



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
[The University of Dublin](#)

School of Computer Science and Statistics

Mood Logging

For Voice Assistants

Liam Byrne

April 2022

A Report submitted in partial fulfilment of the requirements
for the degree of BA(Mod) in Science in Computer Science
and Business

Declaration

I hereby declare that this project is entirely my own work and that it has not been submitted as an exercise for a degree at this or any other university.

Liam Byrne

Acknowledgement

I would like to thank my supervisor Dr Gavin Doherty for his support and guidance throughout this project. I would also like to thank Rob Bowman for his continued support and advice during our Tuesday meetings. My conversations with Gavin and Rob have given me a new appreciation for human computer interactions, and I look forward to studying the topic further. I would also like to thank my family for their support throughout this project and over the course of the last 4 years.

Abstract

An awareness of the symptoms of one's own low moods and anxiety is an essential step in treating them. Improvements in natural language understanding and the mass adoption of virtual assistant devices have broadened the scope of possibility for self-monitoring applications. Interest in their potential to advance mental health supports is well established as one of the most common Alexa commands during the summer of 2017 was "Alexa help me relax" (Anders, 2022). Considering the high demand yet low supply for mental health services, the efficacy of self-help mental health supports, and recent developments in voice technology, an opportunity exists to streamline the self-monitoring process using a more natural medium, voice. therefore, a complex design problem arises. How best to design such an agent?

This project examines the potential of voice user interface devices for the purposes of self monitoring by developing a voice mood logging application. The application which promotes knowledge of one's mental health and related factors run on a Google Nest Hub Device. The design of the application is informed by past research and inspired by aspects of cognitive behavioural therapy which focus on organising ones thoughts.



Outline

Section 1: Introduction

- [1.1 Current State of Mental Health and Supports](#)
- [1.2 Self Treatments and CBT](#)
- [1.3 Mental Health Applications](#)
- [1.4 Objectives](#)
- [1.5 Scope](#)
- [1.6 Competitive Advantage](#)

Section 2: Literature Review

- [2.1 Mood Tracking and Data Collection](#)
- [2.2 Stigma and Impression Management](#)
- [2.3 Dialogue Management Strategy](#)
- [2.4 Rapport & Connection / Mimicking Therapy / ECA's](#)

Section 3. Design

- [3.1 User Research](#)
- [3.2 User Personas](#)
- [3.3 Early Concept](#)
- [3.4 Scenarios](#)
- [3.5 Task Analysis](#)
- [3.6 Designing for Voice](#)
- [3.7 Sample Dialogs](#)
- [3.8 Conversation Flow Map for Mood Logging](#)
- [3.9 Fall-backs and Multiple Responses](#)
- [3.10 Frontend](#)
- [3.11 Wireframes](#)
- [3.12 Brand Identity and Animation](#)
- [3.13 Mock-ups](#)
- [3.14 Prototyping](#)

Section 4. Implementation

- [4.1 Google Assistant vs Alexa](#)
- [4.2 Entity Analysis API](#)
- [4.3 Firestore, Firebase](#)
- [4.4 Vue.js](#)
- [4.5 ECA's.](#)
- [4.6 ECA: Spline](#)
- [4.7 Data Management](#)
- [4.8 Webhooks](#)

Section 5. Created System

- [5.1 Conversation](#)
- [5.2 Graphical User Interface](#)
- [5.2.1 Mood Journaling](#)

[5.2.2 Calendar Page](#)

[5.2.3 Settings Page](#)

[Section 6. Discussion](#)

[6.1 What Worked](#)

[6.2 What Did Not Work](#)

[6.3 Suggestion for Future Work](#)

[Section 7. Conclusion](#)

[References](#)

Section 1: Introduction

1.1 Current State of Mental Health and Supports

Mental health disorders are a common form of disability that affect 29% of people during their lives (Abd-alrazaq et al., 2019). The World Health Organisation (WHO) defines mental health as “a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community” (Abd-alrazaq et al., 2019). An increasing number of people suffer from mental health disorders such as anxiety and depression. Over 25% of the U.S. population experiences one period of anxiety and depression at some point in their life resulting in less interest in activities and significant deterioration of their daily lives (Abd-alrazaq et al., 2019). Epidemiological data shows that mental health diseases will only increase in prevalence and severity in the future (Rastogi, Keshtkar and Miah, 2018).

Despite the general increase in living standards globally, many factors remain that exacerbate negative emotions and contribute to poor mental health. These factors have been exacerbated by the mass isolation and added stress caused by the COVID-19 pandemic. Mandatory isolation and fear of catching the disease resulted in significant adverse effects on many people's lives and mental health. During the pandemic, many people confronted unforeseen stressors such as job uncertainty, concern for maintaining household or medical supplies, and sudden changes to routine.

The pandemic brought attention to the demand for mental health support which currently exceeds its supply. Ireland is a good case study for the need for more mental health support. Ireland has the third-highest rate of mental health illness in Europe (O'beirne, 2022); however, the HSE struggles to provide mental health support to those who need it most. According to the HSE, over 10,800 people were waiting to see a psychologist in Ireland in 2021 (O'beirne, 2022). The first port of call for most people experiencing mental health issues are helplines and GP services. These are not sustainable as regular treatments over the long run (O'beirne, 2022).

