Lab 1 - SuperU Overview

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1. Introduction

SuperU is an intelligent fitness app intended to help lifters increase their one rep maximum liftable weight (1RM). The application can also be used by trainers who want to oversee their clients progress. SuperU will use data tracked by FitBit compatible smartwatches in real-time in order to be analyzed to help lifters improve their liftable weight or 1RM. SuperU, in addition to collecting user data, will deploy algorithms to predict future progress for weightlifters and determine what weekly and daily exercise schedules lifters should follow in order to maximize their results.

1.1 Background

Many lifters encounter plateaus, where they fail to increase their liftable weight for prolonged periods of time. Almost fifty percent of weight lifters’ plateaus are caused from undertraining or overtraining [19]. According to a study involving 20 male weightlifters, these athletes improved in the 1RM in a supervised training environment [1]. According to the CDC, about thirty three percent of people fail to get enough sleep [2]. The US National Library of medicine that high stress training can hinder athletes performance by associated sleep deprivation [17]. Many weightlifters fail to take into account many critical factors affecting their performance.
1.2 Societal Problem

In the context of critical weight training, many lifters fail to take into account many critical factors that have been shown to heavily influence their performance. Some critical factors that affect performance including a lifter’s 1RM include:

- Lack of sleep
- Lack of proper guidance
- Ignoring critical target intensities (RPE)
In addition to recognizing critical factors that influence performance, weight trainers also fail to accurately track these parameters. Such data could be used to formulate decisions and allow lifters to take the best plan of action to most effectively and efficiently increase their lift. Finally, weight trainers often make non-optimal decisions in the context of workout which serves to cause the lifter to enter a plateau.

1.3 Solution Description

A solution to these problems would include a way to make trainers aware of critical factors affecting their progress. However, even if trainers were aware of these factors, they would need a way to track them over time. A solution to this would entail a way for them to track their data and visualize it. Weightlifters would also need assistance making decisions from
the data in order to ensure they take the best actions from their current physical state. The final component required would be a way to generate workout plans for the user based on their training data history.

1.4 Solution - SuperU

SuperU is a mobile phone application that will highlight critical factors the users should consider when looking to increase their lift. Furthermore, SuperU will provide a powerful interface for users to track their training data and visualize it. Lastly, SuperU will use machine learning algorithms and other intelligent algorithms to tailor customized workout plans for the user which will be based on modern body-building research.

Current Solution Process Flow

Figure 3: Current Solution Process Flow

2. SuperU Product Description
Users will make an account similar to most applications, where they will answer a basic questionnaire that serves to establish what lifts that user will be looking to increase. Furthermore, the user will be baselined for a week in order to build up a sufficient amount of data for the workout plan algorithm to work properly. From there, users will wear a FitBit compatible smartwatch of which will track critical parameters such as sleep, heart rate, RPE, etc. The application will use data collected to generate workout plans for the user. The application will be available on Android initially but will be ported over to IOS devices. The goals and objectives of SuperU will include:

- Allow users to visualize and see tracked data.
- Create data profiles for users to allow for user data collection over time
- Use Smartwatches to increase the amount of relevant data that could be used to make decisions.
- Hardware necessary (accelerometer/motion detection, heart rate monitor)
- Process data into proper routine algorithms

2.1 Key Product Features and Capabilities

The key product features and capabilities include the mobile SuperU client application, Firebase cloud architecture, the FitBit API and Firebase administrative functions. These features will allow for SuperU to function.

2.1.1 Mobile Client Application

The mobile application will have two major parts, one for weight lifters and one for trainers. Lifters will have the ability to visualize their progress and view their data history. Users will also be able to receive custom tailored workout plans generated by the workout plan
generator component of the application. The workout plan generator will be comprised of several algorithms required to generate plans the lifter and will include:

- RPE generating algorithm using tracked parameters such as sleep, previous RPE, soreness, Previous 1RM.
- Daily workout generator (selects exercise, # of set per exercise, # of reps per set, and rest time between sets)
- A weekly schedule generator will use tracked parameters such as sleep, previous RPE soreness, previous 1RM to determine when the lifter lifts next.

The trainer will have access to the clients data for visualization purposes and will be able modify clients’ workout plans how they see fit.

Figure 4: Generating Workout plan
2.1.2 Cloud Architecture

The cloud architecture exists as a set of Firebase services of which include:

- Firestore - will serve as the primary database for user’s workout data.
- Functions - Will be were cloud code such as FitBit API calls will be made
- In-App-Messaging - is the Firebase feature that will allow SuperU to message its users through administrative roles.
2.1.3 FitBit/SmartWatch API

The FitBit API will serve as the interface for SuperU to access the users’ third-party smartwatch data. The FitBit mobile app will be able to pair with a user’s smartwatch. The smartwatch will serve to capture large amounts of heart rate data and accelerometer data which can then be analyzed to understand how users are lifting and track progress in realtime.

2.1.4 Administrator Roles

SuperU administrative roles will allow for the maintenance and upkeep of the platform. Admin tasks will include actions such as adding or removing users, database repair or data migrations, and platform performance monitoring.

