

# NavFeel

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<b>Brief Abstract</b>	<b>1</b>
<b>Introduction and Problem Definition</b>	<b>1</b>
<b>Current State of Art and Research</b>	<b>2</b>
<b>Architecture</b>	<b>5</b>
<b>User Studies and Evaluation</b>	<b>9</b>
<b>Conclusion</b>	<b>18</b>
<b>References</b>	<b>19</b>

## **Brief Abstract**

There is an increasing number of smartphone users and mental wellbeing applications being made available. Studies have revealed the potential benefits of these applications. One such study conducted by Tara Donker, PhD states in its findings that, “Usability, helpfulness, and satisfaction ratings, where assessed, were moderate to high [11,23,25], indicating that mHealth [mobile health] apps are perceived to be a useful vehicle for enhancing access to evidence-based monitoring and self-help”(Donker). The system not only allows users to monitor their emotional state, but also let users search to find which locations, type of weather, and times of the day may be associated with which emotions. Furthermore, the system includes a recommendation system which extracts information from these data streams. The system suggests different locations, types of weather, and times where users have felt positive emotions.

## **Introduction and Problem Definition**

### **User Expectations:**

First, the application NavFeel provides users with a secure login. Upon login into the system, users are able to create a new micro-report entry or view previously made micro-reports via search or listed by calendar date. When users make a new entry they are required to input two things. First, the user must click an emoji which corresponds most closely with their current mood. Second, the user must choose the intensity of their selected emotion with a slider bar. Optionally, the user may input text which may be parsed for keywords/phrases.

### **User Need:**

Users of NavFeel need insights into how they feel over time (what they feel, when they feel, and where they feel certain emotions) as well as what things may be contributing to their feelings (why they feel). The search feature lets users express their need by querying their micro-reports. Users may search through their micro-report entries for different emotions, weather, date, and text-entry.

Recommendation-based mobile applications have shown to be effective, especially in the field of mental health. “the conclusions of most of the studies on BPD or on other psychiatric disorders assessing the same issue, and this shows that the subjects using smartphones for mental health outcomes usually report a high degree of satisfaction.” (Prada). NavFeel aims to help close the gap in the market for mental health tracking and improvement.

### **Information Presented to User:**

The search feature presents users with a list of their entries relevant to their query.

The recommendation feature presents users a list of positive (happy or calm) locations, weather, and times. This information is extracted from inputted user micro-reports. The goal of these recommendations is to satisfy the user's need of knowing where they feel most at ease.

## **Current State of Art and Research**

In this section, we will discuss some of the work which has already been done to bridge the gap between technology and mental health treatment. We will examine the findings of researchers in the field, as well as existing mental health wellness applications which have proven to be successful.

### **Research in the Field of Mental Health**

#### *The Brighten Study*

Let us first examine the work of Dr. Patricia Arean and the Brighten Center lab so we can understand and answer the question of, "Why treat mental illness through mobile apps?" Dr. Arean and her team studied the effectiveness of treating depression without the traditional face-to-face psychiatric treatment (Arean). They concluded that there are multiple benefits for treating patients in this way: First, access to treatment is much easier. Most people now have mobile phones, making distribution of treatment much easier, thus allowing more people to be treated. Dr. Arean's team also found that they could reach a much more diverse group of people. Second, the costs of treatment are also much lower. In-person treatment often takes a considerable amount of time. With mobile phones, treatment is accessible wherever the patient might be. While Dr. Arean and her team found that these are very beneficial effects of using mobile devices as a treatment platform, there were also consequences as well: without the human element of traditional treatment, patients often would "drop-out" of their programs by not interfacing with the application as often as was intended.

#### *Interest in Using Smartphones to Monitor Mental Health*

In a 2014 study by Torous, Friedman, and Keshavan, it was discovered (as with the Brighten study above) that most people — about 72% — carried smartphones with them (Torous). However, the researchers also discovered that around half of those they surveyed would be interested in receiving mental health treatment via their smartphones. In their conclusions the researchers note that mental health clinics would only need to provide applications to their patients, and not smartphones themselves, making treatment relatively inexpensive. It is also noted that this approach would most likely prove very effective, since "aiding diagnosis, personalizing patterns of emotions and behaviors, empowering patients to partake in care, and providing a low-cost adjuvant to treatment" are already well understood in the mental health community. However, the researchers also note that *implementing* these well understood methods in the realm of digital technology is not well understood, and would need additional research and experimentation to justify.

In the following passages we examine some successful mental wellness applications which are similar to NavFeel, and have proven to be invaluable in creating our own designs and ideas.

