

# Test Plan, V1.0

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# 1 Introduction

As information technology becomes more ubiquitous in our lives, researchers hope to find new and more complete sources of data. The question for the researcher quickly goes from how do I collect this data to how do I collect, manage and analyze an extremely large data set.

This project hopes to answer these question by providing a framework for the current and future research needs of the project sponsor, Dr. Kyle Winfree. His research is focused on the analysis of human movement, specifically the issues associated with Parkinson's Disease.

While many devices are capable of tracking the count of steps an individual takes, this project aims to provide a framework for collecting data at a much higher frequency with hundreds of samples collected every time a subject takes a step. This requirement places a significant burden on the hardware and software of the layered system that has been proposed. The sheer amount of data presents a great challenge to the team.

The most resource constrained layer of the system is the microcontroller and associated sensors placed on the subject, hereafter referred to as the wearable device. The wearable device must be able to perform a number of functions at full-capacity and any inaccurate or poorly synchronized data will lead to failure. Fortunately the risks identified in the other layers are more easily mitigated.

This document gives a more in depth look into the overall testing procedures of the entire system. Our testing procedures start with unit testing, in order to make sure that each component is working as intended. The second step of our testing is integration testing, as the system consists of three separate distinct parts. Finally, our testing procedures includes usability testing, and functional testing to test the system as a single unit. This testing, has already returned positive and promising results.

## 2 Unit Testing

In regards to unit testing, the most important part of our system is the protection, and accuracy of data being collected. The entire purpose of the system is to be able to gather the data, and aggregate it to a server. If the data is corrupted, or not intact, than it, and the entire system becomes useless. Therefore, unit testing is done at all levels of the system, and primarily focused around any component that interacts with the data in any way.

In addition to data protect, the other main function that needs to be thoroughly tested is the commands, and command handling between components. If our components cannot handle basic communication, they do not make a whole system. The following sections will detail how the wearable device, mobile application and web server are being unit tested.

### 2.0.1 Wearable Device

The wearable device's primary function is to collect and store data. It also sends data over Bluetooth when it receives specific commands. The wearable device is particularly tricky to unit test as most of its components are physical hardware, and cannot be emulated. Additionally, its functions rely heavily on the mobile application.

#### Items Being Tested

- Receiving data from Bluetooth commands
  - The user must be able to express control over the wearable device with commands over Bluetooth. Such commands are start and stop data collection (put the device in idle), and to request data to the phone.
  - Command handling will be tested by mimicking commands sent from a desktop computer using a serial port operating on the Bluetooth protocol, with the program PuTTY.
  - If the wearable device mimics back the exact same bytes that were sent from the desktop computer, it will be deemed that command handling is operating correctly.
- Sending data over Bluetooth
  - The wearable device is required to send data to the mobile device over Bluetooth. This needs to be done in an efficient way, but slow enough to not corrupt data.
  - Sending data over Bluetooth will be tested by comparing data by sending data to a desktop computer. The desktop computer will read an incoming data stream over an open serial port operating in

Bluetooth, and data being printed out over a serial (wired) connection.

- If the desktop computer receives the same data that is being printed out through a serial (wired) connection, it will be deemed to be correct.
- Storing data at a specific index and reading data from a specific index.
  - The wearable device will to be able to store data on an SD card in a structured way. It needs to store values in their specific rows, so a row can be called and read, rather than a specific value in a specific position
  - Storing and reading data from a specific index will be accomplished by writing data to specific positions in the file structure, than read from those same specific positions.
  - This subsystem will be validated if the data being written and read matches, by being read over a serial (wired) connection.

## 2.0.2 Mobile Application

The mobile applications primary function is to be an intermediary device between the wearable device, and the web server. It controls the wearable device through a series of Bluetooth commands. Additionally, once it has the data that was collected and sent from the wearable device, it compiles it into a .csv file and sends it to the web server of WiFi.