The lack of mental health support is particularly apparent amongst young adults. In the United States 40% of young adults do not receive the mental health support that they need (Wang, 2021). This is particularly unfortunate, considering approximately 74% of mental health diagnoses begin before the age of 24 (Rastogi, Keshtkar and Miah, 2018). Some studies in the last year have shown that as many as half of the students questioned reported severe symptoms causing difficulty functioning in the last year (Rastogi, Keshtkar and Miah, 2018). 75% of students who should take additional action on their mental health condition do not or cannot access any clinical services despite relatively low-cost resources generally being available on campuses (Rastogi, Keshtkar and Miah, 2018).

Early Identification of mental health disorders is vital to prevent more serious conditions developing (Rastogi, Keshtkar and Miah, 2018). Acknowledging and responding to the lack of adequate mental health services is essential for treating the growing rate of mental health disorders. Students are the most important demographic to focus on to prevent intense mental health disorders. In this demographic, less severe problems, such as anxiety, that usually do not receive clinical attention can be treated with minor interventions. These interventions are capable of unrooting the severe mental health disorders stemming from anxiety.

1.2 Self Treatments and CBT

Awareness of anxiety is an essential step in treating such feelings and improving moods. Anxiety is often reduced in therapy through recording moods and organising thoughts that can cause anxiety. By acknowledging anxious thoughts or low moods, individuals can gain positive momentum by finding reasonable solutions to anxiety-provoking thoughts. For this reason, journaling has become a popular daily self-treatment for stress and anxiety as it promotes the release of emotional expression.

In clinical contexts, Cognitive Behavioural Therapy (CBT) is a psychotherapeutic treatment that helps patients recognise and alter their thoughts and moods that, in turn, influence their actions. CBT is useful for treating anxiety, addiction, chronic stress and various phobias. CBT focuses on tackling damaging cycles in the patient's thought pattern, helping them control their emotions. CBT helps patients develop coping strategies by focusing on current problems in their life and finding effective ways to address the issue and reduce symptoms of their disorder. The core tenet of CBT is that thoughts influence beliefs, which influence actions. Distortions in the thinking process can reinforce unhelpful behaviours and psychological disorders (Rastogi, Keshtkar and Miah, 2018).

Face-to-face delivery of therapeutic support one-on-one is generally the most effective delivery method; unfortunately, it is costly and time-consuming for a trained professional to deliver. Group interventions are the next most effective, followed by self-help interventions (Fitzpatrick, Darcy and Vierhile, 2017). This is perhaps unsurprising considering the level of personalised attention involved in one-on-one, face-to-face sessions. In addition, clinical groups tend to respond more to self-help interventions, although non-clinical groups also respond well (Fitzpatrick, Darcy and Vierhile, 2017). This is perhaps because clinical groups have a higher potential for improvement when compared to non-clinical groups. Despite these findings, it has been advised that self-help treatments be delivered to a broad population to maximise benefits to public health (Fitzpatrick, Darcy and Vierhile, 2017).

Digital self-help interventions take a relatively short amount of time to complete and are easily administered yet still show significant effect across a broad population. Mood logging and journaling, which are components of CBT, can have therapeutic effects, often without the financial costs and fear of disclosure incurred by in-person therapy.

They can be highly effective and low-cost methods to promote mental health for vast numbers of people whom therapists might not have otherwise reached. This means they could have a significant impact on the well-being of a broad population.

1.3 Mental Health Applications

Today, most people have almost constant access to a smart device. This is particularly true amongst tech native young adults, a target demographic for mental health applications. It is estimated that half of the global population will have a smartphone by 2023 (Sui, Mawston and Wu, 2022). The prevalence of smart devices presents a new opportunity to provide people with mobile mental health support.

Developer enthusiasm in this rapidly growing space has resulted in thousands of mental health applications being published to app marketplaces. There has been growing interest in developing mobile mental health supports, ranging from simple to very complex applications. For example, individuals struggling with mental health disorders can use mobile phones to contact a local crisis centre during an emergency (Crisis Text Line, 2022) or run a sophisticated CBT program daily (Fitzpatrick, Darcy and Vierhile, 2017).

In addition to being a low cost and scalable way of supporting more people, online mental health supports have further benefits including the convenience of using them anywhere and anytime they are required and the anonymity users report experiencing when disclosing information to a computer (Lucas, Gratch, King and Morency, 2014). This technology is also an excellent introduction to more significant support, such as face-to-face, one-on-one therapy for those who would not otherwise seek assistance (Fitzpatrick, Darcy and Vierhile, 2017). Applications may also be a more flexible medium for treatments than continuous therapy sessions, which must be scheduled in advance. Applications are available 24/7 and can reliably deliver the same quality of treatment every time. Despite the benefits of support an application delivers, it cannot deliver the level of personalised attention required in severe cases of mental health disorders. In these situations, applications are better suited to take up supporting roles extending face-to-face sessions and collecting pertinent data about users' current wellbeing.

However, due to a lack of regulation, there remains little information about the efficacy and security of many of these apps, leading to uncertainty amongst consumers about whether they work and can be trusted (Technology and the Future of Mental Health Treatment, 2022). There is a lack of guidance for users as not all applications will work for all users with all mental health conditions. In addition, developers and marketers tend to oversell their applications' effectiveness, leading to more confusion over their suitability.

