

# ECE1778H Final Report

## Creative Applications for Mobile Devices

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Word Count: 2498 words without Appendix and Table of Contents

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## Table of Contents

<b>1</b>	<b>Introduction.....</b>	<b>2</b>
1.1	Background.....	2
1.2	What is “U of T & Me” App?.....	4
<b>2</b>	<b>Statement of Functionality .....</b>	<b>5</b>
2.1	Home Page .....	5
2.2	Sleep Icons .....	5
2.3	Questionnaire .....	6
2.4	Detail Resource Page.....	7
2.5	Trends .....	8
2.6	Resources and Search .....	8
2.7	Set the strategy Page .....	9
2.8	Target Sleep Hours Tonight .....	9
2.9	Set Alarm Clock .....	11
<b>3</b>	<b>Overall Design .....</b>	<b>12</b>
<b>4</b>	<b>Reflection .....</b>	<b>14</b>
<b>5</b>	<b>Contribution by Each Group Member.....</b>	<b>15</b>
<b>6</b>	<b>Specialist Context .....</b>	<b>16</b>
<b>7</b>	<b>Future Work.....</b>	<b>17</b>
	<b>Appendix .....</b>	<b>18</b>
	<b>Permission .....</b>	<b>18</b>
	<b>References .....</b>	<b>18</b>

## 1 Introduction

Health promotion requires people to initiate and maintain health behavior changes, but changing one's health behaviors is a complex process, and new health behaviors are often not maintained [1] [2]. Promoting health and wellbeing in the university setting, has been a large focus at many universities, including the University of Toronto. The key focus of health promotion at the “Health and Wellness Center” has revolved around education and outreach focusing on increasing knowledge and skills in the area of self-care practices [3]. This project is an effort to promote self-care practices using a mobile app; particularly, for the students at the University of Toronto.

### 1.1 Background

In response to the increasing requests from students at the University of Toronto, a tool was developed to support them in making healthier choices on a regular basis. This paper tool is called the *Daily Self Care Log* (Fig 1), and was given to students during a workshop on self-care called *Healthy Habits*.

**health & wellness** **MY DAILY SELF-CARE LOG**

**FOOD CHOICES I MADE TODAY:**

Breakfast	
Snack	
Lunch	
Snack	
Dinner	
Snack	

**My food mood today:**

☐ satisfied ☐ just ok ☐ not happy ☐ help!

Tomorrow I will:

**Today's physical activity:**

Activity/ # minutes	Activity/ # minutes

Tomorrow I want to:

**TODAY'S STRESSORS**

Academics	
Friends	
Family	
Health	
Finances	
Job	
Other	

**My Mood Tracker:**

Today I felt mostly

Sociable	
Content	
Optimistic	
Curious	
Energetic	

What happened today to affect my mood?

**My Goals:**

My self-care goals for today were:

My end-of-day reflection:

My goals for tomorrow:

**My Sleep Record:**

Bedtime last night: Estimated hours of sleep:

Degree of sleepiness today: very ☐ somewhat ☐ none ☐

My sleep target tonight: Target bedtime tonight:

Bedtime routine tonight:

**My network:**

1) I ask for help when:

2)

3)

**Fig 1.** My Daily Self-Care Log

While the *Daily Self Care Log* tool has been well received by students, there are many reasons to believe that a mobile application may be more beneficial. Smartphones are more accessible for students and provide them with a more secure way of tracking their needs. In addition, it would help with the navigation of resources at a very large and complex institution like the University of Toronto. It could also customize information about services and programs according to a user's preferences or needs. More importantly, the mobile app is not limited in its ability to support self-regulation and the maintenance of new behaviors, and it offers a system of prompts or nudges and positive reinforcement. It is for all these reasons that we thought the *Daily Self Care Log* tool would be better received as a mobile application. The application would allow us to take advantage of the unique opportunities that a mobile app offers.

Apps are already widely used by students to help them to manage stress, engage in physical activity, improve their sleep, etc. Research, however, did not reveal any existing apps that incorporate all the various components, and include a database of U of T-specific resources.

