Mobile Data Collection - Near Real-Time Gait Analysis

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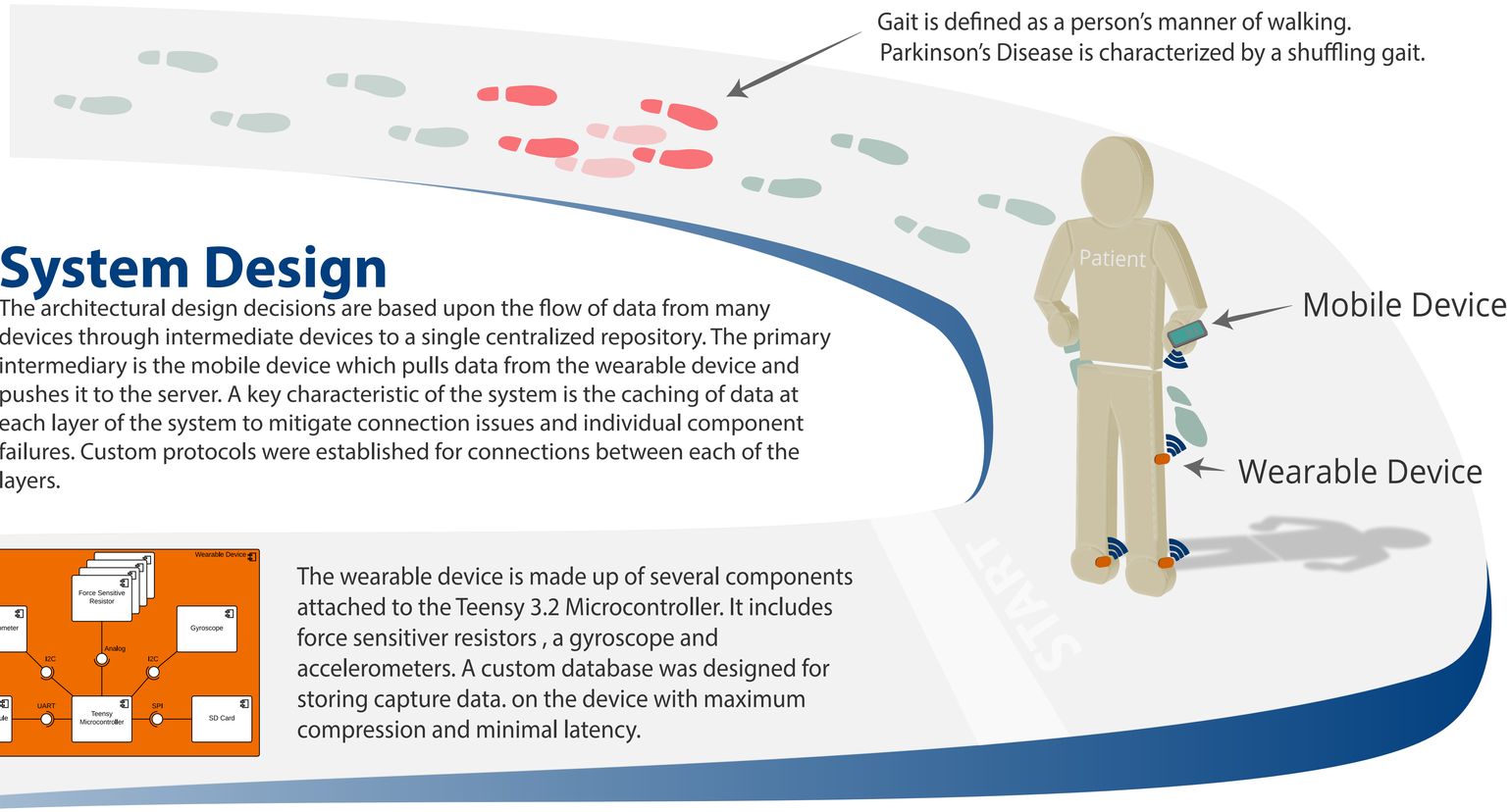
Abstract

Today there exist many wearable devices that collect data on how individuals move and exercise. Other gait analysis tools do exist, but are often limited to the clinical environment and do not allow for easy access to its data. Our wearable device with numerous sensors uploads collected data through a custom mobile phone application that can manage many wearable devices to a central database. Gathering data from wearable devices outside of a clinical setting can lead to a number of discoveries for Parkinson's disease.



