SuperU – LAB1

PRODUCT DESCRIPTION FINAL

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1. Introduction

Weightlifting, like many other sports, can be dangerous if performed under unsatisfactory physical and emotional conditions. At first sight, it seems as if it does not require much preparation to carry out the lifts properly and to achieve optimum results. Many weightlifters ignore key factors that are critical to increasing their lifts as effectively as possible. These factors include proper guidance, lack of decent quality sleep, and ignoring intensity goals. Not everyone can afford a real-life coach and without one, progress can be slow, and goals may not be achieved safely. With no real timeline, goal progression analysis can make progress hard to track. Another major key component in weightlifting that is often ignored, is the quality of sleep in athletes prior to a performance or during a workout plan. Figure 1 below shows in detail the process outlining the issues associated with the current flow.

![Current Problem Process Flow](image)

*Figure 1 - Current Problem Process Flow*
According to the CDC 1 in 3 people do not get enough sleep on a day-to-day basis, something vital to weight training properly (Center for Disease Control and Prevention, 2016) and according to the US National Library of Medicine, there is mounting evidence showing that due to a variety of reasons, such as demanding training schedule, pre competition anxiety, and extensive traveling, athletes often experience sleep deprivation that in turn hinders their performance (Fowler, Duffield, & Vaile, 2015). With sleep deprivation, motor function, mood, and cognitive functions are all affected negatively, which can decrease performance and increase injury risks (Milewski, et al., 2014).

Figure 2 - Lack of Sleep Research Diagram
The tendency for people to train purely on percentages of a one rep max can also result in overtraining, as opposed to using Rate of Perceived Exertion scale (RPEs for short) to measure intensity of exercise. RPE is a scale from one to ten and it measures the intensity of an exercise, the higher the number the higher the intensity. Weightlifters who use the RPE scale, have shown to increase weight more than those who use pure 1RM percentages, thus helping in avoiding undertraining or overtraining and reach target intensities. Because there is a lack of data correlation between individual sleep patterns, heart rate, height, weight, age, proper guidance, and tailored workout plans, SuperU is a smartphone app to solve that problem (Monsour & Dickson, 2020).

2. SuperU Product Description

SuperU is a mobile software application that works in tandem with the smart phone and smart-watch device, such as Fitbit, to provide weightlifting guidance and other training information in real-time. Additionally, it will be designed to create workout plans custom tailored to the user, based on a learning algorithm that takes the data gathered during each workout to allow users to progress safely and effectively towards their goals.

2.1 Key Product Features and Capabilities

SuperU, unlike other comparable products, aims at providing the fastest approach to results with personalization, use of good night sleep score to maximize results, guide users to workouts at most beneficial intensities, learn good training technique, prevent progress plateaus, and an easy to use/track progress. Figure 3 below shows the current solution process flow outlining all the steps.
Some of the key components that are collected or measured to accomplish that, include heart rate (provided by Fitbit PurePulse), rep count, body weight, current max weight liftable, sleep score, RPE, change in body weight, and change in weight liftable. The workout plan generator algorithm will then provide, based on these parameters, the best workout plan to follow for maximum results.
Generating Recommended RPE

\[
\text{Value} = 0.1f(\text{Body Weight}) + 0.2f(\text{Sleep}) + 0.4f(\text{PRPE}) + 0.1f(\text{Body Fat}) + 0.2(\text{soreness}) + 0.1(\text{P1RM})
\]

Target RPE Decision Equation

\[
\text{Decision Value Between [0.0, 1.0]} \times 10 \Rightarrow \text{Target RPE}
\]

Figure 4 - Target RPE Decision Equation

Workout Plan Generation Algorithm

\[
\text{Value} = \alpha f(\text{Body Weight}) + \beta f(\text{Sleep}) + \Gamma f(\text{PRPE}) + \varepsilon(\text{Body Fat}) + \lambda(\text{soreness}) + \tau(\text{P1RM})
\]

Decision Equation

Figure 5 - Workout Plan Generation Algorithm
2.2 Major Components (Hardware/Software)

SuperU will target both Apple iOS and Google Android mobile operating systems. For Android OS we will make use of Android Studio and the de facto standard Java as language to develop the application, while on iOS XCode and Swift are going to be used for native development. However, both platforms will include SQLite for local temporary storage of data and Firebase for server/cloud side database management of all users.

![Major Function Component Diagram](image)

*Figure 6 - Major Function Component Diagram*

Integration with Fitbit wearables will be performed via Fitbit API which is available for free for anyone who wants to develop an application to access and modify a Fitbit user’s data on their behalf. Software version control and code management will be handled via free access to GitHub and Atlassian Jira for the project management of all. Jira will provide access to Agile reporting, scrum boards, issue tracking, roadmaps, while CI/CD is integrated through GitHub.
3. Identification of Customer Base

SuperU is designed to be used by anyone who wishes to become a weightlifter and being guided by a smart algorithm that can decide the best path to carry out that. It can also supply access as a trainer who analyze the progress and workout generated by the algorithm and is able to change the plan for a weightlifter or a group of them.