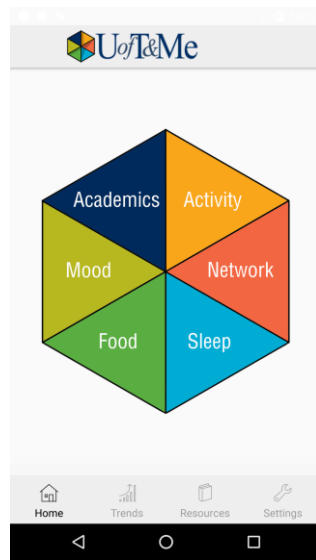
## 1.2 What is “U of T & Me” App?

“U of T & Me” app incorporates a comprehensive list of recommendations that would allow for personalized information to be made immediately available to students-in-need. The recommendations are customized depending on the data that is automatically gathered, and a student's responses to an initial questionnaire. Early in the development process our team chose to develop the application focusing on the sleep component of the health, in order to facilitate a deeper investigation into the possibilities. The final version of “U of T & Me” app; however, will provide a user with six different self-care categories: Nutrition, Physical Activity, Sleep, Academics, Social Network, and Mood.

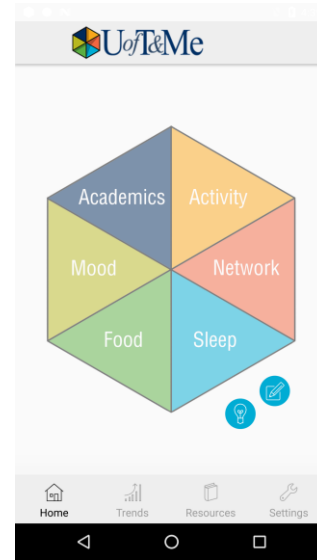
## 2 Statement of Functionality

### 2.1 Home Page

A hexagon consisted of six clickable components of health is displayed in the middle of the screen (Fig 1). Four buttons in the bar at the bottom of the home page allow convenient screen changes between options.



**Fig 1.** Home Page



**Fig 2.** After clicking on sleep

### 2.2 Sleep Icons

By tapping the sleep component, two new icons appear on the screen (Fig 2, 3). By clicking on “pen and paper” icon, the user will be allowed to report on his or her current state of exhaustion (Fig 4). Tapping on the “light” icon leads the user to “Set the Strategy” page (Fig 5).



Fig 3. Icons

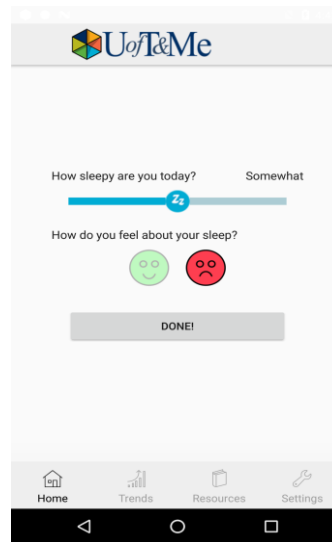


Fig 4. New Submission page

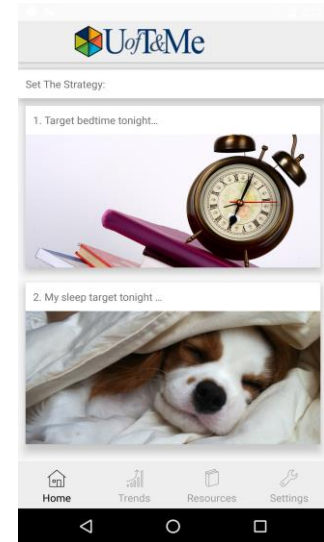


Fig 5. Set the Strategy

## 2.3 Questionnaire

After completing basic health report (Fig 4), a user has an option to answer a series of more detailed questions (Fig 6, 7). It includes personal inventories (Fig 6) and diagnostic questionnaire (Fig 7). Clicking on “Done” button at the end of diagnostic questionnaire automatically guides the user to comprehensive tips and suggestions in a list view (Fig 8).