Having said this, research published by academics studying the effectiveness of these types of apps has been promising. Numerous studies demonstrated the efficacy of such technology-based tools in improving mental health. For example, Reid et al.'s (2011) mobile application could lessen symptoms of anxiety and depression by keeping track of trends related to patients' moods, such as sleep, exercise and drug consumption (Wang, 2021).. This enabled clinicians to treat mental health disorders better by providing more appropriate care and attention.

However, interventions can be more sophisticated than trackers. Attempts to branch deeper into providing automated CBT include Dear et al.'s self-guided internet-based CBT program, which significantly improves symptoms of anxiety and depression. (Dear et al., 2015) (Wang, 2021). Furthermore, Fulmer et al. (2018) provided students with a CBT Program

using their sophisticated psychological AI, Tess. Tess was found to help reduce self-identified symptoms of anxiety and depression. Researchers in these studies praised the cost-effective nature of such an approach however emphasised that their tools could not replace the role of a trained therapist (Wang, 2021).

Developers have focused on mental health apps for self-monitoring and self-assessment as they provide a relatively simple, low cost, and sustainable way to deliver support to a broad population. These applications expand the realm of possibilities for data collection. Phones, tablets, and other smart devices allow therapists, researchers and doctors to better track and understand patient well-being (Technology and the Future of Mental Health Treatment, 2022).. This is also useful for promoting ambient awareness of a patients' own mood and for use in clinical contexts.

Conversational Agents (CAs) are digital software tools that use AI and machine learning technologies to participate in conversations by imitating human speech (Vaidyam et al., 2019). They can engage users in task-oriented and adaptive conversations. Thanks to advancements in social robots and conversational user interfaces (CUIs), we can now converse with virtual agents more naturally than ever before.

Teams of developers behind cutting edge conversational agents like Siri, Alexa, and the Google Assistant argue that voice technology can perhaps be a more natural medium through which to interact with technology (Rastogi, Keshtkar and Miah, 2018). Over 110 million people in the United States use virtual assistants. The use of virtual assistants is prevalent on smartphones and smart speakers. Currently, 15% of Americans own a voice-activated smart speaker, and this number is increasing 1 year on year as the underlying technology becomes more advanced (Stepanov, 2022).

1.4 Project Outline

Objectives

The literature suggests that conversational agents for self-monitoring would benefit from mimicking human conversation, being embodied, providing visualisations as well as following a number of conversational and graphical user interface design guidelines. I aim to examine the potential of voice mood logging applications by creating a smart display application that promotes knowledge of one's mental health and the factors that could relate to them. The application takes inspiration from aspects of CBT that help organise one's thoughts by providing a convenient journaling method. I aim to create mental health support for smart device users to more easily monitor and understand their moods so that they can actively work to improve their quality of life and ask for professional assistance if required.

Scope

To do this, I have used the literature to inform the design and development of a mental health support to aid with self-monitoring. To achieve my aim, the application must

- Log moods.
- Keep track of daily activities related to moods.
- Promote awareness of trends in one's mental health.
- Be convenient and natural to use.

The application is designed to run on a smart display, specifically the Google Nest Hub. As this design of this application is intended to explore the capabilities of Voice User Interface (VUI) devices for the purposes of self-monitoring, the application contains an Embodied Conversational Agent (ECA) which can:

- Ask users how they feel today and classify their response into one of 5 categories: excellent to awful.
- Ask the user open-ended question(s) about their day, such as. "How was your day?" or "What did you get up to today?"

An ECA has been included in the application design due to past research showing that embodiment can enhance rapport and patient disclosure. The proliferation of smart display devices in homes is a relatively recent development and by including an ECA I hope to show what the future of mental health support could look like. To the best of my knowledge, there are currently no other ECA enabled self-monitoring applications available on commercial VUI devices.

Competitive Advantage

I believe this project will provide utility beyond what is already present in literature as it combines multiple factors not contained in other research, that could improve user retention such as:

- The scalability and convenience that is provided by at-home smart displays.
- Enhanced user experience, rapport, and retention provided by including an ECA.
- Combining discrete and open-ended dialogue strategies to enhance candid disclosure.

Section 2: Literature Review

2.1 Mood Tracking and Data Collection

Early mental health diagnosis and interventions are vital in preventing impairment to people's daily lives, and self-monitoring can be a very beneficial practice for identifying issues quickly. Patient health questionnaires prescribed by clinicians are traditional techniques for collecting mental health data.

Popular Health questionnaires include the World Health Organisation 5 (WHO-5) and Patient Health Questionnaire 9 (PHQ-9), widely used tools to provide valuable insight into and measure mental health disorders. The WHO-5 is a clinical scale appropriate for the general population that asks fundamental questions about users' mental health. The PHQ-9 is a widely used 9 section self-report questionnaire that monitors the frequency of depressive thoughts (Maharjan et al., 2021). Other Questionnaires include the "Beck Depression Inventory", the "Positive and Negative Affect Schedule", and the "Generalised Anxiety Disorder-7."

Research shows that user burden is the most significant shortfall associated with completing questionnaires; this is particularly true for open-ended questions, which require more thought and time to write a response (Maharjan et al., 2021). For this purpose, significant effort has been put into developing applications to assist with measuring mental health. One study recorded a strong correlation between responses on the WHO-5 scale when delivered on paper versus via a self-report conversational Agent (CA) named Sofia (Maharjan et al., 2021). This finding suggests that CA's are viable tools for administering self-report questionnaires through a different format.

