AlphaWear
powered by SIGMA+

The Architecture for Localized Precision Health Acquisition from Wearables

RTI International and its partner Two Six Technologies have developed an end-to-end data collection and analytics platform called AlphaWear (Architecture for Localized Precision Health Acquisition from Wearables) to collect and analyze physiological data from wearable sensors (e.g., smartwatches) to assess health and detect viral respiratory illness.

Overview

Smartwatches contain sensors for monitoring activity level, heart rate (HR), heart rate variability (HRV), and SpO2, and this information along with predictive analytics can be used as physiological indicators of an individual's health state. We have developed methods to collect and process data from wearables and extract physiological metrics that are independent of commercial vendor services, apps, or cloud storage. These metrics serve as inputs to the health and illness detection algorithms that deliver a risk score indicating deviation from an individual's healthy baseline.

AlphaWear delivers high-resolution health data and sensitive detection algorithms to designated secure cloud servers for the U.S. Department of Defense as well as public health, first responder, and law enforcement organizations. In the future, this information could be used to provide early warning of illness outbreaks to public health officials or provide information to military or law enforcement about the health and readiness of their personnel.

Decision Making Tool

- **Continuous health monitoring:**
  - Health status (including presymptomatic and asymptomatic viral illness detection)
  - Physical and psychological stress, fatigue, and recovery
- **Response to treatment:**
  - Sleep and activity monitor based on step count and HR
- **Injury and triage:**
  - Core temperature estimation
  - Recent mTBI indications through HR and HRV
  - Near real-time vital signs with short baselining to determine changes in health status

Features

- Extracts high resolution data from commercially available wearables.
- Sends data directly to a secure endpoint without passing through vendor cloud services.
- Runs analytics to reduce the data to features that serve as inputs to algorithms.
- Visualizes data to aid in decision making.

Wearables

Integrated with AlphaWear:

- Garmin smartwatches
- Samsung Galaxy smartwatches

Experience Using:

- Actigraph
- APDM Mobility Lab sensors
- Greenteg Calera®
- Oura Ring
- Polar H10
- Single lead ECG + 3-axis accelerometer
- Shimmer devices

Impact

- **Real-Time Health Status:** Step count, respiration rate, SpO2, and stress (based on HR + HRV) every 60s and HR data with each beat; core body temperature can be estimated from HR.

- **Readiness Monitoring:** Comparing individuals to their recent past baseline can help detect health anomalies related to injury, illness, and fatigue.

- **Longitudinal Monitoring:** Comparing health trends over longer time frames (e.g., months) can help decipher deteriorating/improving health.

- **Injury & Return to Duty:** Leveraging wearables data during prescribed test routines (e.g., balance, cognitive, light exercise) allows for easy quantification of biomarkers versus relying on self-report.

- **Treatment Adherence:** Wearable data can quantify adherence to behavioral interventions such as physical activity and sleep and provide feedback to the user about their progress.
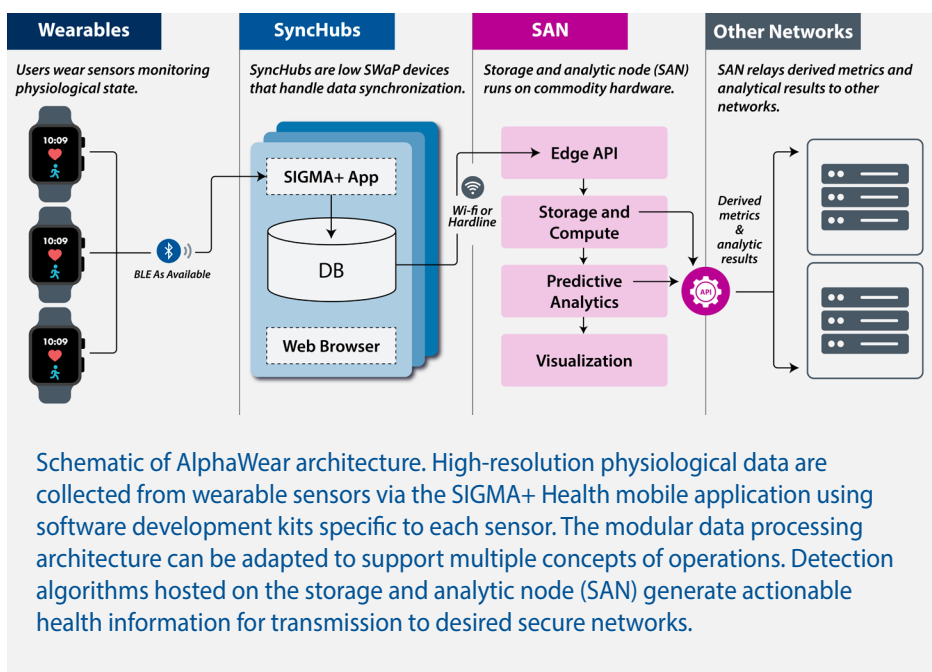
Analytics & Algorithms

- For Garmin devices, AlphaWear has access to higher resolution data:
    - Step count every 60s
    - Respiration rate every 60s
    - SpO2 every 60s
    - Stress every 60s

- We use the interbeat interval data to derive time-domain, frequency-domain, and non-linear heart rate variability metrics.

- We can access sleep and activity intensity information through the Garmin Health API.

SIGMA+ (S+) Health App

- Compatible with iOS and Android mobile devices

- Study PIN allows for cohort-specific acquisition settings and directs data to a configurable endpoint (e.g., AWS GovCloud)

- Participant ID is an alphanumeric identifier that does not contain personally identifiable information

- 1:1 or 1: Many mobile device to wearable pairing

- Configurable foreground and background syncing as well as manual sync options

- Ability to upload location information from mobile devices when a sync is initiated

Schematic of AlphaWear architecture. High-resolution physiological data are collected from wearable sensors via the SIGMA+ Health mobile application using software development kits specific to each sensor. The modular data processing architecture can be adapted to support multiple concepts of operations. Detection algorithms hosted on the storage and analytic node (SAN) generate actionable health information for transmission to desired secure networks.

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