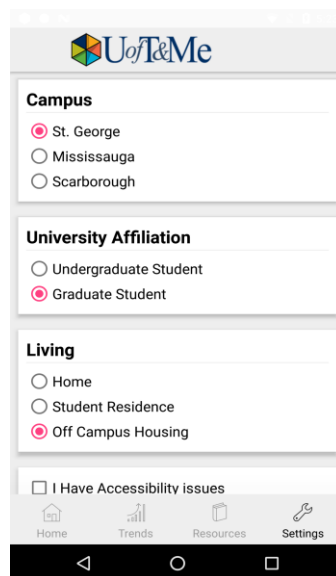


Fig 6. Set Personal Inventories

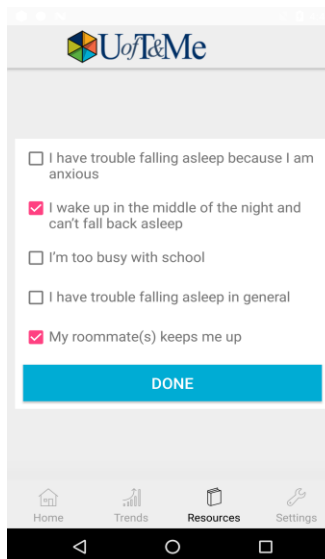


Fig 7. Detail Questions

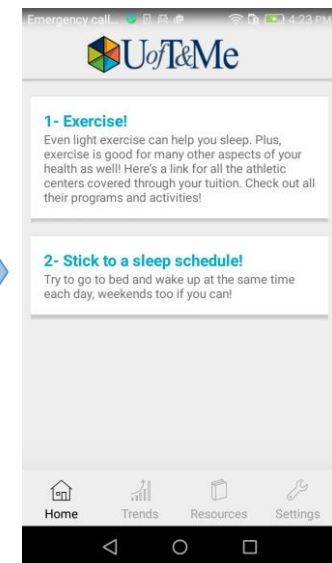
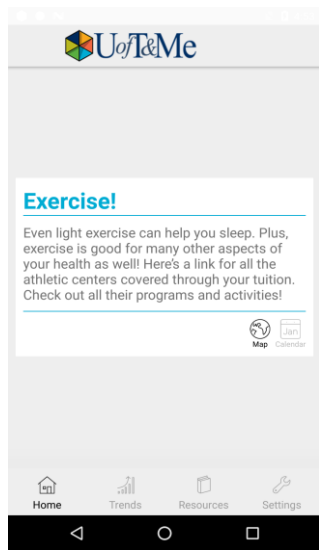


Fig 8. List of Recommendations

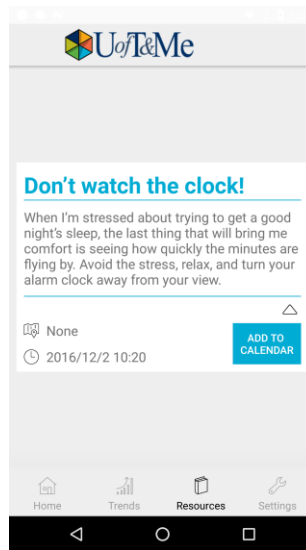
Moreover, a user can update his or her personal inventory at any time by clicking on “settings” (Fig 6). The personal data is significant in decision making for providing proper tips and recommendations.

## 2.4 Detail Resource Page

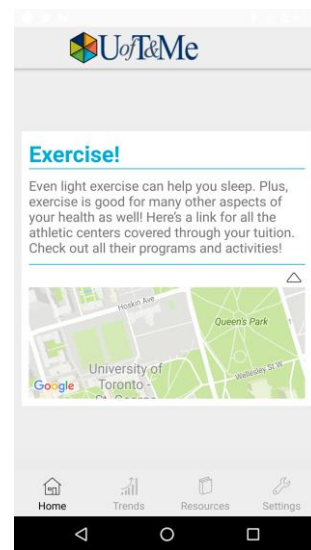
If the user click on each of the suggested items in the list (Fig 8), a detail resource view will appear, which includes a text message, a map, and an export-to-calendar link if necessary (Fig 9). As long as there is an up-to-date event in the resources, the event can be exported into the calendar (Fig 10). Furthermore, if a recommendation contains a specific place, the location is observable by clicking on the map (Fig 11).



