PROJECT INTRODUCTION

OVERVIEW

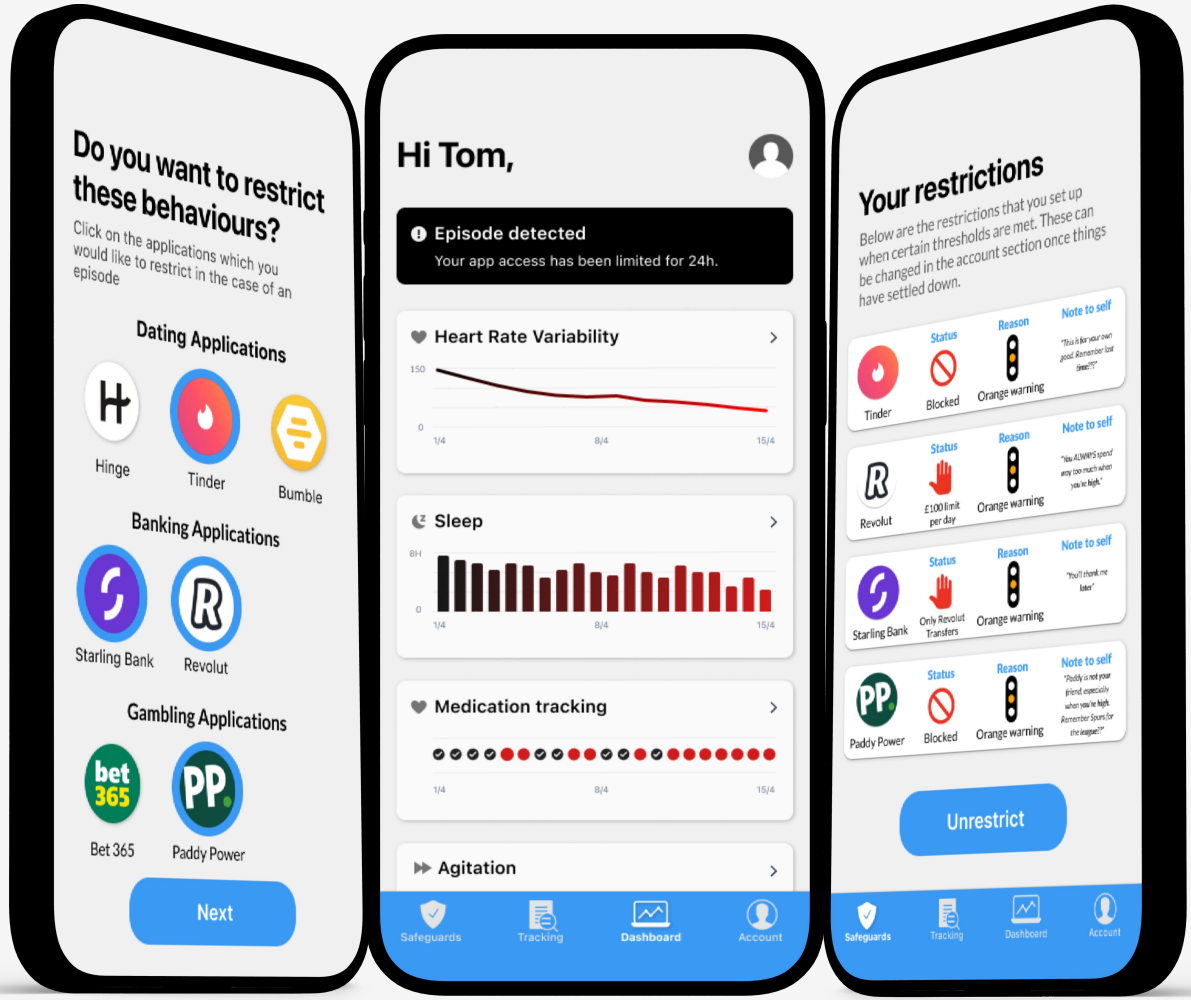
Moodpal is an application for individuals with Bipolar to help them deal with their condition in a manner that grants them autonomy over their episodes. It's an application that I designed for my Disability Interaction module during my masters degree.

THE PROBLEM

Individuals with Bipolar are often unaware when they are undergoing episodes, especially during periods of highs. As a result, they may engage in uncharacteristic risky behaviours, often with devastating consequences. While everyone has different manifestations, such behaviours may include gambling, excessive spending and hypersexuality to name but a few.