Goals

The collection of data in highy varied environments with sufficiently detailed data is challenging. Specific requirements were obtained in collaboration with the project sponser Dr. Winfree and the key goals of the project are below.

Real Time Collection of Gait Data for Parkinson's Patients

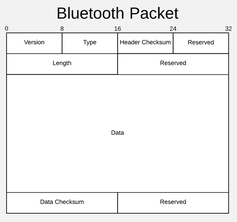
Centralized Repository for Analysis of Data Across Patients

System Design

The architectural design decisions are based upon the flow of data from many devices through intermediate devices to a single centralized repository. The primary intermediary is the mobile device which pulls data from the wearable device and pushes it to the server. A key characteristic of the system is the caching of data at each layer of the system to mitigate connection issues and individual component failures. Custom protocols were established for connections between each of the layers.

The wearable device is made up of several components attached to the Teensy 3.2 Microcontroller. It includes force sensitiver resistors , a gyroscope and accelerometers. A custom database was designed for storing capture data. on the device with maximum compression and minimal latency.

The wearable device communicates to the Android device over bluetooth. A custom bluetooth application protocol was implemented to allow for a standardized set of commands such as clock synchronization, data transfer and on/off.

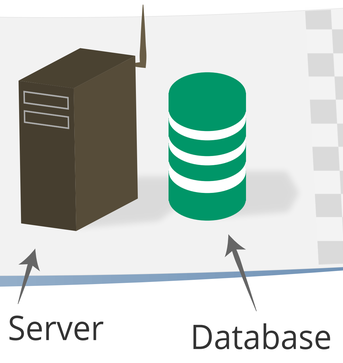


The Android application written in Java provides easy to use connector for patients to bring real-time collection of data out of the clinical setting. The mobile app also caches data in a sqlite database until it has a WIFI connection to upload to the web server.

Future Work

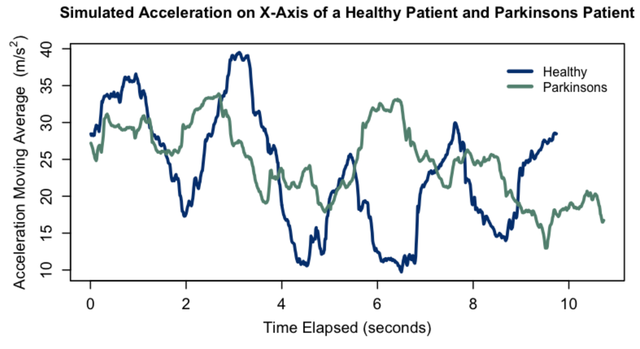
The next logical step to build on this system is to add statistical analysis. Immediate statistical analysis on both the mobile application, and web server can provide near real-time feedback. Additionally, analysis on the wearable device can provide further automation by automatically starting and stopping data collection by detecting the patient's current activity such as walking or sitting.

A Python web application, running the Flask framework, provides a REST API to serve as a gateway to the database. The database is powered by Postgresql, an opensource and free software system allowing interfaces to common statistical analysis software.



Results

Data for gait analysis has been successfuly transfered and aggregated from many devices into a central location . The design of the system has held to our prescriptive architecture with little drift from our initial decisions. In regards to implementation, the system effectively captures highly detailed and sufficiently granular data which can be quickly analyzed to see differences in patient movement(see below figure).



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