## **The State of the Art**

### *Stigma (Related System)*

To begin with, the application that we found related to our project the most was Stigma. Stigma is an iOS application that allows you to journal as well as track your moods throughout the day. It also allows you to input the location of your entries as well. The company's main goal is to provide "a safe way to build your support network, journal what's on your mind, and keep track of your mood" for those who struggle with their mental health. Based on the application description in the App Store, the company boasts of four key features: the ability to "Build Your Own Network", "Reflect On Your Day", "Track Your Progress" and "See What Impacts Your Mood" (Stigma, Inc.).

In this section, we will provide a more detailed explanation of these four key features. In terms of a user building their own network, Stigma gives users various opportunities to connect with others. Users can find "PenPals", others who may struggle with similar issues that they can find and talk to. There are also "Support Groups", which users can join based on similar interests. Lastly, there is a "Community", where people can share their journals and in turn receive, as well as offer, support. Users can "reflect on [their] day" by writing quick and simple journal entries as well as view a "Mood Calendar" that reflects their moods visually by coloring each day with the most dominant mood entered for that day. Users can further track their progress by viewing a "mood graph" to see how their mood changes over time and a "word cloud" which shows what words users write the most in their entries. Finally, users can see how exercise, location and other factors may affect their mood (Stigma, Inc.). Some aspects of this application are reflected in NavFeel, but we provide a way to use this data to positively change users' lives.

NavFeel focuses on giving the user a way to see how their location, weather, and other data may affect their emotions. It does not focus on creating connections with others, but allows one to have a diary of their feelings and be given recommendations of other places based on their own personal data, not others'.

### *Daylio (Related System)*

Yet another application that applied many of the concepts we intended to have in our system was Daylio. Daylio, an android application, similarly allows users to log in their personal moods and activities with an emoji database, providing text as an optional entry. On the whole, the application provides the user with statistics of their entries to analyze their moods and activities, a calendar to track one's entries, and a very simple way to input an entry. A key feature of this application is the ability to keep the diary private, as well as an introductory statement claiming all the data inputted belongs to the user ("Daylio - Diary, Journal, Mood Tracker - Android Apps on Google Play").

Daylio's main focus is to provide a personalized electronic mood diary for the user. It does give users the possibility to share info, but it is intended that this information is kept as private as the users may want it to be. Not only that, this personalized data is backed up via a private Google Drive. The application utilizes the personalized data in various ways, providing monthly mood charts, a mood and activity count, an average monthly mood, the longest mood streaks, and finally, what moods are paired with certain activities the most (Daylio). However similar, NavFeel has other aspects different from this application.

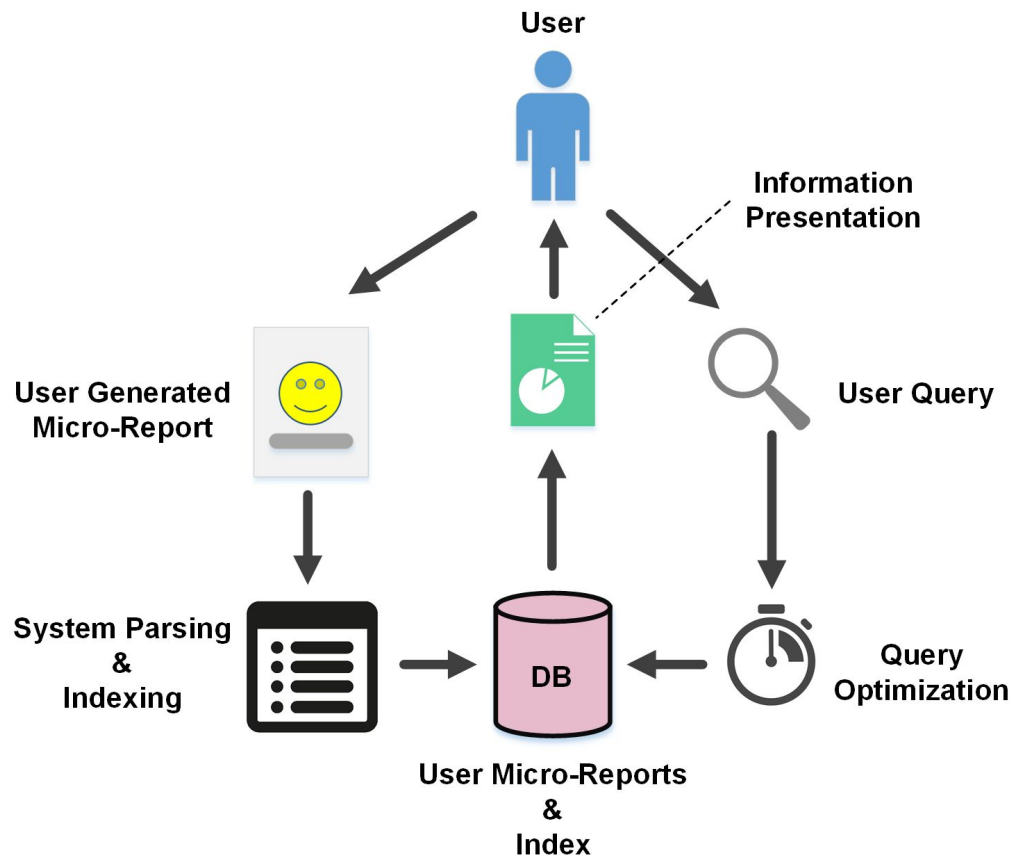
Though some aspects of NavFeel are similar to the applications above, NavFeel's is an application that allows you track your mood and location and provide you with recommendations based on your data. NavFeel has a similar new entry format to Daylio, as there are five emotions that the user can choose from to add an entry, but they are also provided with a scale to measure that mood. With more accurate data such as this, NavFeel provides ways that one can improve their moods, by showing a list of locations, weather, and dates where they were in a positive mood. It provides users with a way to truly use the data in a way that can positively affect their lives.