**Fig 9.** Detail Resource Page



**Fig 10.** Export to Calendar



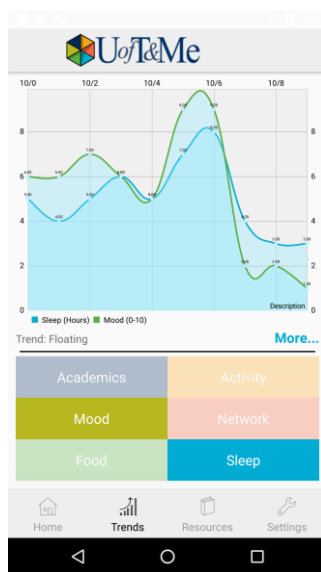
**Fig 11.** Location on the Map



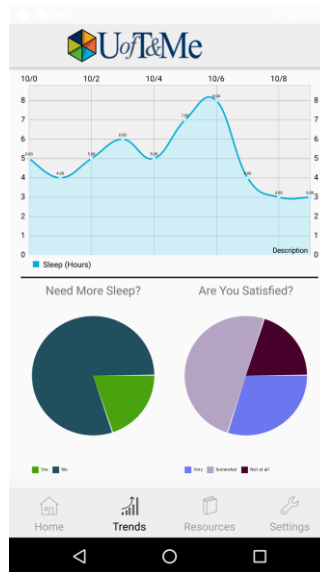
## 2.5 Trends

By tapping the trend button, the user can see an overview of his or her health components and investigate their relations (Fig 12). If they click on the “More...” button, a detailed overview of each component would be shown, including the overview of data which is gained from previous answers to questions (Fig 13).

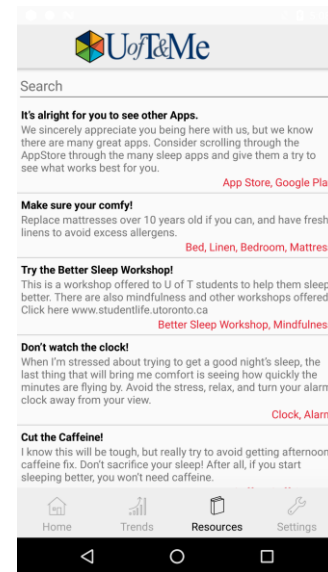
Note: Data in Figures 12 and 13 is only for the purpose of demonstration.



**Fig 12.** Trends Section



**Fig 13.** Detailed Trend View



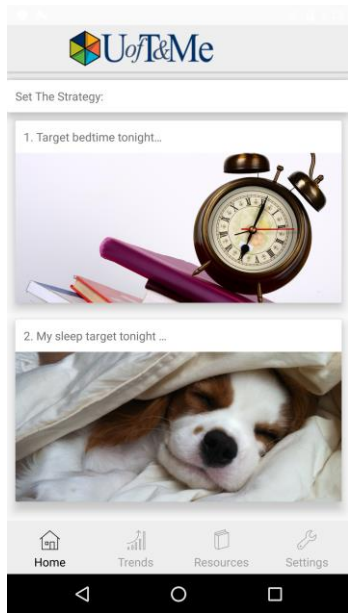
**Fig 14.** Resources and Search Tool

## 2.6 Resources and Search

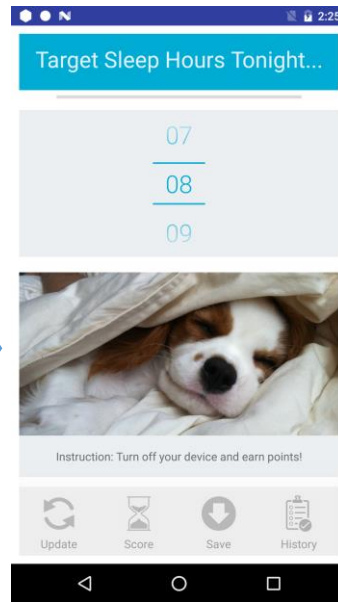
The resources section of the app provides all recommendations and resources available in the app. It offers a fast as-you-type search on both the keywords; which highlighted in red, as well as on their title (Fig 14).