THE SOLUTION

Moodpal first identifies the individuals specific behaviours when they are in a high period. It monitors the individuals activities using machine learning techniques to detect when they are in the midst of an episode and alerts the individual to the likelihood that they are experiencing an episode, compensating for their lack of insight. It also restricts certain applications which are agreed on by the user in advance to prevent them from engaging in risky behaviour while in the midst of an episode.

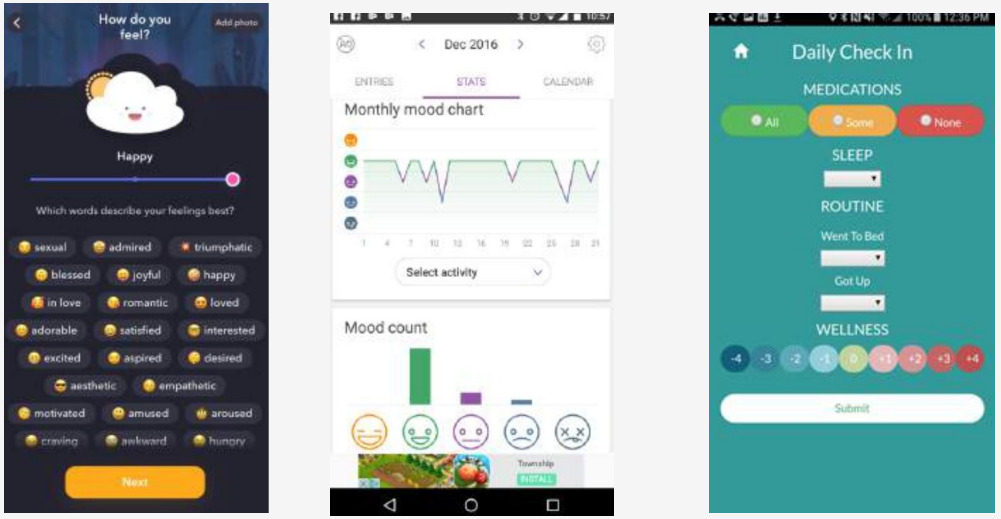


MARKET RESEARCH

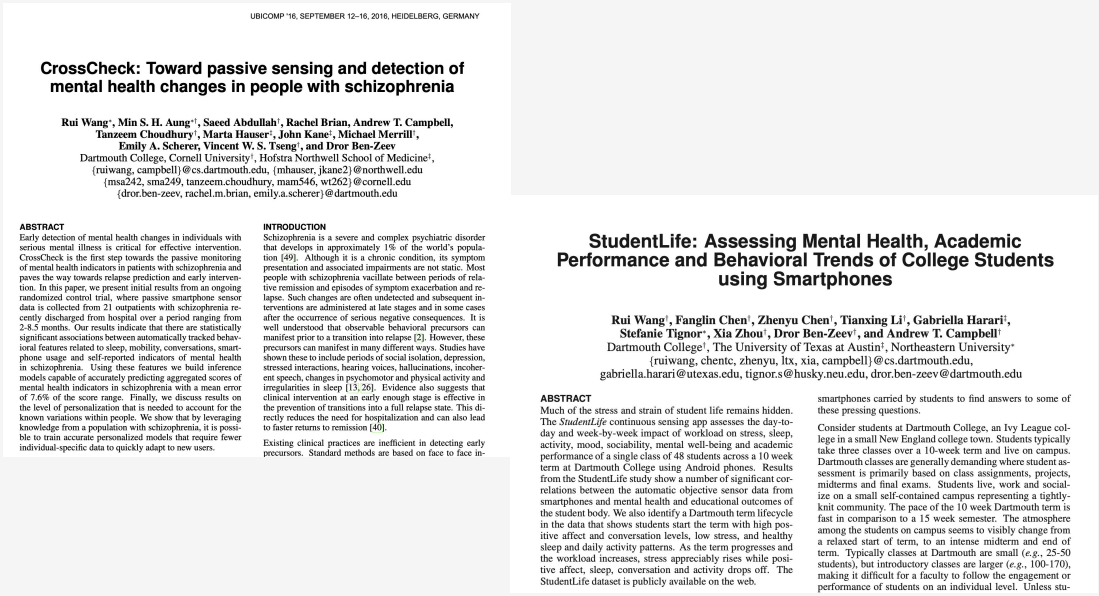
DEFINE PROBLEM

I began my project by reviewing applications on the market that cater to individuals with Bipolar Disorder. Along with this review and the latest in literature studies, I found that there was a major gap in the market for applications which used automatic sensing capabilities. Many studies were using this feature for different conditions, but all applications on the market were using manual tracking, which is cumbersome and time consuming.

