Lab 2 – SuperU Product Specification

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1. Introduction

Reaching weightlifting goals can be challenging for an individual when training without supervision. This is important because receiving proper guidance allows an individual to get results faster and more effectively. A study was done with 20 male weightlifters separated into a supervised group and an unsupervised group, and the results showed that the supervised group's squat and bench press increased greater than the unsupervised group's (Mazzetti, et al., 2000). Receiving guidance is important because many critical factors may be overlooked by a person who lacks enough experience. These factors include the intensity of a set, number of reps of a lift, number of sets of a lift, body fat ratio of the lifter, body weight of the lifter, and quality sleep of the lifter (James, C., 2016).

Overtraining and undertraining can lead to plateaus in a person's lifting progression. Overtraining leads to not allowing the body enough time to rest so that the individual can lift again and undertraining leads to a person not receiving the proper stimulus to gain strength and muscle (Cronkleton, 2020). Therefore, it is important for a weightlifter to execute their exercise sets at a proper target intensity. The Rating of Perceived Exertion, RPE, scale can be used to battle this problem. A study was shown that lifters who use RPE for their sets increased the weight on their lifts more than those who use pure 1 rep max percentages (Helms et al., 2018).

RPE measures the intensity of a lift on a scale from 1-10, 1 being the least intense and 10 being the most intense (Dickson & Mansour, 2020). This means that if a user is told to perform a lift at RPE 7, they would be lifting a mildly heavy weight, and the set should move slightly

slower than RPE 6 but faster than an RPE 8. RPE can be calculated by following the given equation.

$$RPE = Reps - Potential\ Reps$$

This means that if a person performs an exercise set at RPE 8, they should have the capability of doing 2 more reps.

Lack of sleep is another factor that can hinder a person's performance with lifting weights. The CDC found that 1 in 3 people do not get enough sleep on a day-to-day basis (James, C., 2016). A study that was conducted with a collection of student athletes showed that those who had less than 8 hours of sleep on average, were 1.7 times more likely to injure themselves during training than athletes who slept for more than or equal to 8 hours on average (Milewski et al., 2014). This study shows that the more sleep a person gets, the less prone they are to injuring themselves during strength training. The more rest a person gets, the more energy they have to do physical activities as well as more energy to properly set up for exercises.

To become stronger on a certain lift, weightlifters must properly track their data and make optimal choices that improve their one rep max. Their workout plan also needs to be adjusted whenever their progression reaches a plateau. SuperU is a smartphone application that utilizes a weightlifter's data and workout history along with artificial intelligence algorithms to generate optimized workout plans. SuperU can be used in place of a trainer.

1.1. Purpose

SuperU is a tool that analyzes historical workout data and critical factors that are important in a person's strength training. The application's purpose is to increase the weightlifter's strength on their lifts. SuperU is for weightlifters, powerlifters, bodybuilders, and

anyone who wants to increase their strength on a lift. This application analyzes critical data and the user's strength progress then generate an optimal workout plan with the Workout Plan Generation Algorithm. SuperU allows the user to view their progress by generating visual representations of their progress.

The application analyzes the following parameters in the Prediction Algorithm: sleep duration, sleep efficiency, body weight, body fat ratio, soreness, and change in their one rep max. The Workout Plan Generation Algorithm then generates a workout plan that is anticipated to increase the user's strength on their lift if followed through appropriately. SuperU uses a Fibit to collect the sleep duration and sleep efficiency. The Fitbit can also be used to collect body weight and body fat ratio. However, these parameters can be collected during the Entry Survey and Pre-Survey. The Entry Survey is shown to the user for the very first time they sign into SuperU. It asks the user what lifts they want to increase, the one rep max of those lifts, their body weight, their body fat ratio, and their age. The Pre-Survey serves to collect data on the user before their exercise sessions. It asks the user if they are feeling sore on a scale of 1-10, their body weight, and their body fat ratio. During an exercise session, the user verifies that they performed the exercises given to them in the generated workout plan by filling out the weight, number of reps, and RPE of each set. This exercise data is also analyzed in the Workout Plan Generation Algorithm.

SuperU visualizes the progress of a lift with charts. The charts show the change in the user's one rep max.

1.2. Scope

The SuperU prototype includes the Workout Plan Generation Algorithm, data collection with the Fitbit, and visual representations for progress. The objective is to show that these core features work effectively in increasing the weightlifter's strength. SuperU's prototype will have a case study using two weightlifters at the range of 21 to 22 years old for a month and analyze the progress of the one rep max of these three lifts: squat, bench press, and deadlift. An increase in the one rep max's will prove that SuperU fulfills its purpose.