## 2.7 Set the strategy Page

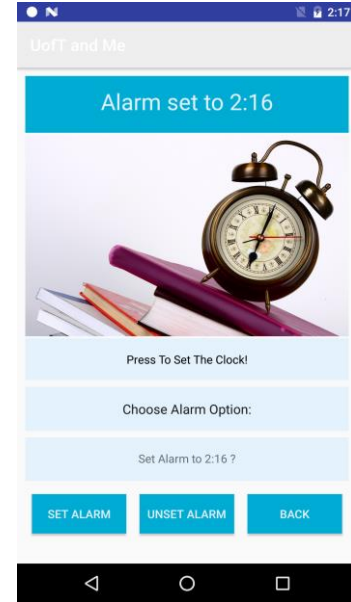
When a user choose to set the strategy by clicking on “light” icon (Fig 2, 3), a new page with two new options will open (Fig 15). The first option is the target bedtime. It offers alarm clock to notify the user at the time he will go to bed (Fig 17). The second option is “my sleep target tonight” which allows the user targets for hours of sleep tonight (Fig 16).



**Fig 15.** Set the Strategy page



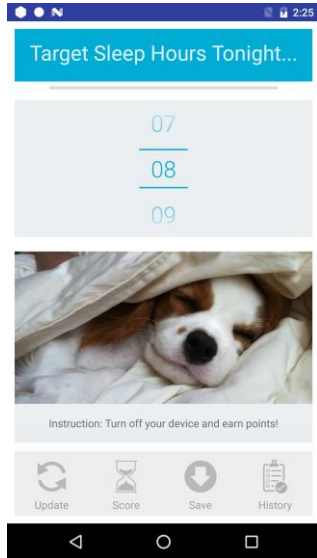
**Fig 16.** Target Sleep Hours



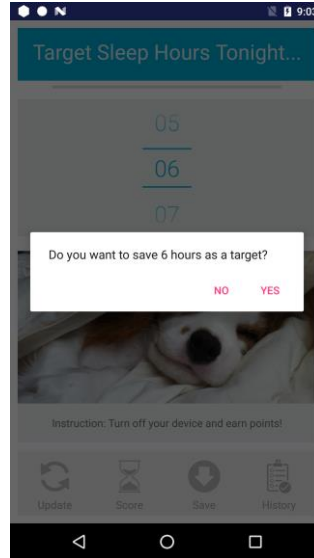
**Fig 17.** Alarm Clock

## 2.8 Target Sleep Hours Tonight

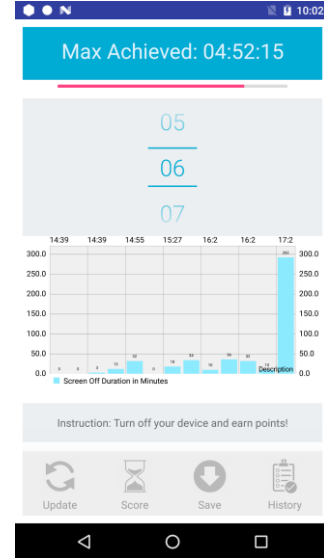
This page provides users with detail information about user's screen activity (Fig 18). A user can target sleep hours by clicking on “SAVE” button (Fig 18). By tapping on “UPDATE” and then “SCORE” buttons, estimated time spent sleeping during one day will be presented in “Max Achieved”; simultaneously, detail screen activity is illustrated in the bar chart (Fig. 20). In addition, progress bar compares the target sleep hours with estimated time spent sleeping (i.e. red line in progress bar shows estimated sleep time 4:53:15 against 6 hours target sleep time in Fig. 20).



**Fig 18.** Target Sleep Hours



**Fig 19.** Set the Target hours



**Fig 20.** The Score

A user can also observe the history of his or her past sleep activities. By clicking on “History” button, the color-coded list of past month estimated sleep hours will open (Fig. 21). Each item in the list shows the sleep time against the sleep target of a day. The intensity of the blue color will show how successful the user is to achieve his goals. For example, the first item in Fig.21 shows 10 percent achievement with very light blue color while the second item shows 100 percent achievement with very dark blue. In addition, clicking on each item opens the detail view (Fig. 22, Fig 23). Detail view page illustrates goal, achievement, estimated sleep time, detail bar chart and finally trend of estimated sleep in one-month period (Fig. 22, Fig.23).