Furthermore, most applications on the market were made with zero clinical input, which is a massive oversight considering the serious nature of the condition. As a result, my next step was to interview clinicians to see what they thought may be useful in the design of an application.



An example of manual tracking apps on the market



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CrossCheck: Toward passive sensing and detection of mental health changes in people with schizophrenia

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ABSTRACT

Early detection of mental health changes in individuals with serious mental illness is critical for effective intervention. CrossCheck is the first step towards the passive monitoring of mental health indicators in patients with schizophrenia and paves the way towards relapse prediction and early intervention. In this paper, we present initial results from an ongoing randomized control trial, where passive smartphone sensor data is collected from 21 outpatients with schizophrenia recently discharged from hospital over a period ranging from 2-8.5 months. Our results indicate that there are statistically significant associations between automatically tracked behavioral features related to sleep, mobility, conversations, smartphone usage and self-reported indicators of mental health in schizophrenia. Using these features we build inference models capable of accurately predicting aggregated scores of mental health indicators in schizophrenia with a mean error of 7.6% of the score range. Finally, we discuss results on the level of personalization that is needed to account for the known variations within people. We show that by leveraging knowledge from a population with schizophrenia, it is possible to train accurate personalized models that require fewer individual-specific data to quickly adapt to new users.

INTRODUCTION

Schizophrenia is a severe and complex psychiatric disorder that develops in approximately 1% of the world's population [49]. Although it is a chronic condition, its symptom presentation and associated impairments are not static. Most people with schizophrenia vacillate between periods of relative remission and episodes of symptom exacerbation and relapse. Such changes are often undetected and subsequent interventions are administered at late stages and in some cases after the occurrence of serious negative consequences. It is well understood that observable behavioral precursors can manifest prior to a transition into relapse [2]. However, these precursors can manifest in many different ways. Studies have shown these to include periods of social isolation, depression, stressed interactions, hearing voices, hallucinations, incoherent speech, changes in psychomotor and physical activity and irregularities in sleep [13, 26]. Evidence also suggests that clinical intervention at an early enough stage is effective in the prevention of transitions into a full relapse state. This directly reduces the need for hospitalization and can also lead to faster returns to remission [40].

Existing clinical practices are inefficient in detecting early precursors. Standard methods are based on face to face in-

StudentLife: Assessing Mental Health, Academic Performance and Behavioral Trends of College Students using Smartphones

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ABSTRACT

Much of the stress and strain of student life remains hidden. The *StudentLife* continuous sensing app assesses the day-to-day and week-by-week impact of workload on stress, sleep, activity, mood, sociability, mental well-being and academic performance of a single class of 48 students across a 10 week term at Dartmouth College using Android phones. Results from the StudentLife study show a number of significant correlations between the automatic objective sensor data from smartphones and mental health and educational outcomes of the student body. We also identify a Dartmouth term lifecycle in the data that shows students start the term with high positive affect and conversation levels, low stress, and healthy sleep and daily activity patterns. As the term progresses and the workload increases, stress appreciably rises while positive affect, sleep, conversation and activity drops off. The StudentLife dataset is publicly available on the web.

smartphones carried by students to find answers to some of these pressing questions.

Consider students at Dartmouth College, an Ivy League college in a small New England college town. Students typically take three classes over a 10-week term and live on campus. Dartmouth classes are generally demanding where student assessment is primarily based on class assignments, projects, midterms and final exams. Students live, work and socialize on a small self-contained campus representing a tightly-knit community. The pace of the 10 week Dartmouth term is fast in comparison to a 15 week semester. The atmosphere among the students on campus seems to visibly change from a relaxed start of term, to an intense midterm and end of term. Typically classes at Dartmouth are small (*e.g.*, 25-50 students), but introductory classes are larger (*e.g.*, 100-170), making it difficult for a faculty to follow the engagement or performance of students on an individual level. Unless stu-

Some papers noting the promise of automatic or "passive" sensing

USER RESEARCH

INTERVIEWS WITH CLINICIANS

I conducted semi-structured interviews with two clinicians. The results from which are summarised on the right.