By collecting data on user behaviour, activities and mood during the day, applications can help raise patient awareness of their mood and bring noteworthy trends to patient and clinicians' attention. If an application detects a particular input sequence, such as a prolonged period of low mood or behaviour that enforces low mood, this can be flagged for private reflection or the attention of a therapist. Such applications can augment the service provided by mental health professionals so that they can provide extra support when needed.

2.2 Stigma and Impression Management

Unfortunately, information disclosed by users is not always reliable. Lack of honesty is a common reason for inaccurate data collection. Patients may not disclose important details related to their wellbeing because of fear that they will be viewed negatively by a healthcare professional (Lucas, Gratch, King and Morency, 2014). Assessments delivered by computer have been shown to result in more perceived anonymity when compared to traditional written assessments (Lucas, Gratch, King and Morency, 2014). Patients are more likely to overcome psychological resistance to providing an honest response when speaking to a CA because they do not perceive anyone observing them.

CA's have a vast potential to be beneficial to mental health. Collecting data that more accurately reflects the user's mindset can help clinicians provide more appropriate care and interventions, helping prevent serious consequences. The impact of CA administered assessments on disclosure is especially important for mental health, considering the private nature of the topic being discussed. The increased honesty also extends to disclosing mundane personal information; however, the effect is particularly notable when discussing illegal or culturally stigmatised subjects. When instructing trial participants to disclose suicidal thoughts to a computer, researchers found that participants answered more honestly and felt better about the assessment method (Lucas, Gratch, King and Morency, 2014). Many conversation topics that can significantly impact mental health (drug use and suicidal thoughts) fit in this category.

The setting of self-disclosure to CA's also matters. Intuitively, Users are found to have fewer worries when disclosing personal information to a CA in private as opposed to in a public setting (Lucas, Gratch, King and Morency, 2014). In addition, research suggests that users with high levels of social anxiety disclose private information to an ECA more easily than to a human (Provoost, Lau, Ruwaard and Riper, 2017). In light of this, my design includes an ECA that operates on a smart speaker in the privacy of one's own home.

2.3 Dialogue Management Strategy

Conversational agents must be designed with a clear understanding of the implications of different conversational design strategies (discrete vs open-ended) on user self-reporting. Conversational design strategies can be categorised interactions into either a) Finite state where the answer to a question is valid or not. b) frame-based where specific data slots are filled from user input or free form where any user input is acceptable (Maharjan et al., 2021)(c). Dialogue management strategies are also not mutually exclusive, and each strategy has its benefits.

Most conversational agents for self-reporting facilitate discrete responses to closed-ended questions. Such CAs are similar to paper scale questionnaires in terms of acceptable input; however, they elicit slower responses than open-ended questions and provide less room for authentic self-expression (Maharjan et al., 2021).

When a CA called Sofia administered the WHO-5 questionnaire using discrete and open conditions, participants took longer to respond to discrete questions. This counterintuitive finding can perhaps be explained by the amount of “help” and fallback commands made when participants forgot what the acceptable responses were. Another possibility is that participants wanted to respond to the question with a more nuanced reply than the system accepted and took longer to respond. In essence, discrete conditions can impede user honesty and slow them down with more decisions, resulting in higher error rates. (Maharjan et al., 2021)

On the other hand, discrete conversational strategies are more habitable than open-ended strategies (Maharjan et al., 2021). Hone et al. (2000) define a habitable system as “one in which there is a good match between the users’ conceptual model of the system and the actual system”. Although the user’s conceptual model of the system may be weaker in open-ended conversation, , Levin et al. (2006) showed that users' efficiency with their self-reporting CA improved over time, improving session speed and error rates. This perhaps emphasises the importance of taking care to design a good conversation. Stone and Shiffman (2002) remarked, “care in the design of questions and response formats can greatly reduce the burden by enabling minimal response time and by making the task more pleasant”.

When combined, discrete and open-ended design strategies can result in richer, more complete data capture (Maharjan et al., 2021). Where it may not be possible to map user input to an open-ended question, follow-up intents can help align responses to discrete slots like that of a questionnaire. For example, if a user answers a question like “how did you feel today?” with “I tried to do things that are interesting”, the CA could then follow up with “how did you feel on a scale of zero to five?” Additionally, this could be followed with a yes-no hierarchy such as “Was today a good day?” which implies the answer “yes” or “no”. In this way, CAs can collect discrete and open information to gather better information about user health.

Despite its complexity, an open-ended dialogue strategy is feasible in most cases and allows for a more complete understanding of user mental health. It also allows users to reflect on their moods and add additional context. Kocielnik et al. (2008) found that their CA “Robota” (which asked open-ended daily reflection questions) allowed users to reflect on and change

their behaviour more than text-based interactions. This is particularly promising for mental health applications considering similar open-ended CA dialogue strategies have been able to elicit private information from users throughout conversations as long as 25 minutes (see DeVault et al.)

2.4 Rapport & Connection / Mimicking Therapy / ECA's

The potential for mental health applications that are carefully designed is clear; however, low adherence remains a significant problem for mental health applications. This is primarily an issue for fully autonomous self-help support (Ly, Ly and Andersson, 2017) . Low adherence can be partially addressed by including a clinician in self-report behaviour, as proven by Mohr et al. (2013) with self-guided depression treatment. However, this relies on therapists' availability and diminishes scalability due to costs and scheduling logistics. Application effectiveness can be improved by increasing adherence through other techniques such as learning to mimic human interactions (Ly, Ly and Andersson, 2017).

