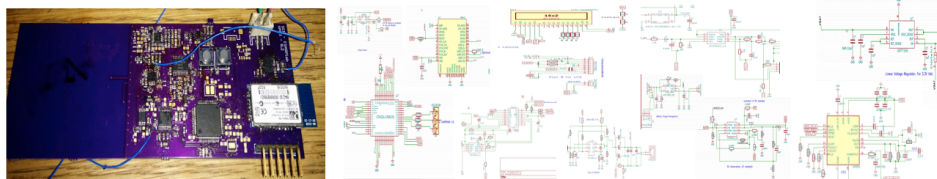## Research Activity 2: Development of Portable Scanner Device

Fig.3. (Left) Prototyped WRAP Scanner device Rev1. (Right) Schematic design of WRAP Scanner device Rev2.

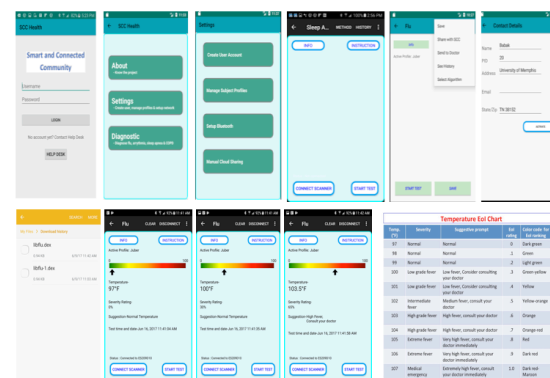## Activity 3: Android smartphone App

Fig. 4. Snapshots of the Android Smartphone App.

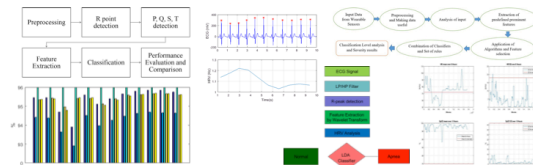## Activity 4: Algorithm for EoI Computation

Fig. 5. Algorithms for (L) arrhythmia, (M) OSA, (R) COPD.
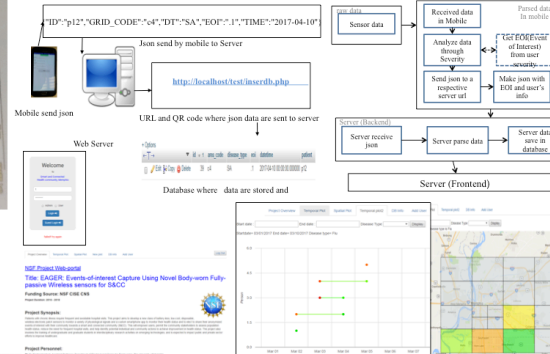
Activity 5: SCC Memphis Web-portal

Fig. 6. SCC Memphis web-portal for temporal and spatial EoI visualization.