Some examples of questions I asked were as follows'

- Can you tell me a little bit Bipolar broadly?
- What, are the biggest challenges that people with bipolar face generally?
- Does every case of bipolar present the same or are their differences in symptoms?
- What are the most important things for people to keep well with Bipolar?

After performing both interviews, I used a bottom up thematic analysis to distill key intersections of both interviews.

THEMATIC ANALYSIS RESULTS

"It's a significant issue for people if they don't perceive that there is anything wrong with them."

Lack of insight on episodes

Sleep, exercise & diet crucial

Mechanism for alerting team or support

Objective markers to compensate for insight

"Metric points like HRV that are concurrently going up that shouldn't be influencing each other in clear sense."

"If there was a way to link someone's banking app card out that would be extremely useful."

Safeguard against reckless behaviours

Support network is essential

"Maybe yellow is like we're approaching danger take discretion, orange is we're heading into the danger zone red is stop."

Medication tracking & adherence is critical

Notification when limits are met

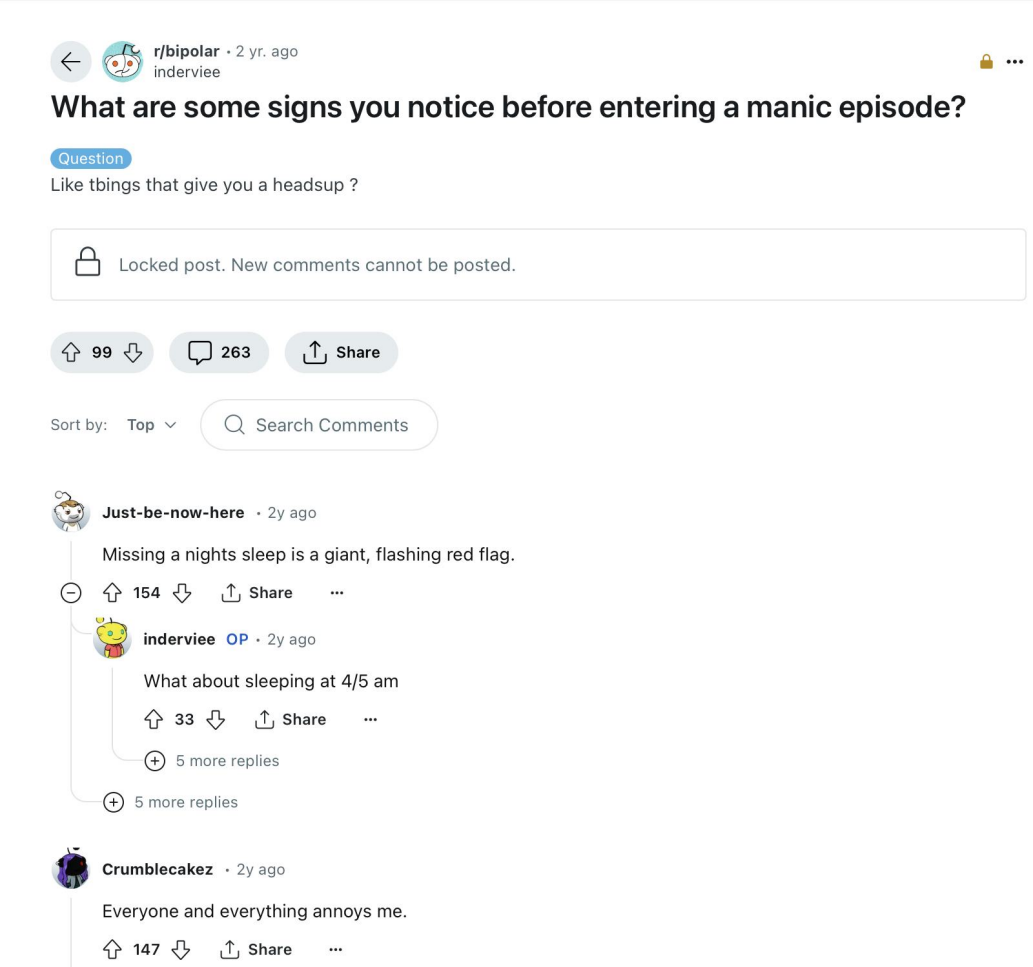
USER RESEARCH

DIGITAL ETHNOGRAPHY

To better understand user needs, I conducted a digital ethnography study on the Bipolar forum on Reddit, analysing the top 10 posts describing episodes of highs and the top 10 comments thereof.