SuperU's prototype is developed during five milestones. Each milestone is two weeks. The first milestone consists of setting up the database and synchronizing the database with the application. The second milestone consists of sign-up, log-in, and querying Fitbit WebAPI querying. The data queried is sleep efficiency, sleep duration, body weight, and body fat ratio. The third milestone consists of implementing the sending of Fibit data to Cloud Firestore. The third milestone involves implementing the Workout Plan Generation Algorithm, progress functionality, and input surveys. In the fourth milestone, the user will be able to input their exercise data and the user interface will be updated to look better. In the fifth milestone, the user interface is beautified and exercise data will be enough to view effectiveness of SuperU.

SuperU's prototype is developed in Android Studio. The database used is Firebase Cloud Firestore.

1.3. Definitions, Acronyms, and Abbreviations

Admin – oversees application and services that are used for the application. They can make changes to the application and services.

Agile – collection of software development principles that values adaptability and small, incremental changes to improve software quality and provide better responsiveness to changing business needs.

Android – Open-source operating system developed by Google and used for smartphones and tablet devices.

Ci/Cd - Continuous Integration, Continuous Delivery.

Discord - A free application that combines the voice chat aspects of services like Skype and TeamSpeak with the text chat aspects of Internet Relay Chat (IRC) and instant messaging services.

Firebase - Platform developed by Google for hosting mobile and web applications.

Firebase Cloud Firestore – A NoSQL database that is composed of collections and documents.

Firebase Cloud Functions – Framework that allows backend code in Firebase.

FitBit – A wearable computing device. It is a fitness band worn on a person's wrist and is designed to track physical activity.

Fuzzy Logic - A form of many-valued logic compared to boolean logic in which the truth values of variables may be any real number between 0 and 1 both inclusive, where the truth values are defined by fuzzy sets.

Fuzzy Set - A tuple consisting of a set and a member function, where the member function identifies a truth value between [0,1] given a parameter value which exists in the set.

GitLab – Web-based repository hosting service that allows developers to store, manage, track, and control changes to their code.

iOS – Operating system used for mobile devices manufactured by Apple Inc.

Jira – Online work management tool for all types of applications, from requirements and test case management to agile software

One-Rep Max (1RM) – The maximum amount of weight a person can lift for a single repetition of a lift.

Plateau – The state where a weightlifter fails to improve their 1RM for a long period of time.

Rating of Perceived Exertion (RPE) – A numeric estimate of the intensity of an exercise set on a scale from 1 to 10, 1 being the least intense and 10 being the most intense.

Reps – The number of repetitions a weight is lifted in a set.

Set – When one or more reps are completed.

UI/UX - User Interface and user experience design.

Weightlifter – One who lifts weights for exercise, muscle strengthening, and/or athletic competition.

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1.5. Overview

This product specification provides the hardware and software configuration, external interfaces, and features of the SuperU prototype. The information provided in the remaining sections include a detailed description of each feature and their requirements for implementation.

2. General Description

2.1. Prototype Architecture Description

SuperU's prototype is developed with the Android Studio 4.1 Integrated Development Environment. The programming language used is Java 8 and the markup language used is XML. Gitlab is used for version control. Firebase Authentication is used for user log in authentication and Firebase Cloud Firestore is used to query and store data. Fitbit WebAPI is used to query data that is collected from the user's Fitbit device. The Stasonis Fitbit OAuth 2.0 Github library is used for Fitbit log in authentication on the Android. SuperU's prototype will run on a touch screen mobile Android device running on Android version 9.0 or higher. Fitbit data will be taken from a Fitbit device.