#### *T2 Mood tracker (Related System)*

T2 Mood tracker is an existing mobile application that lets users input their emotional state via sliders and offers users optional text input journal entries. The most exceptional feature of this application is the automatic generation of line graph reports which show different emotions and their intensity over time. Nigel E. Bush studied returning military personnel with PTSD who used T2 Mood Tracker. Bush found, "T2 Mood Tracker offers a flexible and easy-to-use behavioral health self-monitoring and recording tool that is highly portable, simple to use, readily accessible, and, we believe, acceptable by military service members and providers"(Bush). This study supports the idea that mood tracking applications can be beneficial to people struggling with their emotions. It should be noted that one user had tremors and utilized voice input which is a stretch goal for the proposed NavFeel application.

A key feature of NavFeel is that it provides a recommendation list of weather, location and date to the user. These recommendations, of course, come from the user's personal input, so the possibility of the application not being sensitive to the user decreases. However, as a possible stretch goal, NavFeel would like to present possible activities the user is comfortable performing. One of the down sides of mobile applications that provided mindfulness recommendation exercises is that the users felt like the app was not being sensitive to the conditions of the user. For the mobile application "Headspace", a mindfulness meditation app, some users felt like it could take more into account the routines they perform on a daily basis. "A central concern for users was how to fit their use of the app into their busy city lifestyles. Participants explained that their busy lives were a significant factor in limiting their app usage." (Laurie) This means more engagement can be made by allowing users to choose the level of interactivity the recommendations NavFeel provides. Many people live busy lives and do not feel that they can spare a second more than is necessary to perform a certain task.

## Architecture



A.1) Diagram of system component interaction

The diagram above (A.1) shows the high level interaction between the different components of the NavFeel system. The User only interacts with three components of the system: the Micro-Report Generation component, the User Search Query, and the Information Presentation component.

In the Micro-Report Generation stage the user is presented with a list of emotions that they can choose to report on. After the user selects an emotion they are presented with an intensity scale and an optional text box. These micro-reports are sent to the Indexer for Parsing and information extraction. Once this stage is complete the data is placed into the Database. This describes the whole process of creating and submitting a micro-report through the NavFeel interface.

In the Information presentation component the system presents the user with the results of the query page ranked by the different parameters included in the search (Emotion, Weather, keyword). If we continue work on NavFeel, we will explore displaying the average emotional

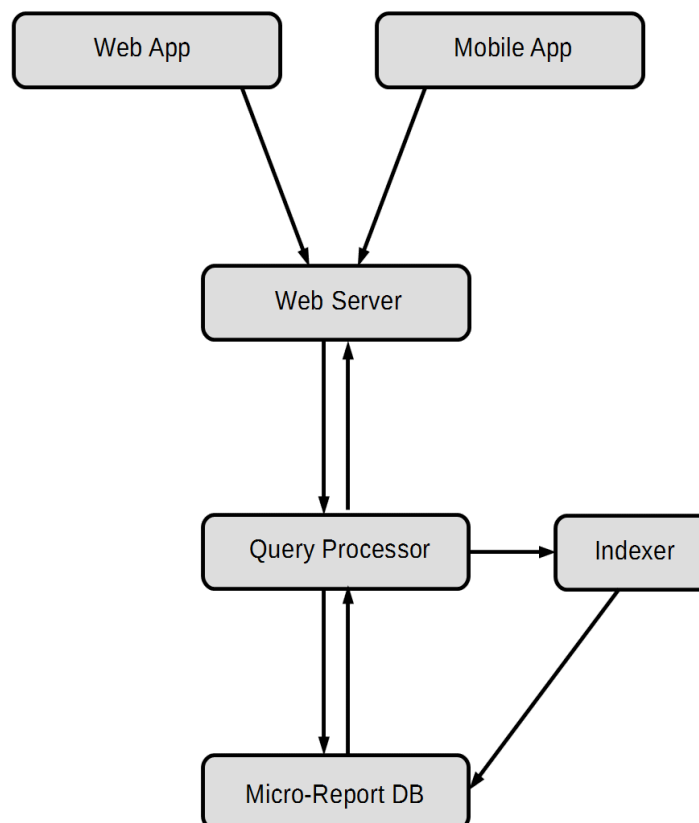
state over a certain period of time (e.g. day, week, month, etc.) and queries that allow a location parameter. The user could also decide to be presented with different recommendations for activities that help them reach their emotional state goal.