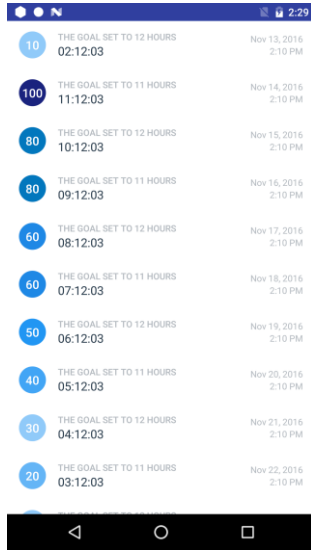


Fig 21. History List

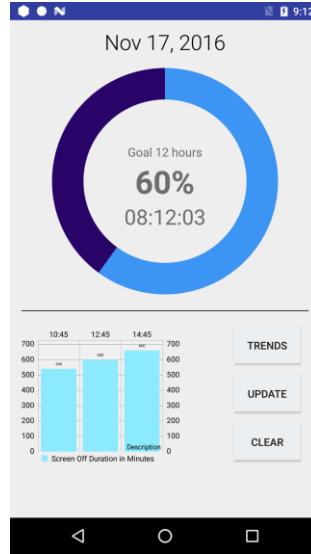


Fig 22. Set the Target hours

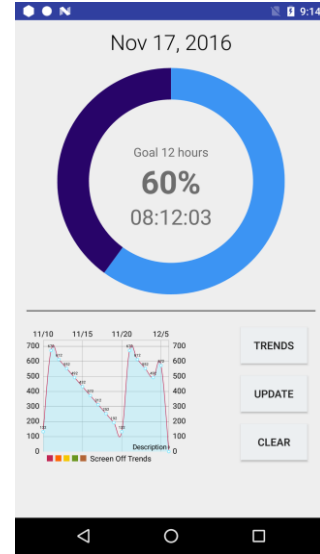


Fig 23. The Score

## 2.9 Set Alarm Clock

User can set the bedtime using alarm clock (Fig 24, Fig 25). The app will notify the user that “it is time to go to bed” (Fig 26).

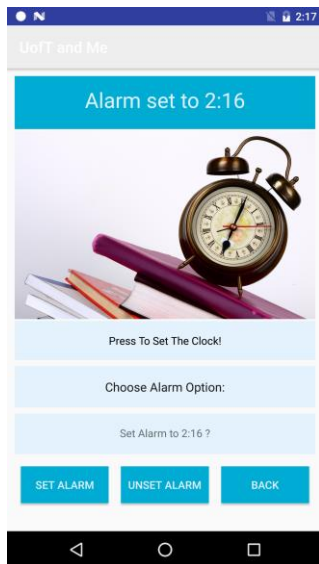


Fig 24. Alarm Clock

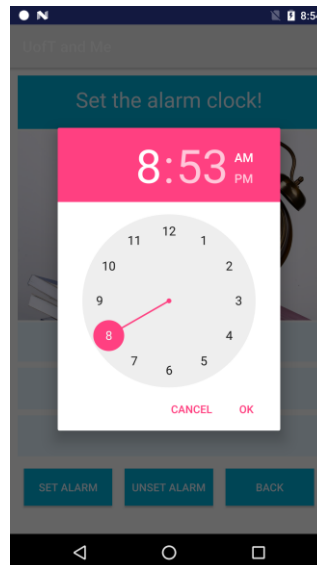


Fig 25. Time Picker

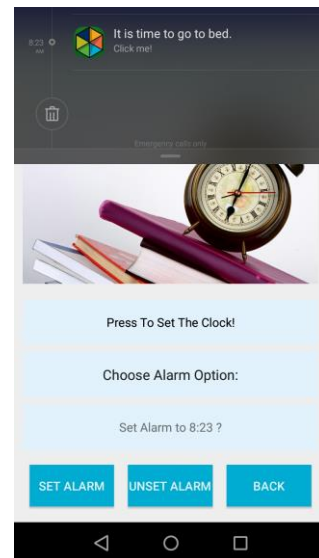


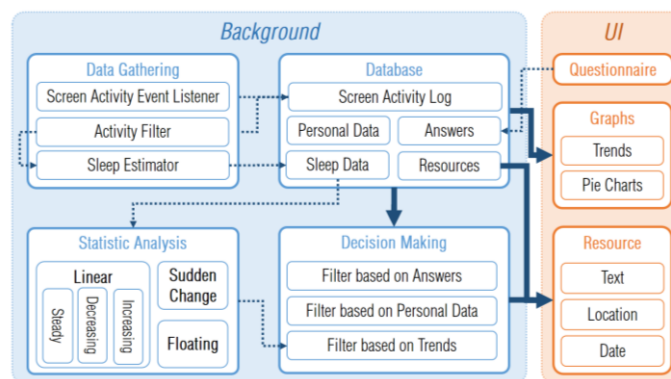
Fig 26. Notification

### 3 Overall Design

Upon installing the application, it constantly monitors the time when the screen is turn-on or turn-off and log those data into files, even when the application is not open. Each time the user opens the app, all data in the file is exported into a Realm database and the sleep time for each day is estimated based on the longest continuous period of the screen being off during one day. As the user might have a brief look at the phone during the night, i.e. for checking out the clock, any screen-on activity less than 3 minutes will not be considered in the previous calculation.