I then performed a bottom up thematic analysis, the results of which are summarised below:

- Destructive, impulsive behaviours previously mentioned were common experiences for people during mania.
- The biggest triggers for episodes were generally not taking medication, stress and lack of sleep.
- Deep regret, shame and lack of control were common amongst those who had experienced major episodes.

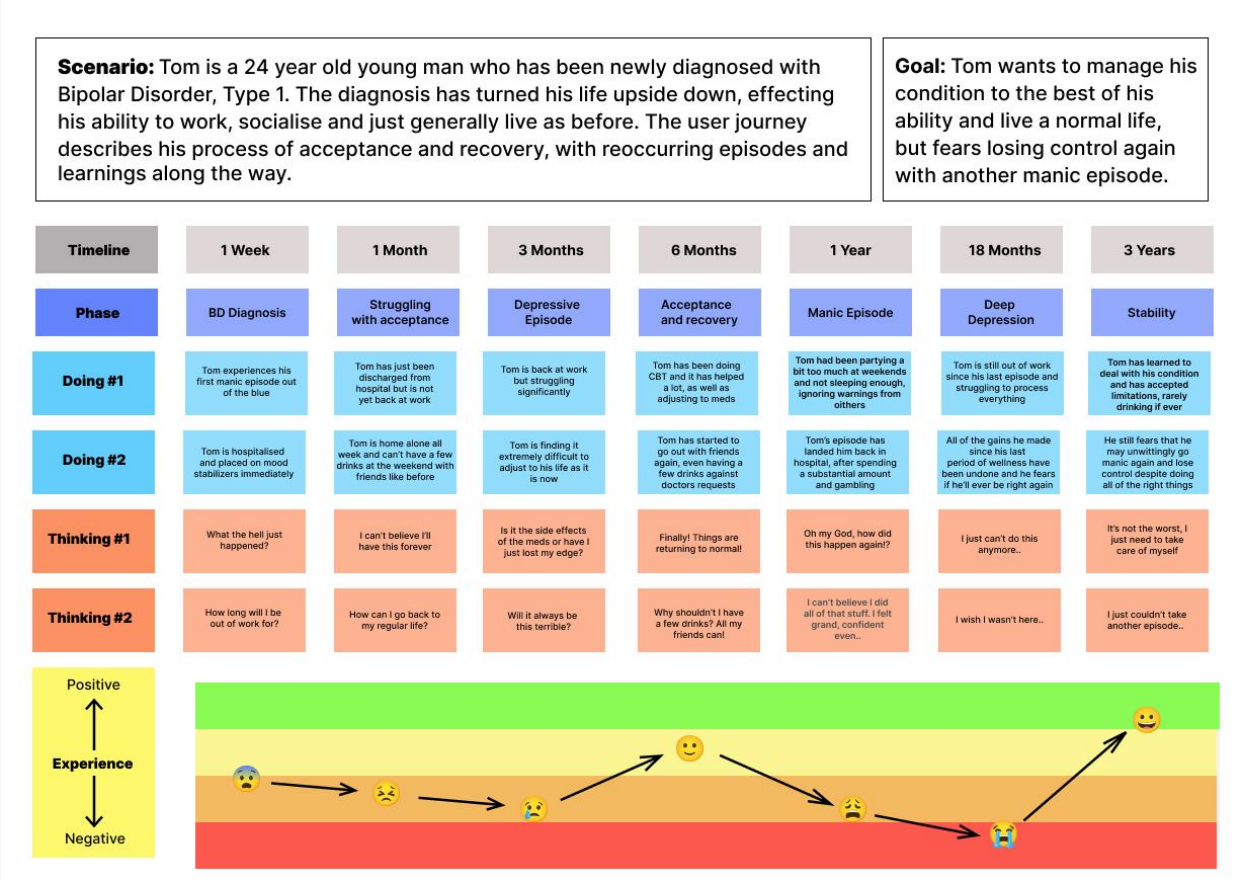


An example post describing the precipitation of an episode

PROBLEM DEFINITION

USER JOURNEY MAP

From a combination of user research and market research I was able to create a user journey map for a fictional individual with Bipolar disorder, charting their journey from diagnosis to acceptance.

