Machine Learning MS Application - Executive Summary
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Overview:

Multiple sclerosis (MS) is a demyelinating disease that breaks down the coverings that surround nerve cells in the brain and spinal cord, preventing parts of the nervous system from communicating with each other. MS can develop at any age, but typically patients are diagnosed between the ages of 20 and 50. MS presents differently from patient to patient, manifesting itself through over 20 symptoms that vary in their expression and severity. Symptoms can occur either in isolated attacks (relapsing forms) or build up over time (progressive forms). When MS patients visit their doctor, they typically only have about 15 minutes to communicate all of the symptoms they have been experiencing to the physician. In most cases, the interaction is hampered even further by the patient's inability to remember specifics. This decreases the physician's ability to identify problems and craft solutions that could improve the patient's quality of life.

In passively and actively collecting data from MS patients, MS (the application) is a medical study that will 1) improve physicians' understanding of the disease and 2) inform researchers of the viability of using mobile technology as an MS patient-management system. In its current form the application consists of four components: an onboarding and consent component to confirm study membership, an activity component consisting of utilities and patient surveys, a health data visualization component to help patients and their doctors track symptoms and performance, and a didactic component that enables patients to learn more about MS and its symptoms.

Target Users:
MS patients throughout the United States that possess iOS devices.

Value:
The MS application will help patients keep better track of their symptoms, maximizing the usefulness of their doctor visits. The application will also grant valuable insight to researchers and physicians regarding how MS affects the daily lives of patients and what can be done about it. The knowledge generated by the application as well as improving the quality of care provided ultimately serves to empower MS patients and improve their quality of life.

Functionality:
There are four phases of the MS app, each with particular functionality:

Phase 1: Study Onboarding and Consent
The user will be taken through a digitized version of a medical consent form and be able to grant access to health information stored on Apple's Health application. If step tracking or sleep data is not available, the user will be prompted to download a third party application or integrate a wearable.

<u>Phase 2</u>: Patient Activities and Symptom Tracking
The user will have access to a collection of games/challenges designed to measure basic functionality that will record their score. Health data will be migrated from Apple's Health application, populated from either a third-party application or wearable. Users will be able fill out specialized surveys to record their exact symptoms and the severity at the point of relapse. Users will also have access to a medication tracking utility that keeps track of their medication schedule. Notification functionality should be incorporated that instructs the user what tasks to complete, when, and when to take medications.

<u>Phase 3</u>: Health Data Visualization
Users will be able to see a scrollable dashboard containing visualizations of their performance activities and symptom severity.

<u>Phase 4</u>: Didactic Resources
Users will have access to helpful resources including information about the study, information about managing MS systems, and general knowledge resources related to MS.

Technical Recommendation:

We will create the app in iOS because of the open source resources that exist on the platform. Apple has displayed their commitment to healthcare data on all iOS devices with the inclusion of the Health app. The HealthKit allows us to easily collect data from the user (such as sleep and fitness), while the ResearchKit gives us additional resources to conduct our research study.

By utilizing specific ResearchKit open source projects such as the parkinson's research app, mPower, we will be able to start with a solid foundation and layout for our app. Therefore, we will be able to focus on incorporating MS-specific features as well as machine learning on the data. Our app will be open source as well, and will help contribute to the growth of ResearchKit apps.

We will plan on storing the medical data on a Duke server so the server costs should be minimal. We will experiment with wearable devices for our data collection so there may be minimal expenses for the wearable hardware.