The components that the user never interacts with are the Parsing & Indexing component, the database, and the Query Optimization component. These three parts of the system can be thought of as existing in the middle and backend of the NavFeel system.

## Query/Input Environment

For the query input, the user navigates to a search page that allows the user to input the data to search via three inputs. The user is able to search for five different emotions (happy, sad, angry, calm, stressed) and weather (humid, cloudy, sunny, clear) via a drop-down menu. The user can also search for any optional text input via an open search-input, meaning the user can type in a few keywords relevant to the entries they want in order to find them. Of course, the user is not required to use all three search inputs in order to retrieve their results, but a combination of such. They must tap on the large search button, indicated by a large search icon, in order to send their query and obtain their results.

## Details of Components



## A.2) Software Abstraction Architecture for NavFeel

The diagram above (A.2) shows a high-level architecture description of the different software components that have been implemented in the NavFeel system.

The Mobile Application component was implemented using the Android ecosystem; this is mainly because it required a lower bar of entry to implement. This required us to utilize the Android APIs along with Java to implement the mobile application. The Mobile Application requires a Web Server which handles all user requests coming in from the mobile application and directs said requests to the Java Servlet. The servlet then parses and passes the query to the MySQL database.

A minimalistic Web Application component was implemented alongside the web server. This web app acts as an alternative user interface. If we were to make the web app available to the public, we would add JavaScript, and CSS styling to make it comparable to the Android application styling. If the application grew beyond the size of a small project we would need to account for load distribution since the server would be responsible for handling requests from the web application as well as the Android application.

The Tomcat Web Server was chosen because it is free, open source and allows us to run Java servlets. However, it could be replaced in the future if a better alternative is found.

The Query Processor (Java servlet) sanitizes (prevent malicious queries to the backend database) and also processes and optimizes valid query requests. Whenever the user creates a micro-report the Java Applet is also responsible for sending the micro-report to the indexer. The Query Processor also is responsible for handling the logic required to create a new user account. If the web application is implemented, it will also be necessary to incorporate logic to handle the state of the user i.e. stateful user sessions.

The Indexer (also to be implemented as a Java servlet) handles the parsing and extraction of information from the user generated micro-reports. Once the indexer has processed all of the data it is sent to the database for storage.

The database stores the user account (login, password) information, as well as the micro-reports generated by the users. The index is also stored in the database. The database was implemented using MySQL. We decided to use MySQL because some group members had prior experience with it. If we were to continue work on NavFeel, for extendibility and efficiency, we may consider switching to PostgreSQL/JSON format.

### **Input:**

Data Sources for Report (Episodic, user determined intervals):

- 1) User Input (Required) - Emoji Selection
- 2) User Input (Required) - Emotion Intensity Scale
- 3) User Input (Optional) - Text Box Entry



- 4) Time Stamp
- 5) Geo-Location
- 6) Weather
- 7) Stretch Goal: User Input - Photo
- 8) Stretch Goal: User Input - Sound Clip Voice Recording (Parsed to text)

**Output:**

Recommendations - Suggested locations, weather, and time based on previously generated micro-reports along with emotions/descriptions of the environment which may elevate the user's mood.

Filtered search results - All entries are searchable via their associated emotion, time and date of creation, geolocation of user upon creation, weather upon creation, and are ranked based on intensity and relevance. Examples of user queries may include: search for "Happy" entries, "Sunny" entries, or entries near "Long Beach".

**Information Extraction:** Query processing requires extraction of information such as: location, weather, past user entries, and possible user text-entries.

In order to extract locations, we used the Android GPS.

In order to search past user entries, we used the Android system to extract time and date.

In order to extract the weather information, we used an open weather API.