The database stores all information about a user via the personal inventory (i.e. level of study, campus, housing, etc.), answers given to questionnaire and daily achievement in completing the sleep target set earlier. But more importantly, all resources, tips and information that should be presented to different users are hardcoded into this database, as well as the criteria that help determine when a specific tip is relevant.

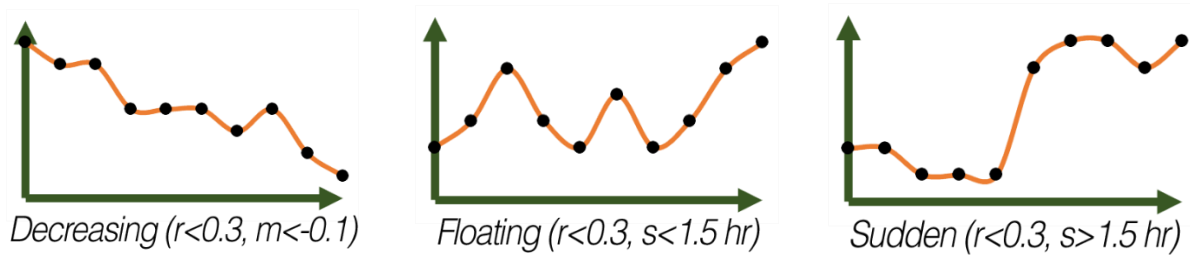
When a user seeks advice, by sending a new submission, he or she would be asked a series of diagnostic questions. The software will choose a few tips that are catered for that specific problem the student is facing, based on the answers to diagnostic questionnaire, personal inventory, and the trend in his health (in this case, hours of sleep).



**Fig 27.** Structure of Software

The trends in user's data is identified using basic statistics. If the data is showing any linear trend, the magnitude of "Pearson product-moment correlation coefficient" [4] would be bigger than a threshold (e.g. 0.3). In that case, the linear regression will be calculated and the slope will be used. If not, the software will look for a sudden jump in data, by comparing average sleep time of the first and second half of the last 10 nights. If there is a significant difference (e.g. 1.5 hours), the data is showing "sudden change".

If none of the aforementioned statements are through, the app will label the trend as "floating". This trend can be incorporated in selection of tips and resource. For instance, when the person's hours of sleep is constantly low, the possibility of it being a side effect of stress is eliminated, as stress will create a floating sleeping pattern based on each day's mental workload clearly there must be difference in sleeping pattern, at least on weekends.



**Fig 28.** Sample sets of data and how the code determines the trend.

Incorporation of the personal inventory into the decision-making process for showing tips ensures that the irrelevant tips are eliminated. For example, a graduate student who is also a parent will need a lot of tips and suggestions that is not useful for an undergraduate student. Or a person who is living in her parents' house, would not need tips that are pertinent to dealing with roommates.

## 4 Reflection

One of the key learnings in this project is the emphasis on creativity during the app development. In this project, we revisited specifications and asked if “there is a better way of doing requirements”. For example, in the beginning of the project app directly asked the user “How many hours did you sleep last night?” while at the end of the project application automatically estimates hours of sleep by tracking screen activity of the user. Furthermore, the statistical analysis was not part of the requirements in the beginning. However, by the end of this project, analysis runs on the data and predicts the trends of sleep. It feeds into decision-making block in order to provide more accurate resources and suggestions.

Furthermore, since we aimed at an attractive design to enhance user experience, we had an extensive learnings for developing a good UI. It includes the interface that visualize students’ data such as well-designed lists and graphs and linking locations to Google Map etc.