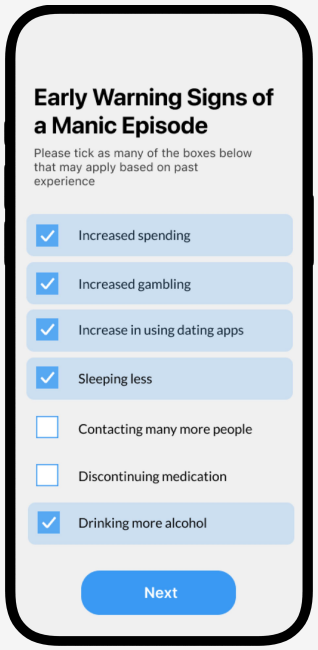


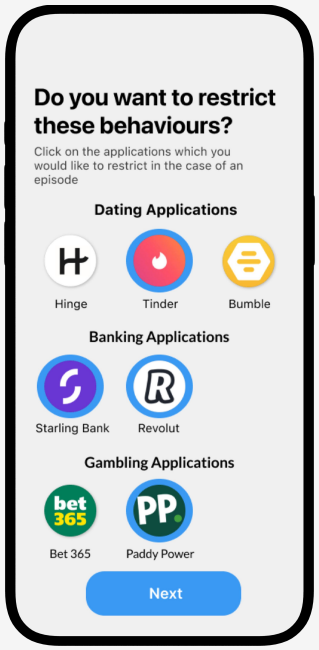
PRODUCT REQUIREMENTS

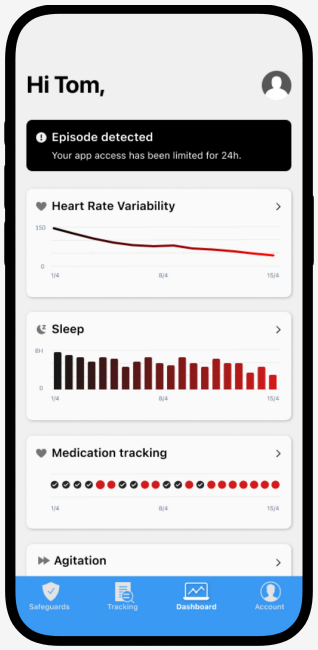
The user journey map helped crystalise the main requirements for the product. It should do as follows:

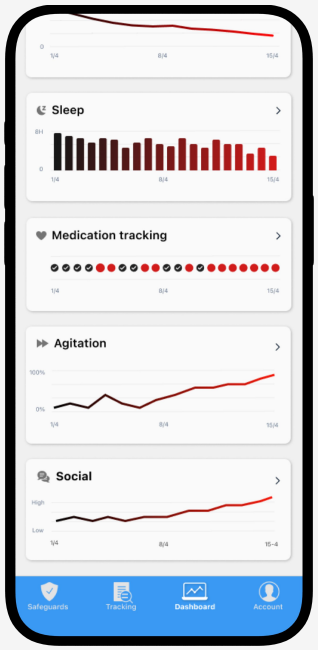
- Automatically detect manic episodes through objective phone and wearable sensing data.
- Include personal early warning signs to improve the system's detection capabilities.
- Alert the user in the case of a detected episode and suggest actions to take.
- Allow the user to alert others in the case of an episode for support.
- Take protective actions to prevent reckless behaviour during a manic episode.

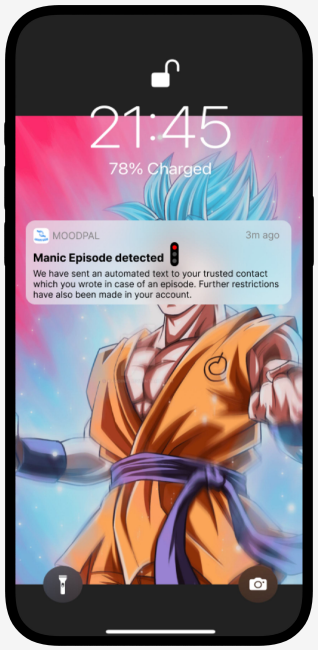
FINAL PRODUCT











Early Warnings Signs

This screen allows the user to input their own individual warning signs so that the application knows what to look out for.

Restrictions

This screen allows the user to restrict certain applications once thresholds of behaviour are met.

Dashboard 1 + 2

This dashboard shows the user trends in their behavioural data that are automatically sensed from their phone and wearable device along with an episode detector which predicts the likelihood of an episode occurring.

Safeguards

This section shows the user which applications have been restricted with a note placed by the user on the account to remind them why. It features a traffic light system as suggested during interviews.

Notification

This screen shows a notification alerting the user to an episode and letting them know that a trusted contact has been notified along with further restrictions.