In order to search a user's text-entries, we utilized a Twitter API in order to obtain data for user text-entries. We queried the Twitter API for sets of words relating to each of the five emotions (happy, sad, angry, stressed, calm) which are part of our system. We then processed the results, eliminating any garbage text, non-english text, and hashtags, yielding hundreds of text snippets that correspond to the five emotions. Lastly, we inserted that data into the MySQL database as a part of the user's emotion journal reports. We also made our own entries to help test our application.

**Indexing:** We used an inverted indexing structure in our application. For example, suppose we have two entries for Ayala library, one with a happy emoji and one with a sad emoji. Each entry is a "document" with "Ayala library" and "X emoji" being a term. We then have a fast way of indexing key terms the user requests.

**Matching:** We match the documents with the most key terms first. Using our above example, say the user queries: "Ayala library \*sad emoji\*", While this query matches "Ayala library" twice, it only matches "Ayala library \*sad emoji\*" once, making it our top choice.

**Presentation:** Users are presented with locations which are matched with either keywords or emojis. These locations are ordered by: Number of relevant terms matched, frequency of visits, and proximity to the user.

## User Studies and Evaluation

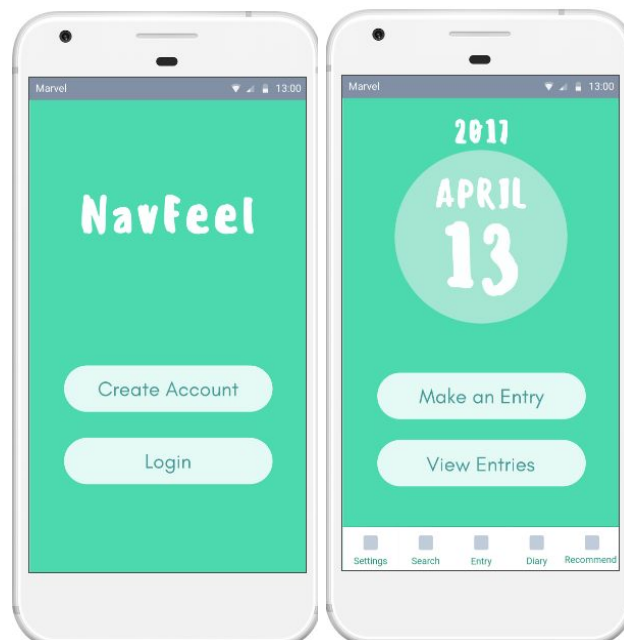
During the development process of our project, we created a high fidelity prototype via Marvel to highlight key aspects of our application:

<https://marvelapp.com/4e3j001/>

Overall, the application follows a blue-green and white color scheme, as studies have shown the color green represents personal health (Arora). Furthermore, once the user logs in, we intended to have a menu with five buttons provided at the bottom of every screen, so that the user can easily navigate to Settings, Search, Entry Homepage, Diary, and Recommendations.

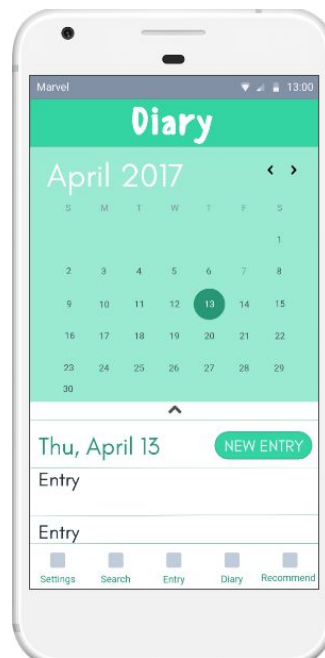
### Initial Prototype

*Login Screen and Homepage Screen:*



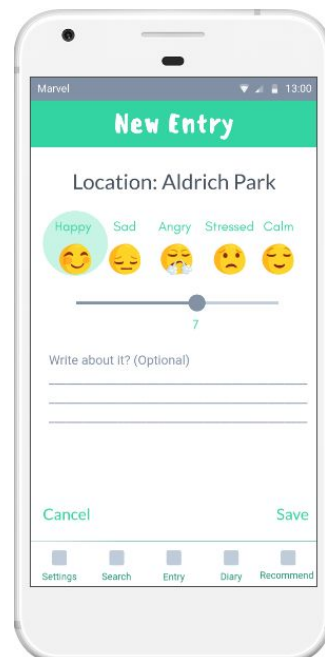
As shown above, the login page provides you with two options: to create an account or login to view your personal data. The homepage of the application displays today's date, as well as an option to add a new entry on today's date or view past entries, which would link you to the Calendar Diary Screen.