## 5 Contribution by Each Group Member

Section		Mohammad Owlia	Farshad Safavi	External Specialists
<b>UI</b>	Home, New Submission, Detailed Questions	X		
	Health Components Trend, Detailed Figures, Personal Inventory	X		
	Detailed View of Each Tip (Map, Calendar)	X	X	
	Setting New Strategy, Target Sleep Time		X	
	Previous Sleep Data, Trends, and Graphs		X	
<b>Functionality</b>	Storing Resources, Criteria, and Keywords	X		
	Gathering/Storing Sleep Data (Screen On/Off Log + Filtering)		X	
	Alarm, Notification, Setting Goal, Scoring Goals,		X	
	Search Functionality		X	
	Statistical Analysis and Deciding What Tips to Show	X		
<b>Resources</b>	Idea, Gathering Data about Resources			X
	General Design and App's Flow	X	X	X
	Designing Questionnaire			X



## 6 Specialist Context

Development of the app was based on an established tool called the Daily Self Care Log [Fig 1]. This tool was designed to support students at the University of Toronto to make healthier choices on a regular basis. The tool encourages students to reflect on their current health choices or practices in four key areas: stress management, sleep, nutrition, physical activity. It then asks students to reflect on their mood, and to take note of any possible connections between their tracked activities and mood. Students are encouraged to use the tool on a daily basis, looking for trends, interconnectedness of their tracked activities and their mood over periods of time.

The team chose to focus on the “sleep” component of a student’s health. The app needed to perform all of the functions of the existing paper tool, in addition to other key functions including: personalized information, tips and suggestions dependent on ones identified area of need, opportunity for goal setting, prompts and reminders to follow through with these set goals; positive reinforcement or rewards when goals are achieved, easy demonstration of the interrelatedness of the various health areas (i.e., sleep and stress); and support in navigating resources at the University according to one’s needs. These key functions were all achieved within the “sleep” category. The app automated certain tracking functions, such as hours of sleep each night, it allowed users to set a *goal bedtime*, *goal number of hours* of sleep and set a reminders or prompts to achieve this outcome. The app also customized a list of resources and sleep hygiene strategies according to the user’s personal information or data, but also allowed the user to opt to search the full database of resources and strategies. The app tracks the user’s sleep each night over periods of time, and if all other components were fully developed, would allow for easy assessment of the interrelatedness of sleep and other health behaviors and mood.

The UofT&Me app, when completed, could be an important tool, supporting students at the University of Toronto to make healthier choices on a regular basis. The app is simple enough that students could download it and use it independently. It also has the potential to be applied in the clinical setting by health practitioners in order to regularly counsel students on general health behaviors. This app could provide health care practitioners with important self-reported client data, as well as allow for facilitated discussions regarding goal setting and implementation with their clients.

## 7 Future Work

The current project concentrates only on sleep activity as the first step toward developing UofT&Me application. The app could be augmented by adding more health components such as nutrition, academics, physical activity, and so on. Adding new health components could include exploring methods for automated data gathering; for instance, adding pedometer for physical activity; or, tracking time a student spends in a library or classroom for analyzing academic activity. Additionally, the application could be improved by adding a feature which notifies the user in real-time for various events happening on the campus.

Finally, considering the size of the application and its usage, regressive testing and validation process on the software is necessary in the future. Moreover, pre-releasing the primary version of the app to students and measure their response and incorporating their feedback will enhance the quality of the application in the future.

## Appendix

### Permission

Permission for posting following material on course website:

<b>Section</b>	<b>Mohammad Owlia</b>	<b>Farshad Safavi</b>	<b>Geoffrey Hartin</b>	<b>Judy Vorderbrugge</b>	<b>Laura Duncan</b>
<b>Video of Final Presentation</b>	agree	agree	agree	agree	N/A
<b>Final Report</b>	agree	agree	agree	agree	agree
<b>Source Code</b>	agree	agree	N/A	N/A	N/A

### References

- [1] P. R. C.-B. POLLY RYAN, "Integrated Theory of Health Behavior Change Background and Intervention Development," PMC, May-Jun 2009. [Online]. Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2778019/>. [Accessed 13 12 2016].
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- [4] Stigler, Stephen M (1989). "Francis Galton's Account of the Invention of Correlation". Statistical Science., 4 (2): 73–79. doi:10.1214/ss/1177012580. JSTOR 2245329.