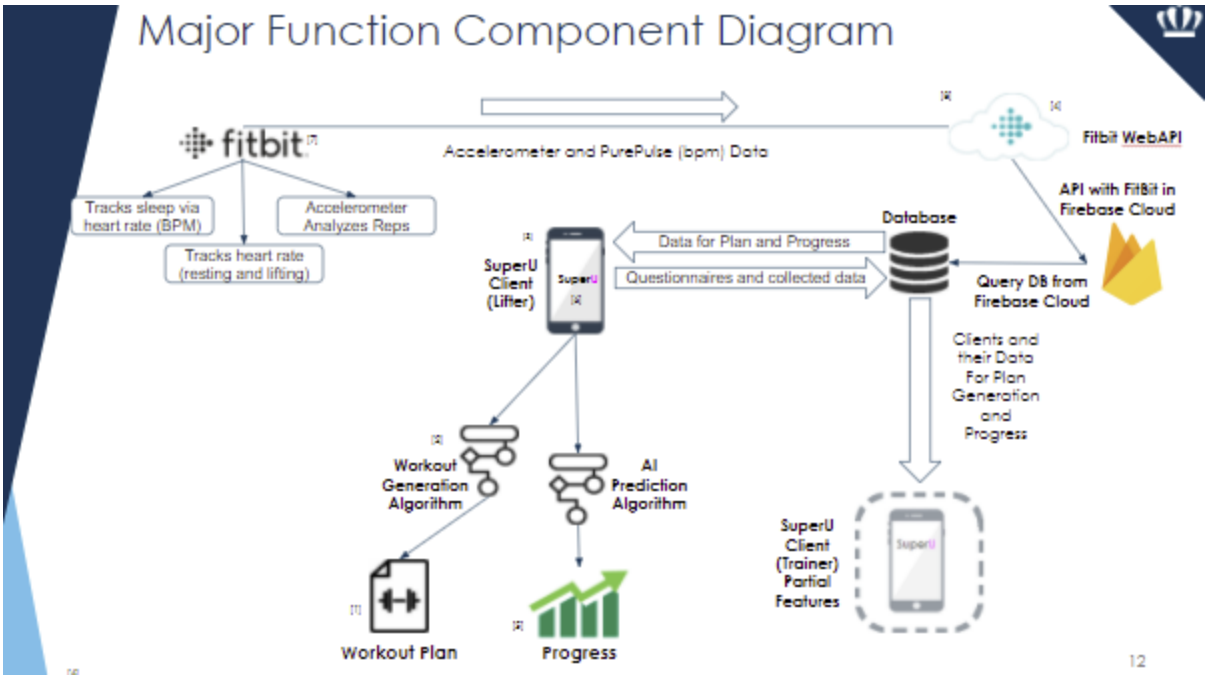

Figure 1 – SuperU Prototype MFCD

2.2. Prototype Functional Description

SuperU's prototype contains a user interface that allows the user to interact and move through each screens of the application. The prototype has a sign-up screen with the following parameters: email, username, and password. When registered, the user's data will be stored inside of Cloud Firestore. If already registered, the user can navigate to the sign-in screen. The sign-in screen contains an input for email and password. Once the credentials are entered, if verified, the user will be directed to an entry survey. The entry survey asks the user what lifts they want to increase. The user checks a box for the lifts which then asks the user what their current one rep max is for that lift. The user is also asked for their age, body weight, and body fat ratio. After this data is submitted, the user is directed to the home screen.

The prototype contains the ability to collect data from the user's Fitbit. The data collected is sleep efficiency, sleep duration, body weight, and body fat ratio. To enable this, the user must

first log in to their Fitbit account through SuperU's app by clicking connect Fitbit. Here, the user will be asked to enter their Fitbit email and password, and if verified, the account will be synchronized with the application. After the Fitbit account is signed in, the user's Fitbit data is added to the database through a background service.

The first week using the application, the user is given a workout plan and the user follows the enters data for each of the exercise sets. The user enters the weight, reps, and RPE of the set. After the first week, the Workout Plan Generation Algorithm generates workout plans based on the queried Fitbit data and historical data of the inputted workout information. The user is given a survey before each workout that asks the user if they are feeling sore, what their body weight is, and what their body fat ratio is.

SuperU's prototype provides a screen that visualizes the user's progress. The visualization comes in the form of charts that show the progression of their one rep max for each of the exercises they are trying to increase.

The application contains a settings portal where they can add or remove exercises that they would like to focus training on.

Functional Elements	Real World Product	Prototype
Trainer can adjust workout plans	Fully Functional	Non-functional due to time constraints
Workout plan is generated by algorithm	Fully Functional	Fully Functional
Clients' data is collected for workout plan	Fully Functional	Simulated data for previous weeks, normal functionality for current day
Tracks sleep via heart rate (BPM)	Fully Functional	Fully Functional
Tracks heart rate (resting and lifting)	Fully Functional	Fully Functional
Cloud Storage	Fully Functional	Fully Functional
Create new user account	Fully Functional	Fully Functional
Questionnaires for collecting data	Fully Functional	Fully Functional
Accelerometer counts reps and estimates RPE	Fully Functional	Fully Functional
Data for Plan and Progress	Fully Functional	Fully Functional
Trainer can view client's data.	Fully Functional	Non-functional due to time constraints

Table 1: SuperU Real World Product vs Prototype

2.3. External Interfaces

2.3.1. Hardware Interfaces

The smartphone running SuperU runs on Android version 9.0 or higher. Any Fitbit device can be used to collect the Fitbit data.

2.3.2. Software Interfaces

SuperU's prototype is developed in the Android Studio IDE. The programming language used for development is Java 8 and the markup is XML. SuperU uses Cloud Firestore to store and query exercise data. The sleep efficiency, sleep duration, body weight, and body fat ratio are queried by using Fitbit WebAPI.

2.3.3. User Interfaces

A touch screen Android device is necessary for moving through each screens and interacting with the application. SuperU requires internet connection for collecting and storing data.

2.3.4. Communication Protocols and Interfaces

Fitbit OAuth2 is used for authenticating SuperU with the Fitbit application.