Advancements in voice technology behind consumer CA's such as Amazon's Alexa, Samsung's Bixby, Microsoft's Cortana and The Google Assistant have made it possible to mimic human conversation. It has already been proven by FitzPatrick et al. (2017) that mimicking therapeutic conversations can significantly reduce symptoms of anxiety and depression amongst students compared to participants who only received information on mental health. Chats or synchronous text conversations have also been shown to have significant and sustained benefits on mental health compared to conditions patients would be in when on a waitlist (Ly, Ly and Andersson, 2017)

ECAs, in particular, have shown potential for mirroring the therapeutic process. ECAs are "*more or less autonomous and intelligent software entities with an embodiment used to communicate with the user*" (Provoost, Lau, Ruwaard and Riper, 2017). ECAs have three parts i) An application interface that enables user input to the ECA. ii) an algorithm that gives the ECA to mimic human thinking and speech capability. And iii) an embodiment or graphical portrayal of the agent (Provoost, Lau, Ruwaard and Riper, 2017). ECAs are suitable for self-monitoring mental health applications as they create a sense anonymity not present between a real human clinician and patient. As touched on before, this is particularly valuable to socially anxious users or for disclosing information about stigmatised subjects.

The main benefit of in-person one-on-one therapy, as opposed to computer-administered support, is the face-to-face element. Patients experience greater rapport, which is a critical for enhancing disclosure during face-to-face sessions (Lucas, Gratch, King and Morency, 2014). Unfortunately, while CAs benefit from users feeling a sense of anonymity, they struggle to build rapport. Critically, an embodiment can make up for some of the shortcomings of CA's with regards to mimicking the therapeutic process and enabling a higher level of rapport building (Clark et al., 2019). Bick-more et al.(2005) showed that a well-thought-out ECA with a face mimicking that of a human could build rapport and increase daily conversations and physical exercise without the presence of a human therapist. Such innovations in conversational interfaces for mental health provide us with a peek into what future supports could look like.

This does, however, raise the question of what qualities ECA's should have to benefit users?. ECAs that can convey empathy are more highly valued than those without (Provoost, Lau, Ruwaard and Riper, 2017). However, negative emotions should not be mirrored back to the user so as to not worsen the user's mental health by giving the impression they are being judged. Studies have also shown that users trust ECA's more when small talk is employed; however, this varies depending on user personality and the level of embodiment (Clark et al., 2019).

Using speech and synchronised nonverbal behaviours, Provoost, Lau, Ruwaard and Riper's (2017) ECA was able to actively probe patients for information by engaging them in open-ended dialogues aimed at self-disclosure about psychological problems. The Help4Mood project's Web-based CBT treatment integrated an advanced ECA that uses a dynamic emotion model to convey empathy in real-time to improve the ECA's capacity to build rapport (Provoost, Lau, Ruwaard, and Riper, 2017).

While it appears that users do not necessarily want to build rapport with CAs, often seeing them as tools as opposed to friends (Clark et al., 2019), there have been attempts to mimic the type of rapport building experienced with an actual human therapist by using an embodiment. Inspired by this, I have incorporated an ECA into the design of my project.

Section 3. Design

3.1 User Research

The most effective mental health supports are those that are liked, enjoyed and that engaged people (Technology and the Future of Mental Health Treatment, 2022). Given the strong emphasis on carefully designed systems in the literature, I conducted user research before beginning the design process to better understand and meet user needs. I wanted to understand why and how people interact with mood loggers, CAs, and multi-modal smart speakers.

Mood Loggers

I wanted to understand who used mood loggers and why they used them. Research by Schueller, Neary, Lai and Epstein (2021), found that users were motivated by periods of low mood and negativity in their lives. Users also believed tracking their moods would lead to more self-awareness and facilitate reflection and an understanding of the factors affecting their mood. Having said this, they also found that users were less likely to record negative emotions preferring to record positive emotions. People who use mood loggers advocate that applications include personalisation and simple features and visualisations that help highlight trends, such as calendars. Users also note a lack of guidance on interpreting mood data and improving mental health in self-monitoring applications. User burden associated with self-monitoring is highlighted as the primary limitation of user experience (Schueller, Neary, Lai and Epstein, 2021).

CAs

Users' experience is an essential metric in any application's design; however, this is especially true of voice applications. Some studies have even reported users were satisfied when Alexa did not produce the right information suggesting that interaction experience is more important than interaction output (Lopatovska et al, 2018). For this reason, it is crucial to examine how users interact with CAs. Voice assistants such as Alexa and The Google Assistant are most commonly used to check the weather, play music, and control other devices such as light bulbs, cameras, or TVs. Interactions with CA's are generally short, with users often engaged in other activities simultaneously, such as driving or cooking. They are used at weekends more than during the week; however, general usage tends to decline over time (Lopatovska et al., 2018). It is unclear whether voice-controlled applications are viewed primarily as information retrieval tools, leisure systems or simply as toys (Lopatovska et al., 2018).