**User Roles and Stakeholders**

Users:
- **Weightlifter**: Individual that trains to increase their lift.
- **Trainer**: If enabled, analyzes the progress and workout plan generated by the algorithm and is able to modify the workout plan for the weightlifter.

Stakeholders:
- **Gyms**: The gym will hire trainers and distribute the application to them.

*Figure 7 - User Roles and Stakeholders*

Additionally, the app can also be a perfect solution for gyms where trainers and weightlifters can work with each other while keeping track and analyze the progress under one single pane of glass.
4. SuperU Product Prototype Description

SuperU prototype functional elements should be fully functional except for clients’ data which will be provided as simulated data for previous weeks. The diagram below summarizes the elements for the real-world products and the actual prototype.

Real World Product vs Prototype

<table>
<thead>
<tr>
<th>Functional Elements</th>
<th>Real World Product</th>
<th>Prototype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trainer can adjust workout plans</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Workout plan is generated by algorithm</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Clients’ data is collected for workout plan</td>
<td>Fully Functional</td>
<td>Simulated data for previous weeks, normal functionality for current day</td>
</tr>
<tr>
<td>Tracks sleep via heart rate (BPM)</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Tracks heart rate (resting and lifting)</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Cloud Storage</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Create new user account</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Questionnaires for collecting data</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Accelerometer counts reps and estimates RPE</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Data for Plan and Progress</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
<tr>
<td>Trainer can view client's data.</td>
<td>Fully Functional</td>
<td>Fully Functional</td>
</tr>
</tbody>
</table>

Figure 8 - Real World Product vs Prototype

4.1 Prototype Architecture (Hardware/Software)

For the prototype, Android smart phone will be employed and a Fitbit device or Fitbit API compatible wearable. Initially the prototype will be implemented on Android devices only to provide a quick result for testing its functionalities and then ported to iOS. Initially, our software development for the application will start with Android Studio IDE which is available for Microsoft Windows and Apple Mac OS. This will allow the team to develop on different
platforms and not be constrained on one or the other. As explained above, we will use Firebase, which provides all services needed for the app to run.

![Database Schema](image)

**Figure 9 - Database Schema**

Firebase provides Firestore as the database, cloud functions, in-App messaging as Web Server, and other functionalities such as multiple secure methods to authenticate, storage and sync of data between users and devices at a global scale. The usage of Firebase systems will provide all the necessary tools to prototype SuperU in a fast and efficient way, without wasting time and resources on decentralized infrastructure.

## 4.2 Prototype Features and Capabilities

All features and functional elements described above and detailed in (Figure 8 - Real World Product vs Prototype) will be included in the prototype of SuperU. It will include a monitoring of the heart rate and movement mid routine to estimate the RPE to use during the
workout and average heart rate throughout the day for comparison. The sleeping score, which is collected by the Fitbit or compatible wearable, is stored by the prototype to determine the quality of the sleep pattern, and calculate the best progress going forward. Functional routine alerts will also be part of the whole design and include alerts such as workout reminders, sleep notifications if sleep pattern shows to be poor, and reminders for rest period as well as next workouts. All these functionalities are described in (Figure 6 - Major Function Component Diagram).

4.3 Prototype Development Challenges

Every application or other product prototype will face challenges in one form or another. Those challenges, however, are there for a reason and can justify the need for a prototype so they can be analyzed, and subsequently mitigated or conquered. In the SuperU prototype or at least the concept of a prototype, because at the time of writing this report there is only an outline of such, the one significant challenge we faced was the design of a prototype. How to design the interface and how to set the flow of using the application from a user and a trainer prospective is a challenge which is currently being addressed. Planning and development will probably be the most challenging aspects yet as we move forward to the next phase of the project. For a successful development of the prototype and subsequently the final product, planning is an important factor, which if neglected or abused, can create a ripple effect of challenges. Additionally, time constraints and team members contribution are among the most challenging parts of the project. All these challenges, however, are strictly connected and if any delay or disruption happens in one, others will suffer as well.
5. Glossary

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

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

**Ci/Cd** – Continuous Integration, Continuous Delivery.

**Discord** - Discord is a free app 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 creating mobile and web applications.

**Fitbit** - The Fitbit is a wearable computing device. It is a fitness band, worn on a person's wrist and is designed to track physical activity.

**GitHub** - Open source, cloud-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** - In weight training is the maximum amount of weight that a person can lift for one repetition.
**RPE** - Rate of Perceived Exertion scale is a way of measuring physical activity intensity level based on objective parameters and the person’s experience.

**UI/UX** - User Interface and user experience design.

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

Center for Disease Control. (2020, Sep. 17). *Perceived Exertion (Borg Rating of Perceived Exertion Scale)*. Retrieved from Center for Disease Control:
https://www.cdc.gov/physicalactivity/basics/measuring/exertion.htm#:~:text=The Borg Rating of Perceived,like your body is working


Fitbit, Inc. (2020). *What's Sleep Score In The Fitbit App?* Retrieved from fitbit.com:


