



RU Healthy?

REPORT 1:

Specifications of Work and Requirements

Class

ECE 567 – Software Engineering 1

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Group #2

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Website

[RU Healthy?](#)

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1 Effort Breakdown

All members contributed equally for this report.

2 Customer Statement of Work

2.1 Problem Statement

We live in a technology driven, quick paced, gluttonous society. We know that exercising has various benefits include: weight management, decreasing health conditions and diseases, improving mood, and boosting energy [2]. The issue is that we don't always receive these benefits because we don't regularly exercise. It is easy to get caught up in online profiles, games or social statuses and neglect physical exercise. It is also extremely convenient to purchase fast food from a local McDonald's rather than making a healthy home-cooked meal. Unfortunately, these habits lead to obesity and multitude of health issues. According to the 2016 Health Study by the United States Department of Health and CDC (Centers for Disease Control and Prevention), over 70% of Americans over the age of 20 are overweight [10]. Another study from the CDC showed that 80% of Americans don't get the recommended amount of exercise [3].

The similarities in these numbers between those that are overweight and those that do not get the recommended amount of exercise is not surprising. According to the Merriam Webster dictionary obesity is defined as: "a condition characterized by the excessive accumulation and storage of fat in the body" [6]. We know that body fat is essentially excess calories that have not been burned. Exercise provides a way to burn calories at a rapid rate. So the more the exercise, the more calories you burn. The more calories you burn, the more fat you lose.

According to the CDC, each adult should do a minimum of 150 minutes at moderate intensity or 75 minutes of vigorous activity each week [8]. Put simply, this amount is about 22 minutes of moderate active per day or 11 minutes of vigorous activity per day. A moderate activity is one that is able to raise your heart rate enough for you to sweat. Examples of moderate aerobic activity include [8]:

- Walking fast
- Doing water aerobics
- Riding a bike on level ground or with few hills
- Playing doubles tennis
- Pushing a lawn mower

Vigorous activity raises your heart rate moderately and involves heavy breathing. Some forms of vigorous activity include [8]:

- Jogging or running
- Swimming laps
- Riding a bike fast or on hills
- Playing singles tennis
- Playing basketball

Additionally, muscle strengthening activity is advised [8].

2.2 Current Market Solutions

As a way to promote activity and reduce obesity, various fitness devices and applications have been developed. Some of the fitness applications on the market include: Jawbone, Fitbit, Johnson and Johnson's 7 minute workout, FitStar, Lose It, Workout Trainer, JEFIT, Sworkit, and Strong Workout Tracker [7]. Most of the fitness applications offer activity tracking, calorie counting, and step tracking. Many of these apps, such as Fitbit, include web interfaces that allow you to join in with other workout groups. Some apps such as JEFIT and workout trainer, demonstrate how to do certain exercises [7]. Additional apps such as JEFIT also allow you to map your workout routines and offer workout timers [7]. These advancements in technology have made it easier to track activity progress while also encouraging people to exercise by the positive cognitive reinforcements of social media groups.



Figure 1: Applications of same category that are currently available in market [13]

2.3 RU Healthy? App Solution

The “RU Healthy?” app wants to continue this trend of using technology to motivate people to exercise. It will implement the basic fitness features such as activity tracing and step counting by using the motion sensors and camera of the smartphone. The app will also detect whether you are exercising according to your schedule. Furthermore, the app will store these statistics to an online database that both physician and user can access.

No one enjoys the problems that come with being overweight and we know that exercise reduces body fat. So, why don’t exercise more? For many of us there are three main reasons that we don’t exercise: lack of accountability, lack of motivation, or scheduling inconsistencies. The RU Healthy? app addresses all these issues.

To address the issue of the lack of motivation, let’s consider the impact of accountability. Accountability motivates us to move forward. There is a friend who recently started a 30 day challenge to burn 1000 calories a day. The challenge was started because she wanted to buy a special shirt from her friend. The friend would not offer the shirt to her but stated that if she was able to complete the 1000 calories a day challenge, he would give it to her. He then opened up the challenge to other friends in their group in a fitness app. The one who does the best on the challenge gets the shirt and a \$200 cash prize. What is interesting about this group of people is that many of them are not very active and are not usually motivated to exercise. However, because they are part of the group and their progress is reported to the group in this fitness application, they are intentionally exercising. The group’s accountability motivated the non-active members to get up and move. The RU Healthy? app would essentially do the same thing except the user would be accountable to their physician.

Another reason that we don’t exercise consistently is because we have a very busy lifestyle, we never have the time and we simply “forget” or don’t put it in our schedule. The RU Healthy? app offers a possible solution for this issue. The app has a schedule reminder that sets off an alarm when it is time to exercise. The user can set up their own workout schedule, or be advised a schedule by a physician or personal trainer. This schedule will look different for each patient. For some, it may be 5 to 10 minutes of activity at certain points of the day. For others it may be a block of time setup specifically to work out. Once the schedule is set, it will sync with the phone calendar and timer to send an alert notifying the user that it is time to exercise. This alarm or alert gives the user a reminder to get up and move. The chances that we will forget to exercise are reduced. Additionally, because the schedule will be set up and agreed upon by the user, it should be at a pace that they can adhere to and follow.



"What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?"

From a physician's perspective, the RU Healthy? app makes it easier to hold their patient accountable to the exercise regiment. Think about it, everytime we go to the doctor they ask the question: are you exercising? The answers to this question often frustrates physicians because their patients are either not following their suggestions regarding exercise or not being honest about the exercise routine. What if the physician already had the answer to that question prior to the appointment? This would save time from the doctor trying to decipher the patient's honesty and commitment to the exercise. Furthermore, this helps the patient to develop an action plan, a technique that increases the probability that the person will exercise and meet the goal [9]. In short this makes it easier for patients to be accountable to their physicians. This is one of the concepts that makes our app unique. Other fitness application do not promote allowing physicians to access the patient's activity results.

[Image 2 - www.glasbergen.com]

Additionally, the doctor would have access to the patient's basic health statistics like heart rate. For the patients who are at risk this information could be extremely useful because it could make the physician aware of anomalies such as irregular heart rates. Because an irregular heart rate is often an indicator of other health issues, having this information could help physicians diagnose problems in early stages. The physician could examine the heart rate levels of patients and detect possible issues such as thyroid problems or heart palpitations.

2.4 How will 'RU Healthy?' accomplish this?

Let's say the patient, Mike, visits a physician and creates a user account, log into the app and links it with the doctor's account. Then, Mike will have to do an initial one-time configuration to enter his age, gender, height, weight.

With the app, he will have the ability to check: when he started and stopped walking, and the total distance that he walked. Moreover, he will be able to see and keep track of the calories he burnt during the week and his activity history, along with a heart beat rate history.

At the other end, the physician will be able to see Mike's activities in a web UI. The web UI will provide him/her with all the necessary information about the patient status, it will also contain the patient's personal data:

- Name
- Age
- Gender
- Weight
- Height
- Activity history
- Heart rate history and average heart rate
- Number of the steps he/she walked
- How many miles he/she walked
- How many calories he/she burnt during his activity

The physician will have the ability to control all the patients from the web UI, and review their information. The data of this UI will be obtained from a database which regularly stores user activity (say, weekly). We can use Django or a similar platform to make the web UI for the doctor. Data from the Android smartphone can be sent to a server/database with the help of Java or Android libraries or this can be synced to the cloud. We can further scale this up to ensure that the physician is able to see all of his patient's records, if they have installed the app.

Every day, the person's data will be stored. The weekly update will be sent to his/her physician. This way, the physician will get to know whether Mike is following his schedule or not. The doctor will have a web page with login information, and when he/she logs in, he/she can see the information updates coming from all their patients. And whichever patient is failing to follow the schedule, it will be marked by red and the device will give the patient a "warning" or a notification. The physician will set up an appointment with those patients to talk about it.

2.4.1 How does the proposed system count the steps?

The user just needs to carry his smartphone with him/her or leave it in the pocket. It will detect the unusual movement of the user and try to calculate the acceleration, based on three variables (x, y and z). The accelerometer sensor is found in every Android device (old and new). It is a device that measures the acceleration (or rate of change of velocity) of a body in its own instantaneous rest frame. Single and multi-axis models of accelerometer are available in Android devices to detect magnitude and direction of the proper acceleration, as a vector quantity, and can be used to sense orientation (because direction of weight changes), coordinate acceleration,

vibration, shock, and falling in a resistive medium. That is one of the features that will give the advantages for the app , so it will not need any extra costs for the user to use this feature.

Our Footsteps Detector will collect the data from the sensors (x, y and z), velocity and device acceleration which is measured by m/s^2 . After collecting these data we will process them and we will store the data in arrays.

These arrays will try to help us to filter the data and normalize them based on normalization algorithm that have a specific limit (which we will call sensor sensitivity) to detect the abnormal data that is coming from the sensors and store them in single dimension array or vector so we can retrieve it and count how many abnormal data we got and view it as a step.

Below is a specific description of the classes that we used for the Footsteps Detector:

Application Classes

- Step Listener Class Interface: This class-interface will listen to number of alerts about steps being detected.
- Step Detector Class: A class which will accept updates from accelerometer sensor and deploys the filter to detect if a step has been covered by the user.
- Sensor Filter Class: A class with an algorithm to filter out values that have a close approximation to steps sensitivity.
- Main Activity Class: This class will contain all the buttons on click activities and all the data returns from the main classes.

Application Functions

- On click Listener: This function will activate the Sensor Manager Listening to the abnormal acceleration from the Step Listener Class.
- On Sensor Changed: This function will update the sensor values from the Step Detector Class.

2.4.2 How does the proposed system measure heart rate?

Just to provide a general idea for now, to be able to measure the heart beat rate we plan on using the smartphone's flash and camera. All the user has to do is open the app and hold his/her index finger over the camera lens to start measuring. The camera is used to track color changes on the fingertip that are directly linked to the pulse. This is the same technique that medical pulse oximeters use. The whole process should not take more than 30 seconds.

2.5 Glossary of Terms

Table 1: Glossary

Term	Description
Accelerometer	Handles the axis-based motion sensing and is used to count the steps or distance walked.
Account	Entity in database that contains specific information about the user including profile details, body measurements, progress etc.
Alarms	User can set his personal alarms for exercise.
BPM	Beats Per Minute is the number of times the heart beats in one minute.
Calorie Counter	It will track the number of calories the user burnt based on the distance covered and how many left to reach the target.
Database	Place to store information. Stores the data of the user as a structured set.
History	Shows the previous data of the calories burnt/steps covered and if the user is working as per schedule.
Messages	Users can check some links of various exercise available in this option.
Profile	This includes the user's name, age, height, weight, profile picture(optional), email, gender etc.

Register	User can give username and password and register to use the mobile application.
Scheduler	Feature in the app to display the schedule of exercises for each month for ease of user.
Settings	User can change the profile settings like steps/calories target, distance measurement units, etc.
Smartphone	Portable personal computer with a mobile operating system with features useful for handheld use.
Step Tracker	A feature in app that tracks the number of steps completed and steps left to reach target.
Web Application	Web interface which the physician can use to access the patient data.

3 System Requirements

3.1 Functional Requirements

A requirement is defined as "a condition or capability to which a system must conform" [4]. A system may have a variety of requirements and these are often categorized to ensure better focus on each.

Functional requirements may be calculations, technical details, data manipulation, data processing and other specific functionality that define *what* a system is supposed to accomplish. These type of requirements are expressed in the form "system shall do <requirement>" for all the features that must be implemented, whereas features that are an optional addition are expressed in the form "system should do <requirement>". The priority weight assignment is based upon customer's essential requirements that must be satisfied. A higher number indicates that a requirement is more crucial for the project.

Table 2: Enumerated functional requirements for 'RU Healthy?'

ID	Priority Weight	Requirements
REQ-1	5	The system shall be able to obtain and process the information from the Android device sensors.
REQ-1a	5	The system shall be able to obtain motion sensor data and count how many steps the user walked during his/her last activity.
REQ-1b	5	The system shall be able to obtain the data from camera and compute BPM.
REQ-2	4	The system shall be able to store the data collected from the sensors in an offline database.
REQ-3	4	The system shall be able to compute how many miles the user walked, how fast his paces were and duration of travel.
REQ-4	4	The system shall be able to compute how many calories the user burnt based on his/her traveled distance and speed.

REQ-5	4	The system shall be able to complete a successful user profile registration.
REQ-6	2	The system should be able to give the user notifications about his/her current progress.
REQ-7	3	The system should be able to store the offline database to an online database.
REQ-8	5	The system shall be able to send a weekly activity summary to the Physician.
REQ-9	4	The system shall be able to deliver the patient all the important notes that the Physician wants the user to follow.
REQ-10	3	The Physician should be able to access the user profile to view account data.
REQ-11	2	The Physician should be able to edit/add/remove a user account.

The first thing to do in RU Healthy? is to create a user profile (REQ-5). However when it is time to link it with a doctor, how will the patient do that? Does he know a doctor? Does he prefer someone in particular? We thought about it, and we have come up with the following policy:

RUH-BP01: A prior connection between the patient/physician will need to be established through a physical visit that will allow the initial configuration of the app. That is, setting up initial information and linking the user's profile to the doctor's account.

We also analyzed the option in which the patient does not have a physician, and he/she could select the area and choose a physician of preference, or even the system could get the patient's current location and match him with a physician nearby. But what if after the blind selection, the user actually gets to know his/her physician and does not like him/her?. The user would have given the doctor records and private information that could expose him/her. So for now, we will be staying with our current business policy.

Once the physician selection through physical visit is complete, the primordial function of the system will be to obtain and process information from the camera and motion sensor every time the patient exercises. So in order to satisfy this, we have separated REQ-1 into two different processes: activity and heart rate, that is REQ-1a and REQ-1b. Without this, the system has no point and no future development.

Because the software will only use the internal sensors of the Android device, there is no way of continuously monitoring the heart rate. Therefore, we need to introduce our second policy:

RUH-BP02: The heart monitoring won't be a continuous feature. Instead, the patient will need to measure it manually every time he/she needs to.

The system will also provide additional metrics about the exercise, and we need REQ-3 and REQ-4 for this.

An optional feature that the system could have is to provide the user with updates on his/her workout every now and then while he/she is exercising. This is accomplished with REQ-6.

In order for the system to be successful, a communication between patient/physician is crucial. The physician needs to be able to monitor the patient's activity, so he/she can recommend or give him/her further indications. For this, we have REQ-8 and REQ-9. But what if the patient, besides sending the data to the physician, wants to be able to backup everything online? Imagine he/she gets robbed, or ends up losing their smartphone? REQ-7 makes sure he/she feels safe in this matter.

One more thing. The system will have no administrators. Nobody will control the creation or removal of user profiles. The physician needs to be able to access the user profile for reviewing purposes (REQ-10). However, he/she also needs to establish the following (in conjunction with REQ-11):

RUH-BP03: the physician can terminate the online account at any point if he feels that the patient does not need it anymore. The patient can choose to save his/her profile and data locally and keep using the app.

3.2 Non-Functional Requirements

Non-functional requirements are based on the environment and quality of the system-to-be. The acronym ‘FURPS+’ represents a widely used model that classifies software quality attributes. This set of attributes includes: Functionality, Usability, Reliability, Performance and Supportability. The ‘+’ symbol denotes the requirements to include design constraints, implementation, physical and interface requirements [4, 5].

The attributes related to ‘Functionality’ of our proposed system is enlisted in Section 3.1. Based on our study on existing applications, previous related works and informal survey on target customer population, we specify the non-functional requirements for our proposed system ‘RU Healthy?’ in Table 3.

Table 3: Enumerated non-functional requirements for ‘RU Healthy?’

ID	Priority Weight	Requirements
REQ-12	5	All information from sensors will be stored in the system database.
REQ-13	4	The interface of the mobile app will be easy to navigate. The patient shall be able to change between menus with minimal effort even when working out.
REQ-14	3	The system response shall be prompt to user’s command. Patient shall not feel delay between action (click) and reaction (system response).
REQ-15	2	The app should not crash if running for a long period of time.
REQ-16	3	Both the mobile and web application shall be intuitive, so that general experience with Android app will suffice to use the basic features effectively.
REQ-17	3	The app (mobile and web) should provide a help document to guide the patient and physician into initial registry of the system.
REQ-18	2	The app should disclose the degree of access it will have to patient’s phone and his information before actually starting to use it.

REQ-19	3	The patient information stored in the database of the application shall have a high-level security. Each patient will have access to his/her information only.
REQ-20	4	The physician will be required to protect the privacy of the patient. This means he/she will not disclose login information to his account to web application with others.
REQ-21	5	The system will prohibit manipulation of work-out data by the patient or the physician. All data stored in the database and presented by app will be collected from mobile sensors.
REQ-22	3	The patient should be able to stop the alarm/reminder from the app by starting his scheduled work-out on that time.
REQ-23	2	The app will stop running after sensing inactivity of the patient for a certain period to save battery life.

Usability Requirements

The concept of ‘RU Healthy?’ focus on providing a user-centered design and a satisfying user experience. The user interface, with its easy to navigate features and prompt response to command, will mark consistency for the user experience (REQ-13, REQ-14). The proposed requirement for an intuitive design on interface will ensure that anyone with experience of using an Android app will be able to accomplish their goal (REQ-16). Alongside that, the help document will be able to help a novice user (REQ-17).

Reliability Requirements

The app, with the amount of data processed during work-out, will be required to elicit adequate reliability. While the app is running for a long period of time, it should not crash with the data for the session being lost (REQ-15). Also, with all data obtained from the sensors and not from manual input, the integrity of the data will be ensured (REQ-21).

Performance Requirements

The performance of the system should be efficient, quick and accurate. The app thus needs to provide quick reaction to user command and operate as such (REQ-14). Once the user start working out, it should provide explicit feedback for the user to confirm response and availability (REQ-22).

Supportability Requirements

All information from the sensors will need to be stored for processing and analyzing of data. The processed data will be used for fathoming the progress of the user for a period of time (REQ-12). In addition to that, the resource usage by the app during idle time should be restricted (REQ-23).

Design and Implementation Restrictions

This portion of requirements sets the dimension for policies of database integrity, resource limit, etc. As a large amount of private information about the user will be available in the database, each user should only have access to their own information only (REQ-19). The physician is restricted to maintain confidentiality of the information regarding his/her patient as part of his professional confidentiality agreement (REQ-20). The integrity of available data in the database should be maintained by avoiding direct manipulation from any of the users (REQ-21)

3.3 On-Screen Appearance Requirements

The section below show hand-drawn sketches that demonstrate the user interaction.

3.3.1. Mobile Application

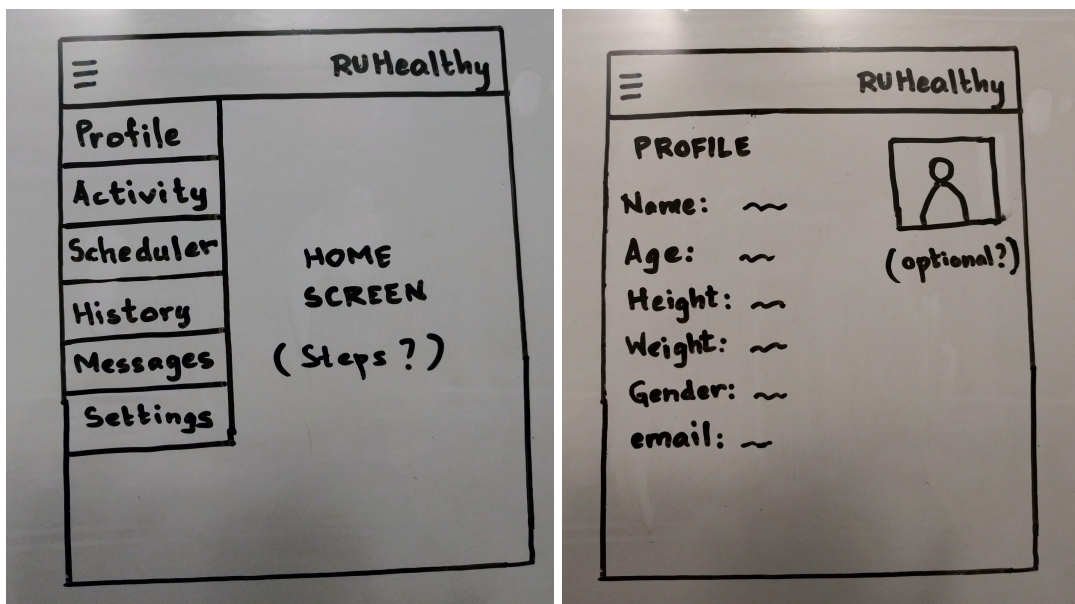


Fig 2: Options and User Profile

Figure 2 shows the available options on the mobile application. The user will be able to register and login. User's details will be stored to a database. Once the user logs into their account, they will be able to add details to their profile. This details include: age, height, weight, and gender and will be used to set a reasonable target for their activity. They can also provide their email for further communication.

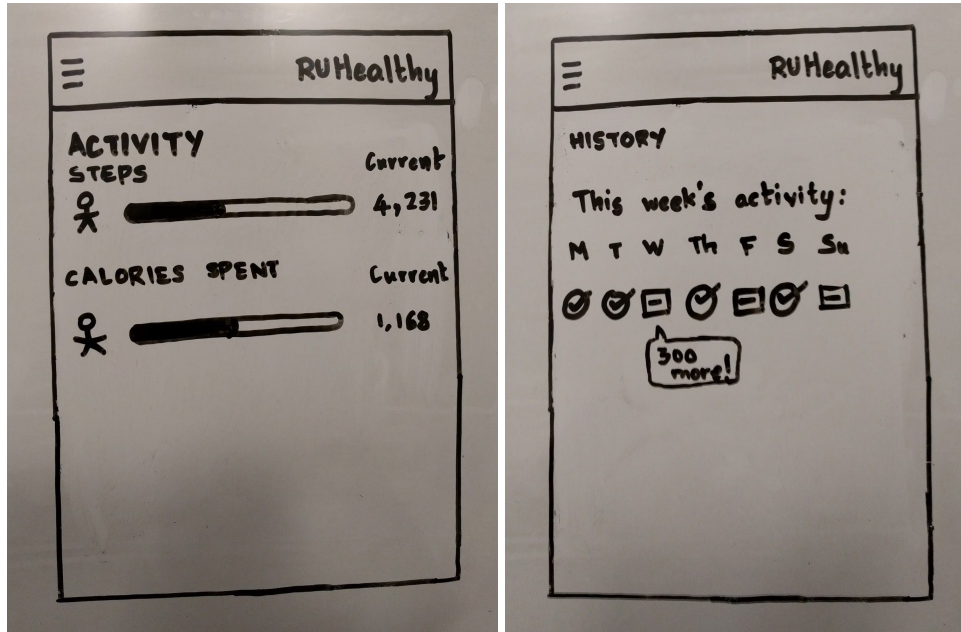


Fig 3: User Activity

Figure 3 shows how the User Activity will appear. The Users will be able to see their current progress for the day as a number and also as a graphic in comparison to their target. This includes the number of steps taken in miles or steps, the number of calories burnt (which will be calculated based on the profile details provided). Users will also be able to view a history of their activity as a timeline view, which highlights whether or not they have reached their target for each day.

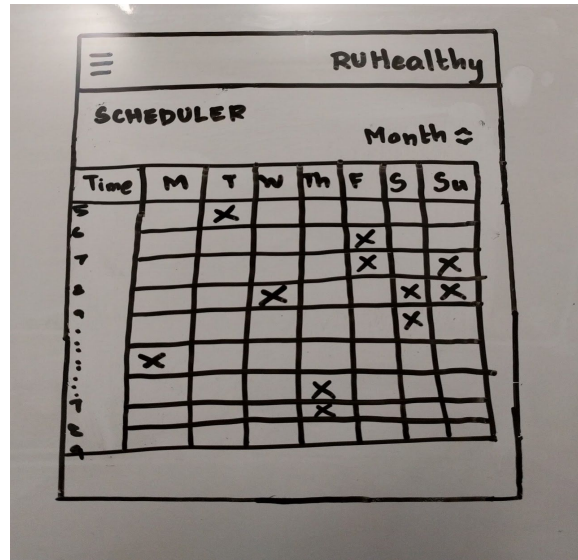


Fig 4: Scheduler

Figure 4 shows the Scheduler option. The Users will be able to mark some time of the day for exercise. The app then detects whether or not the User is performing any activity at that specified time. Since, we assume that the phone is on the user for the app to fully function, if the app detects the user being idle or lack of activity, it will remind the user that it's time for exercise.

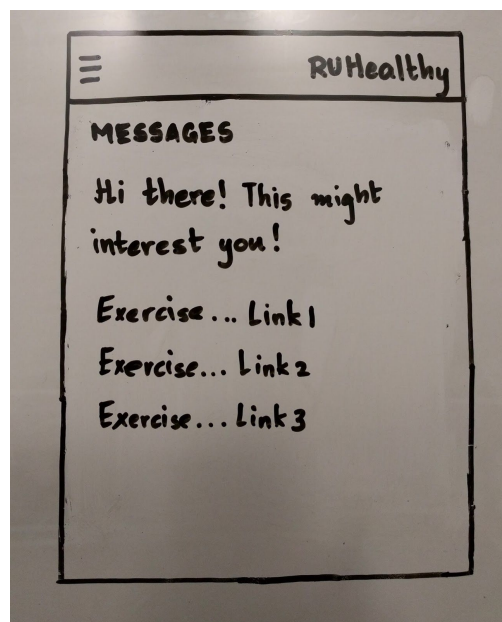


Fig 5: Messages

Figure 5 shows the messages option for the app which could include messages that have been auto generated based on the activity the user performs or it could be messages sent to the user by their physician/personal trainer. This may include articles or links to some related exercise options or those advised for that particular user.

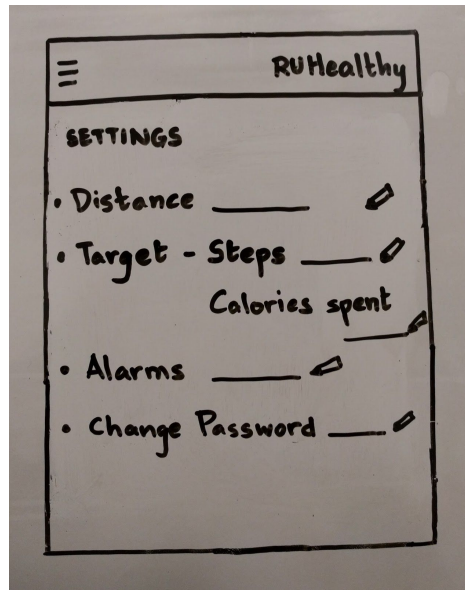


Fig 6: Settings

Figure 6 shows the Settings page of the app users may set their targets, reminder options etc.

3.3.2. Web Application

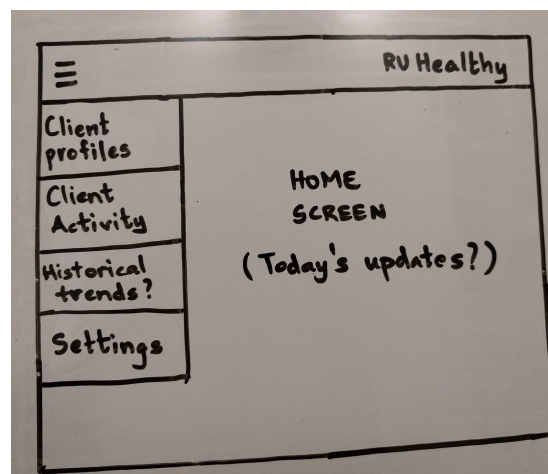


Fig 7: Options

We have also proposed a Web based application which will help the Users' physicians or personal trainers view their activity status. Let us call them admins. The admin will be able to register and login to the Web application. They can add or delete Client profiles i.e., details of their clients like, Name, age, gender, height, weight, BMI and possibly their health record. They will also be able to view Clients' activities. We envision that this information will help in better diagnosis and treatment and/or help clients lose weight.

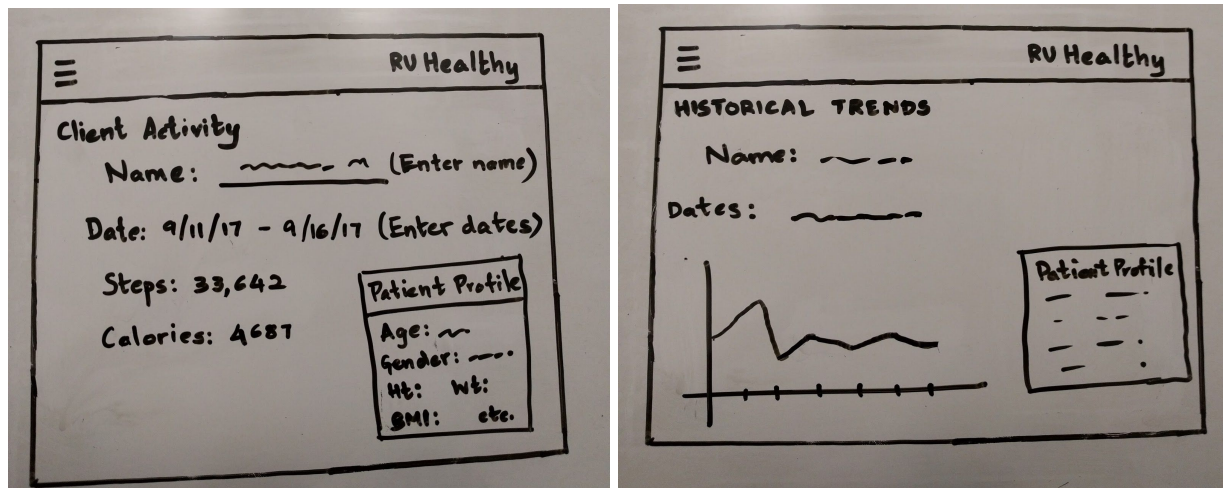


Fig 8: Client activity

Figure 8 shows how the admin will be able to view Client activity. This includes 2 pages, one to view activity and one to view trends in their activity. We may merge this into one page if that seems like a better and more user friendly view of the client's' activity. The admin is allowed to choose a specific set of dates and the User activity for that period is displayed on screen.

4 Project Management

Please note the the project management portion will be updated in later reports to include a schedule and timeline.

4.1 Basic Management

Team Leader: Tahiya

Primary Communication Method: WhatsApp

Meeting Time: Mondays, 5:00 pm to 6:30 pm

Meeting Location: Alexander Library

Document Repository:

https://drive.google.com/drive/folders/0B0NuB15TDP7_N2RaRk9BaUEyOTA?usp=sharing

Project Repository: https://github.com/karahbit/RU_Healthy

4.2 Tasks

Functional Tasks

- Research applications performing similar functions - **2 days**
- Create/include basic structure for phone application in Android Studio - **5 days**
(We may use code structure from a previously developed application)
- Create the mobile application with the basic features - **10 days**
(This includes registration, login, and entering user details such as height, weight, age etc.)
- Learn how to use phone sensors to collect the heart rate, distance walked, etc. - **4 days**
- Create database tables to store patient/user information and their records - **4 days**
- Plan and create structure for web application - **10 days**
(add basic functionalities like login and patient profiles)
- Sync the mobile application with the web application - **5 days**
(Try to find necessary libraries to send data to a server/database or sync with cloud and use the data)
- Add data view capability to the Web UI - **5 days**
(Query database to obtain user information when corresponding function is chosen)

Quality Tasks

- Merge code components - **3 days**
(Customer registration, data processing, data management, data transport, etc.)
- Use some gathered data to test the application - **4 days**

(Since we will have only a limited time to collect actual user data, we could use some relevant random values as data for the remaining duration of time)

- Test the web application with multiple mobile app users - **3 days**
- Do beta testing on application - **2 days**
- Make adjustments to optimize application - **2 days**
- Retest application with adjustments - **2 days**

4.3 Product Ownership

Tasks	Aymen	George	Tahiya	Himabindu	Tina	Ramya
Customer Registration			X	X		X
Data Capture and Storage	X	X				
Data Processing	X	X	X	X		
Web Development			X	X	X	X
Data management					X	X
Sending data to Android server					X	X
Non functional features	X	X				
Documentation	X	X	X	X	X	X

5 References

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- 5) <https://en.wikipedia.org/wiki/FURPS>
- 6) <https://www.merriam-webster.com/dictionary/obesity>
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