### Items Being Tested

- Send Commands Over Bluetooth
  - The mobile application will be able to send specific commands over Bluetooth. This is to be able to express control over the wearable device.
  - Sending of commands will be tested by verifying the incoming bytes from the mobile device on a desktop computer using the software PuTTY.
  - If incoming bytes match that which was sent by the mobile application, the sending of commands over Bluetooth will be deemed successful.
- Receive and store rows of collected data over Bluetooth into a SQLite database
  - The mobile application will be able to receive rows of data from the wearable device. The mobile application must read these rows, and store them into an SQLite database without corruption

- Receiving data over Bluetooth will be tested by an output screen printing what the device is receiving over Bluetooth, from a desktop computer. Storing data will be tested by querying the entire database. Both of these measures will be compared to what is being sent from the desktop computer and from what is stored in the SQLite database.
- If what is being read, printed and stored in the database is the same as what is being sent from the desktop computer, this function will be deemed successful.
- Convert SQLite database into .csv file
  - The mobile application must be able to convert its current contents in the SQLite database into a .csv file to be easily sent to the web server.
  - This function will be tested by comparing the contents of the new .csv file, and that from a query of the entire SQLite database.
  - If is .csv output file has the same contents of the database query, this function will be deemed successful.
- Sending .csv file to a web server
  - The mobile application must be able to send its .csv file containing the entire SQLite
  - This function will be tested by reading the response to the server from an HTTP POST.
  - If the web server accepts the file, and response that it accepted the file, this function will be deemed successful.

### 2.0.3 Web Server

The web servers only function is to accept .csv files being sent to it, and parse them into a database.

#### Items Being Tested

- Receiving and correctly parsing .csv files into database
  - The server will be able to receiving files containing an predetermined layout. It will be able to correctly parse these values in the .csv file into appropriate columns and rows.
  - This function will be tested by sending a file to be uploaded from a desktop computer, and comparing the contents of the database to the file that was sent.
  - If the file that was sent, and the contents of the database match, this function will be deemed successful.

### 3 Integration Testing

This system is comprised of three different parts. A wearable device that collects data from various sensors. A mobile application that controls the wearable device and that uploads data from the wearable device to a web server. The web server stores all data for future analysis. The system is heavily reliant upon the three subsystems working together fluidly. Therefore, majority of the testing in this system will be integrating the three parts into a working system.

- Commands sent from mobile application are received by wearable device
  - Commands being sent from the mobile application must all must conform to the same standard. The wearable device must be able to read these commands, and parse them to make sense of the commands without a lose of data.
  - This will be tested by sending commands from the mobile application, and received by the wearable device. The mobile application will print the bytes that it sent on the debug screen. The wearable device will print out what it receives over Bluetooth through a serial (wired) connection.
  - If the command being sent from the mobile application, the command being received by the wearable device match and the wearable device acts accordingly to the command as expected; integration one way between the mobile application and wearable device will be deemed successful.
- Data being sent from wearable device is received by mobile application
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- Data being uploaded from mobile application is received by web server
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## 4 Usability Testing

One of the intents of this project is to have the user interact very little with the overall system, other than putting it on. This causes a very unique testing environment, as testers will be analyzed for how intuitive the system is, and how much its functionality impacts their lives. Additionally, another type of end user, the researcher, will test the usability of retrieving data from the web server.

### 4.0.1 Participants

Due to the lack of accessibility of patients with motor skills deficiencies, in early stages of testing, participants will be healthy adult volunteers. Participants will range from individuals with smart phone experience, and individuals without it.

### 4.0.2 Procedures

When testing the wearable device, mobile application and web server, all participants will use the same devices and web server. Once wearing the device, they will given a set of instructions of tasks to perform with the system. Likewise, participants testing the web server will be given a set of instructions for retrieving data. After completing the test, participants will be asked their thoughts on the systems usability.

### 4.0.3 The Test

The test for the wearable device and mobile application focuses on two areas, controlling the device and sending data through the system. Each participant will be instructed to do the following things.

1. Connect to Device
2. Start Data Collection
3. Stop Data Collection
4. Send Data to Server

Individuals testing the web server will only have one task, download the data stored on the database.

### 4.0.4 Measurement

During the testing, the time it takes to complete each task will be monitored. It will also be monitored how the participant is reacting to each task as one of the goals of this system is to have low wear burden. Meaning it does not affect their life, or become a disturbance.



#### **4.0.5 Measures of Success**

Success for the wearable device, mobile application and web server will be measured by speed and visible levels of frustration. Individuals should be able to express control over the wearable device almost immediately, without any forethought. Interacting with the devices should also cause no visible frustration.