2.2 Major Components
The major components of SuperU can be broken down into Hardware and Software respectively. The hardware components include:

- Smartphone/Tablet (Android ready device)
- Smartwatch (FitBit compatible smartwatch)
- Google servers that host our Firebase instances (individual servers managed by Google, service is pay-as-you-go)

Core software components of SuperU include:

- Local Database (SQLite) (used to store data locally in individual devices)
- Client workout generation algorithm (will be used to generate workout plans based on data queried from the database)
- Client progress visualization and prediction algorithm (will be used to visualize current lifter progress and predict future progress)
- FitBit API service (FitBit API that allows SuperU to access smartwatch data associated with a given user)
- Firebase Services
  - Firebase authentication (Used during user login/registration)
  - Firebase Firestore (database)
  - Firebase Functions (cloud code)
  - Firebase In-App-Messaging (cloud messaging service)

The software components can be seen working together at a high-level in the MFCD seen in figure 7. Everything flows from the phone clients, whether a user is using the service as a lifter or trainer. For the SuperU lifter client, the application queries and posts user data to and from the database. The phone client will also house the modules/components that will be used to generate the workout plan and progress. The trainer queries their client’s data from the database and may write to a lifter’s workout plan part of the database in the case the trainer chooses to modify a lifters generated workout plan. A Firebase cloud server will be responsible for handling client database queries as well as calling the FitBit API.

The software development components of SuperU include:
- Android Studio IDE with Java (will be used to write the mobile android application)
- Xcode with Swift (write IOS version, will be implemented for real-world product)
- Product Testing Software
3. Identification of Case Study

3.1 Who is the product for?

The primary target audience for SuperU includes:

- Weightlifters
- Powerlifters
- Bodybuilders
- Personal trainers

3.2 What will it be used for?

The product will be used to allow for lifters to increase 1RM for a selected set of exercises. SuperU will be used as a substitute or in conjunction with trainers in order to allow users to break free from lifting plateaus and increase the amount of weight they can lift. SuperU will be used for heavy weight trainers to achieve a maximized performance as safely and effectively as possible.

3.3 Who else might this benefit?

Other possible individuals who might benefit from SuperU include:

- Non-athletes who are meeting job strength requirements
- Athletes for other sports who might benefit from strength training
- Trainers who want to track and visualize client data
- Data could by fitness industry to make calculated business decisions

4. SuperU Product Prototype Description
The proof of concept for SuperU will include a functional android mobile application that allows for user registration, data management for those users, and decision making that allows for lifters to progress. The application will allow pairing with a user’s smartwatch, so long as said smartwatch is able to be accessed via FitBit’s API. The smartwatch will allow the collection and analysis of data in realtime before being stored in order to be used for decision making later on pertinent to the user’s progress. To elaborate on the aspects of what the prototype mobile application will entail, SuperU will have a registration and login screen for either lifters or trainers. The main logical components the application will provide for a lifter include:

- Workout plans (plans developed by the app based on the user’s collected data)
- Progress Viewer (shows a lifter the progress and expected position for 1RM if they continue to receive guidance from the app)

SuperU will also provide the two components for trainers, with the exception that each of the components will be associated with an individual trainee under that trainer. The trainer will have a list of lifters they are currently training. The component break down for the trainer will include:

- List of clients/Lifters (Trainer can select a user and access the corresponding workout plan and progress for that selected user)
- Workout Plans (plans on a per client/lifter basis where the trainer will also be given the ability to modify such plans)
- Progress Viewer (progress on a per client/lifter basis, where the trainer will be able to track and visualize the clients progress)

The above components are the breakdown of the core components of the SuperU prototype. Furthermore, the prototype will offer administrative functions critical to protecting the integrity of the service such as but not limited to:

- Manually adding/deleting users
- Performing data migrations
- Implementing/refining core algorithms or other components
- Scalability concerns outside of data storing

4.1 Prototype Architecture (Hardware/Software)

The hardware that will utilized by SuperU includes:

- Smartphone/Tablet (android running devices that will run SuperU Client)
- Fitbit/SmartWatch (FitBit compatible smartwatch that will allow for the collection of important data such as heart rate and lift acceleration)

Core software components SuperU will deploy include:

- Firebase Authentication (Login/Registration Service)
- Firebase Firestore (database)
- Firebase Cloud Functions (cloud code)
- Firebase In-App-Messaging (cloud messaging service)
- SuperU Client .APK android application (smartphone or tablet (android device))
Software that will be utilized during development will include Android Studio IDE with JAVA and Javascript for writing cloud code.

4.2 Prototype Features and Capabilities

SuperU will include a variety of features that increase the viability of the product by allowing for SuperU to make better use of collected data. Some features will include:

- Monitoring heart-rate and movement during exercise
- Monitoring heart-rate throughout the day and while sleeping
- Functional workout routine notifications and alerts
- In app administrative messaging to allow for effective communication with SuperU users
- Ability to generate effective workout plans for users
- Ability to allow lifters to visualize their progress
- Provide meaningful prediction of where lifters will be in the future with respect to their progress

The feature set for the prototype implementation is intended to include features that are critical to the MVP (minimum viable product) of the service of which the product needs in order to function ideally.

4.3 Prototype Development Challenges

SuperU has a variety of development challenges that will need to be addressed in order for the prototype to be considered successful. Some of these challenges will include:

- Integrating credible research into our algorithm
● Designing a Gantt chart that allows the team to maximize productivity be being able to track module dependencies
● Developing effective testing harness to verify our solution performs as intended
● Refining design to ensure it follows S.O.L.I.D design principles as closely as possible
● Refining features based on how users will actually use our product

5. Glossary

a. **Rating of Perceived Exertion (RPE)** - A way of measuring physical activity intensity level based on objective parameters and the person’s experience[1].

b. **One-Rep Max (1RM)** - The maximum amount of the weight you can lift for a single repetition of a given lift[1].

c. **Weightlifter** - One who lifts heavy weights for exercise, muscle strengthening, or athletic competition.

d. **Plateau** - State where a lifter fails to improve their 1RM.

6. References