Multi-Modal Smart Speakers

My application is intended to run on a multi-modal Google Nest Hub Device, and so I researched how people interacted with conversational agents on smart displays. Widespread use of voice assistants on home displays is a relatively recent occurrence; however, these devices are intended to be used hands-free, potentially from across a room (Introducing Google Nest Hub, 2022). Therefore developers are encouraged to make

applications voice first and with highly visible features (Design guidelines, 2022). The Google Nest Hub has sleep tracking capabilities and so is commonly used later in the day in bedrooms. The theme of the device will automatically switch to dark mode at sundown so as to not disturb the user's sleep (Introducing Google Nest Hub, 2022). In line with this, I incorporated a dark mode into the design of my application.

3.2 User Personas

After conducting user research, I created two user personas. These were representations of archetypes that I envisaged using my application.

The first user persona I named Sean. Sean is a college student in his early 20s. He's usually very busy with coursework and assignments. He is often stressed because of the pressure of maintaining good grades and a social life. He spends a lot of time outside of the house in college and at work. He does not have much time to check in on his mental health. He is interested in journaling to keep track of what he is doing and how it makes him feel. He is also interested in using his smart speaker to input and monitor moods to review the problems that lead to negative emotions.

Sean has mild stress and anxiety. He is also usually tired and has not taken care of his mental health due to a lack of time and structure in which to do it. Sean fears the social judgement and stigma surrounding mental health issues. He also fears his information being released or judged by clinicians. Sean aims to improve his awareness of mood trends so that he can proactively counter negative emotions and better understand himself. He needs a structured way to record emotions regularly to do this. He needs to improve his ambient awareness of his mental health and mindset.

I chose these characteristics as, from my research, I knew that there was a huge need for mental health support amongst students. In addition, 74% of mental health diagnoses begin before the age of 24 in a more manageable form than severe conditions. I believe that the application will have the most significant benefit to public health by targeting this demographic and providing support before issues become more serious.

Rebecca was the second persona that I designed. Rebecca is a mother who loves her family. She is often busy with work and taking care of her children. Rebecca is under pressure and has little time to take care of her mental health. Spending all day doing housework and taking care of her children, Rebecca does not have time to pamper herself, making it easy for her to generate negative emotions when facing her husband and children. Rebecca will use her smart speaker to input and monitor her daily mood development to review the problems that lead to negative emotions.

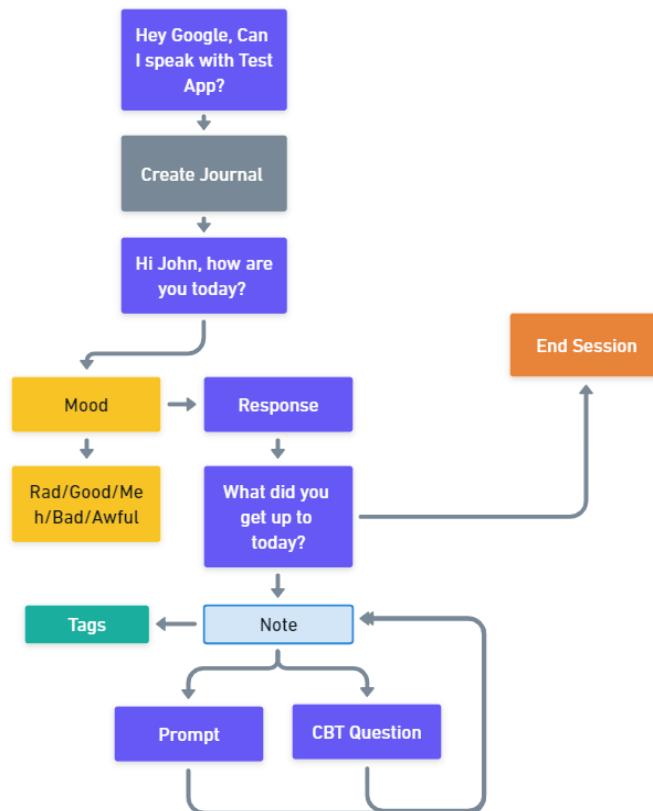
The problems she struggles with are mild emotional disturbances, fatigue and anxiety. She also has less time to take care of herself than before she had kids. She fears having to learn how to use applications on her smartphone that are time-consuming, and she does not trust apps on her smartphone to keep her information private. Rebecca wants control over her emotions, thereby minimising fatigue. She also wants to have time to take care of the family home and minimise worries about problems in life. She needs a method to read her personal emotions and time to take care of herself.

She was chosen because she represents an older age group than students but is still a tech-savvy millennial. This persona was already under a lot of pressure with busy family life; however, this has been worsened by the impact of the pandemic.

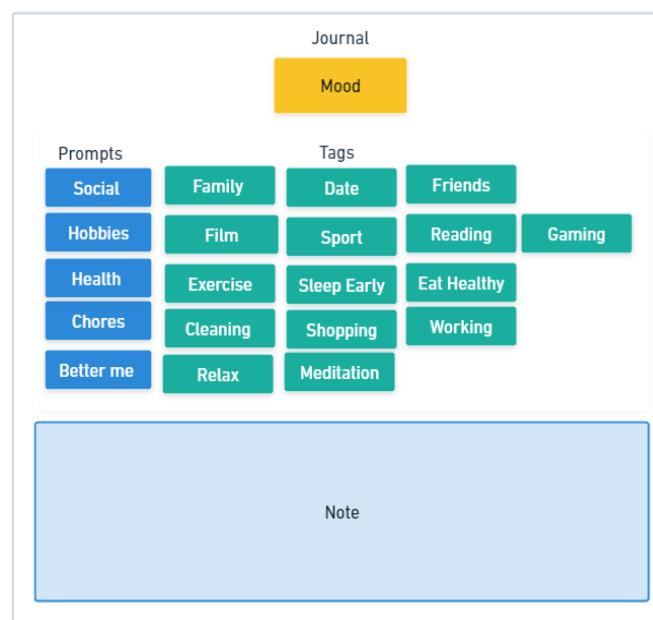
3.3 Early Concept

These were early concept designs for the application, which I kept in mind when writing the scenarios below.

Conversational User Interface



Graphical User Interface



3.4 Scenarios

I used the above personas as actors in two vivid descriptions of the user experience. Through writing out scenarios, I reflected on aspects of the design issues I had not foreseen and arrived at a fixed interpretation of the design. The first scenario describes Sean's interaction with the application, and the second focuses on Mary. These scenarios included details such as the users' intentions when coming to the system, a step-by-step walkthrough of the actions they took, and a description of what they could see on the graphical user interface at each stage of the process and how they interacted with the system. I also tried to include their thought process in the user experience description.

Through exploring these interactions, I developed a sense of the environment in which users were likely to interact with the system and how this might affect the design. For example, based on Sean's personality type and interests, it made the most sense that he would use the device at night in his bedroom. I came to this conclusion as he likely still lives at home with his parents and would prefer to disclose sensitive information in private. Additionally, a busy college student interested in sports would likely want to take advantage of applications on the Google Nest Hub device that could be used in tandem with the mood logger, such as the sleep sensor. Therefore Sean's scenario describes him routinely using the application at night before going to bed. Creating this scenario made me realise that creating a dark theme for the application to run in could be valuable to certain users.

In contrast, Rebeca's scenario takes place in the kitchen during the day as she has less fear of disclosure around her husband and kids and infrequently gets time to monitor her mental health. Rebeca takes opportunities to interact with the device when she gets them. In the scenario, this means talking to the CA hands-free while she is making lunch. This scenario brought the importance of clear and large GUI elements to my attention, as it needs to be legible from across a room. Unlike touch applications, voice technology allows the user to be further away than is generally needed. This scenario also reinforced the importance of designing the application voice-first, as recommended by Google's Developer Guidelines.

After each of the interactions takes place, I note that the actors take a moment to reflect on the information they reported. I believe this is an essential note as although the system does not attempt to recommend a treatment for low mood, the literature on mental health supports states that an awareness of one's own mood is the first stepping stone in treating issues and arriving at a higher quality of life.

3.5 Task Analysis

1. Initiate conversation
 1. Say "Hey, Google" or "Alexa"
 2. Wait for the device to respond.
 3. Listen to the question of the device.
2. Wait for the application to load.
3. Log mood
 1. Listen to the opening "would you like to log your mood?" question.
 2. Declare intention.
 - i. Decide whether to log mood or not
 - ii. Respond "yes" or equivalent
 - iii. Ensure correct interpretation.
 3. Respond to mood questions.
 - i. Listen to the opening "How did you feel today?" question.
 - ii. Reflect on mood from the day.
 - iii. Say Mood
 - iv. Ensure correct interpretation. {optional}
 1. Listen to the clarification "is this correct" question.
 2. Respond yes or equivalent.
4. Add a journal entry.
 1. Listen to the "would you like to add a journal entry for today?" question.
 2. Declare intention
 - i. Decide whether to log mood or not
 - ii. Respond "yes" or equivalent
 - iii. Ensure correct interpretation
 3. Listen to the opening "How did you feel today?" question.
 4. Respond to mood questions.
 - i. Reflect on the day's activities.
 - ii. State activities.
5. End conversation. {optional}
 1. Say a quit keyword.
 2. Ensure the process has ended.
6. View information collected. {optional}
7. Reflect on insights provided. {optional}

Upon completing the scenarios, I analysed the tasks the user would have to complete to do a full run-through of the system. The user can choose not to log their mood for a day and just record a journal entry and vice versa. The system will not always require some tasks, such as ensuring correct interpretation. For example, if the user replies to the question: "What was your mood today?", with "Good" or any of the other suggestion chips ("Excellent", "Good", "Okay", "Bad", or "Awful"), the system will not ask for clarification as their intent is clear. However, the system will request clarification when encountering responses such as "I feel quite well", the NLP algorithm will likely match it to "Good" and ask for confirmation. This was done to make the process more efficient. The task analysis above is a verbose description of the conversation. In reality, many of the tasks above are done with minimal effort from the user, perhaps even subconsciously as a side effect of the natural delivery method.

3.6 Designing for Voice

When designing the CUI for the application, I attempted to follow conversation design guidelines and best practices as set out in the Google Conversation Design Guidelines. This involved ensuring action works well for conversation, creating a brand persona, handling errors in the conversation and experimenting with a voice-only interface before testing a graphical user interface (GUI). In line with these guidelines, I tried to provide the same experience with touch as with voice as far as possible and ensured that the main route through the application was possible through voice alone. I also attempted to reduce the cognitive load placed on the user throughout the interaction by avoiding verbose voice responses.