### Calendar Screen:



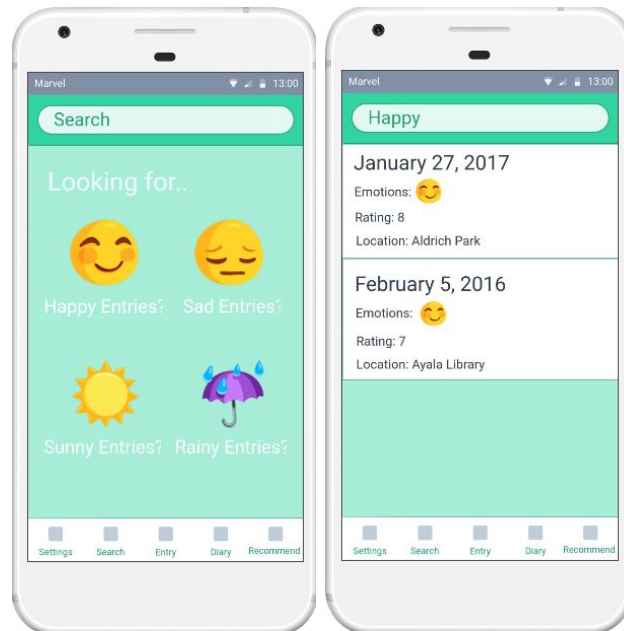
The calendar screen is provided so that users can view past entries in an organized fashion. By tapping on the date as shown in the screen above, a list of past entries may show below, as well as an option to add a new entry to that day if the user wants to.

### New Entry Screen:



In order to reach the new entry screen, users can tap on the “Make an Entry” button on the homepage or tap the “New Entry” button on the Calendar Screen. The user can then choose from the emotions above and rate how much they feel that emotion, and then write a text entry if they may want to.

### *Search Screens:*



For the search screens, users can tap on the emojis provided to quickly be shown past entries by that filter or type a keyword into the search bar. Past entries are ordered by level of highest rated emotion. Future implementation may include a button to help with filtering out results.

### *Recommendations Screen:*



The recommendations screen shows the user locations of places they may want to visit based off of their personal entries. If users want to know more than just the location's

atmosphere and the activities the user can do there, they can tap on one of the recommended locations to learn more about it.

We have begun conducting user experience research on the above high fidelity mockups. These studies so far consist of four Usabilityhub active links which are collecting user feedback.

The first test is a click test which is assessing the ability of users to correctly navigate from the home screen in order to view old entries. Feedback consists of a heat map of where users clicked as well as text based-input where they explain why they clicked where they did. As of now, 80% responses correctly clicked on “View Entries”. Results may be viewed here:

<https://usabilityhub.com/tests/b9140f53fbf/results/ebc10fc616c9>

The second test shows users the main screen as well as the search screen and in both cases asks them where they would click to search through entries. This study has already revealed we must refine the bottom menu options to avoid confusion since users only had a 50% success rate of navigating to search from the home page. On the other hand, once users were already on the search page, 100% correctly navigated to the “Search” bar. Results may be viewed here: <https://usabilityhub.com/tests/4e8cdeac4f1/results/83e5219a6ba6>

The third test shows users the New Entry screen for five seconds and then asks them what the application is for. 100% of the user feedback accurately describes a journal/emotional diary related description. The word map reveals “emotions” and “how you feel” are dominant. Results may be viewed here: <https://usabilityhub.com/tests/47af322d7713/results/9ba1729f4f1d>

The fourth test also presents users with a screen for five seconds. The screen presented in this case is the Recommendations screen. Users are then asked what is being recommended. 11/12 users understood the recommendations were locations/things to do at different locations. Results may be viewed here:

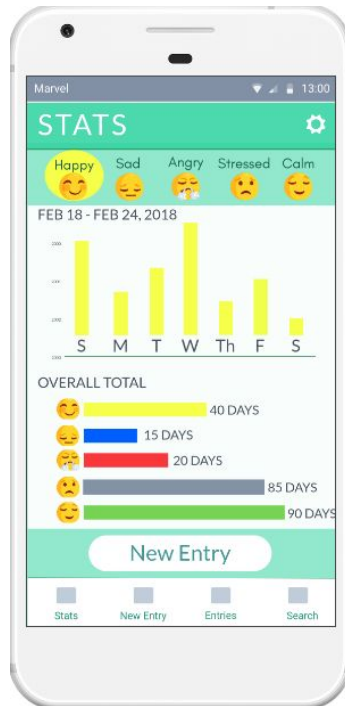
<https://usabilityhub.com/tests/1e969f7d4af5/results/901cc642b8d8>

## **Changes to Prototype as Implementation Progresses**

We initially decided to have a five-tab menu, but we decided to have a menu consisting of search, recommendations, new entry, and calendar.

*Initial Altered Home Screen:*

As we progressed in the implementation of our application via Android Studio, we decided to revamp our home screen and provide statistics of the user’s input, displaying the frequency of each emotion by week, as well as an overall count of the emotions by number of days. As you can see below, the new entry button is still available on the screen, so that the user can easily navigate to that screen if they would like to.



However, we realized that the scope of our project was too large to complete with the time we were given to complete this project. As none of our team had any experience using Android Studio, it was a much larger learning curve than we intended. As such, we decided to re-do the stats page and make it a recommendation page, displaying the top three most frequently happy or calm entries into three categories: weather, time of day, and location.

*Current Home Screen:*



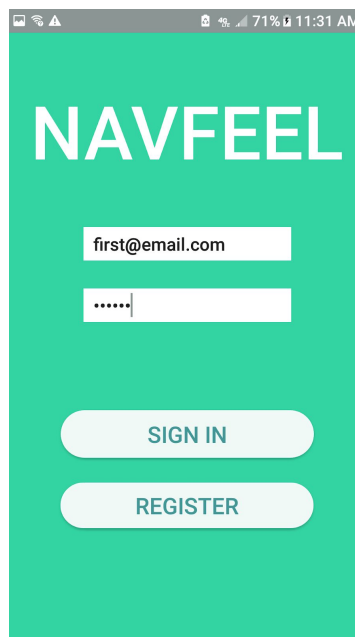
### *Changes to Search Screen:*

For the search screen, we realized having only a search input so that the user could search for an entry about weather, emotion, and text-entry would be difficult to implement in the few weeks we had to complete the project. As such, we decided to display the search page as a logical view, where the user could choose from a drop-down menu of the five possible emotions as well as for weather conditions. The user could also search for text-entries, though that would be typed user-input in a search bar format.

### **Final Product Implementation in Android Studio**

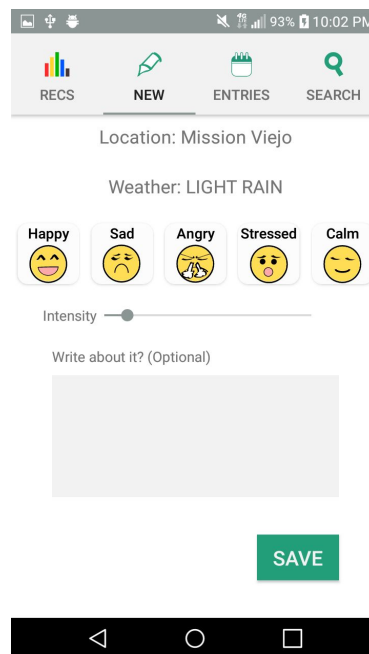
The initial implementation of NavFeel is complete. The Android application utilizes a MySQL Database (DB) backend which stores and queries user report data. The Android application communicates with the MySQL DB via a custom implemented web server which runs on Tomcat 9.0. The application search and recommendation features are fully functional. We tested our application on a Samsung Galaxy S7 and a LG Stylo 2, and found our application was indeed fully functional. See below for details.

### *Login Screen:*



As you can see, the login screen follows the prototype. Shown above, the user inputs an email as their username and a password.

### New Entry Screen:



The New Entry Screen is a mobile application interface. At the top, there is a navigation bar with four icons: a bar chart for 'RECS', a pencil for 'NEW', a calendar for 'ENTRIES', and a magnifying glass for 'SEARCH'. Below the navigation bar, the screen displays the following information: 'Location: Mission Viejo', 'Weather: LIGHT RAIN', and five mood selection buttons labeled 'Happy', 'Sad', 'Angry', 'Stressed', and 'Calm', each with a corresponding emoji. Below the mood buttons is an 'Intensity' slider and a text input field labeled 'Write about it? (Optional)'. At the bottom right, there is a green 'SAVE' button. The screen is framed by a black Android navigation bar at the bottom.

The new entry screen differs slightly from the prototype, as we added the weather conditions to the entry as seen above. There are some slight differences in the user interface as well, but due to time constraints, this was the only feasible design.

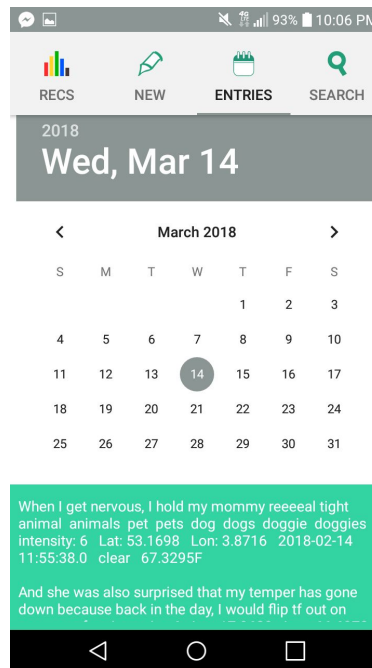
### Recommendations Screen:





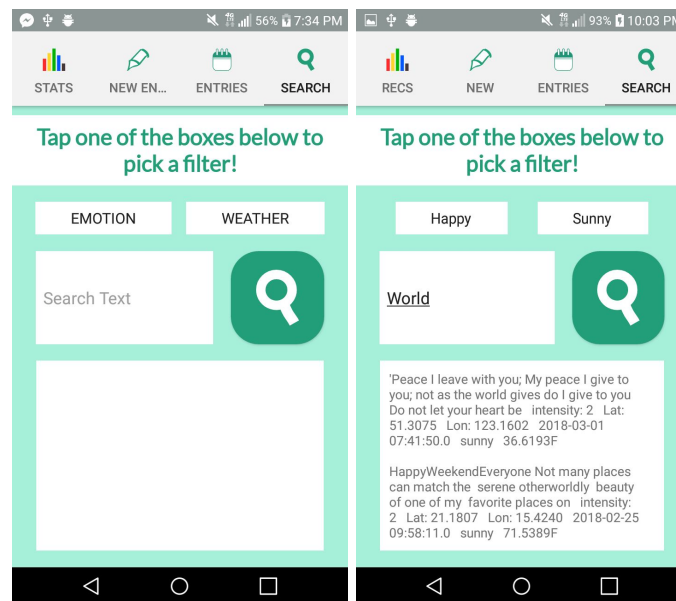
The recommendations screen differs from the prototype slightly. We decided to change insights to recommendations to make it more clear to the user that these locations, weather conditions, and time periods will most likely put the user in a better mood, based off of their entries. These “top 3” are ordered by frequency of happy/calm user entries.

### *Calendar Screen:*



The calendar screen provides the user's old entries by tapping on the day desired. When you tap on the day, below the calendar a list of entries including the time, emotion, location, possible text-entry and weather conditions entered that day are displayed.

### Search Screen:



The search screen provides the user with three ways of input, two of which are drop-down menus where the user can choose from a set list of emotions and a set list of weather conditions. Also, the user can type in any keyword in the search text input to find any text-entries that match that input.

## Final Product Evaluation

### User Testing

We implemented four usability tests via UsabilityHub to see if our application was user-friendly.

Test 1: <https://usabilityhub.com/tests/56c452bc61a/results/aa5a71d765d5>

We tested user navigation to an old entry and found that most users were able to understand to click on the Entries tab in the menu bar, when represented with the recommendations screen.

Test 2: <https://usabilityhub.com/tests/4c3e1268d19a/results/f0b39117b912>

We tested if users were capable of searching through previous entries in their application, and found that most were able to understand that they should click on the Search tab in the menu bar. However, some chose the entries as they believed that would hold past entries they could look at.

Test 3: <https://usabilityhub.com/tests/b9402b175e0/results/e55fb6ced82f>

We tested how understandable our application was by displaying the entry screen and asking the users what they thought the application was for. Many seemed to be confused and thought the application was designed to input weather entries rather than emotion entries and how that emotion may have been affected due to environmental data. It should be noted that our application should alter the instructions provided to better explain the purpose of our application.

Test 4: <https://usabilityhub.com/tests/6b0b1172bc89/results/a6bb94291252>

We tested whether users understood the purpose of the recommendation page. We found that most users were able to understand that the page recommended various weather conditions, locations, and times of day.

## **Conclusion**

### **Expected content of demo:**

The NavFeel demo will consist of two parts. We will show an existing NavFeel account as well as allow for a live account creation and app usage walkthrough.

### **Data sources we use:**

To reiterate the data sources we use for generating micro-reports are episodic in nature, since they require user input. In other words, the micro-reports are only created when users decide to create them and therefore the interval lengths will be determined by the user. We require only two inputs from the user to trigger the generation of a micro-report. These inputs are an Emoji Selection and a numeric value selected from a slider Emotion Intensity Scale. An optional user input is a text box entry where users can explain in further detail why they are feeling a certain way. Most importantly, we automatically collect the Time Stamp, Geo-Location, and current Weather and correlate this information with the user's entry. If we continue work on NavFeel, we will explore the use of Photos and Sound Clip Voice Recording forms of user inputs.

### **User interactions:**

Again, users are able to interact with the system in three main ways. They can create and view emotion based diary entries, search through their entries with various queries, and view recommendations generated for them based on the micro-reports.

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