3.7 Sample Dialogs

Writing the scenarios provided the context in which the conversation would take place, and the tasks analysis highlighted in detail the order in which tasks would need to be executed. I decided to create a more nuanced and focused investigation of the conversation itself with these in mind. For this reason, I created sample dialogues designed to showcase the most common pathways through the system, other rarer yet critical paths, and error recovery examples.

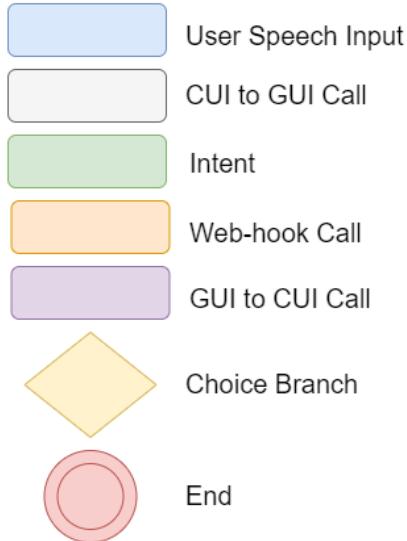
I wrote out two conversations that achieved all the tasks in the task analysis using completely different sentences from both the user and the CA. I then had two variants for each stage of the conversation ready to be transferred into code during the project's implementation phase. Writing the sample dialogues and then reading through them made me realise that some parts of the conversation were too formal. I had written the sample dialogues as though I was writing an essay or email. I revised parts of the dialogue and ensured that they sounded more natural.

After writing out two successful run-throughs of the conversation element, I decided to write out another sample dialogue where there was an error in the system. In this example, the CA misinterprets the user's mood and must be corrected. I mapped out how the CA's logic would deal with this situation and referenced it later when coding the logic for the conversation in the Google Actions Console.

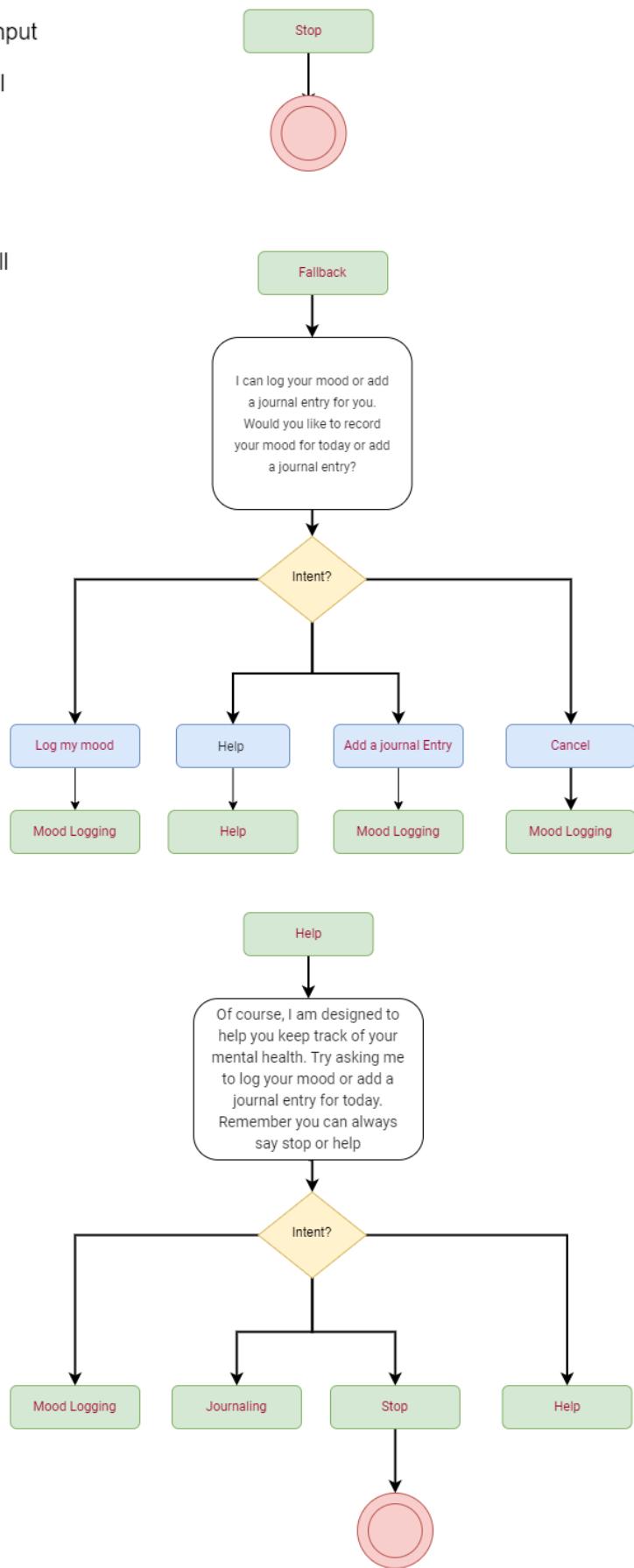
I also understood what information had to be available to the back-end of the conversation and when. For example, the CA would say "hello {{username}}, would you like to log your mood for today?" at the beginning of the chat; therefore, the user must have loaded the user's login details very early on before the conversation can proceed.

3.8 Conversation Flow Map for Mood Logging

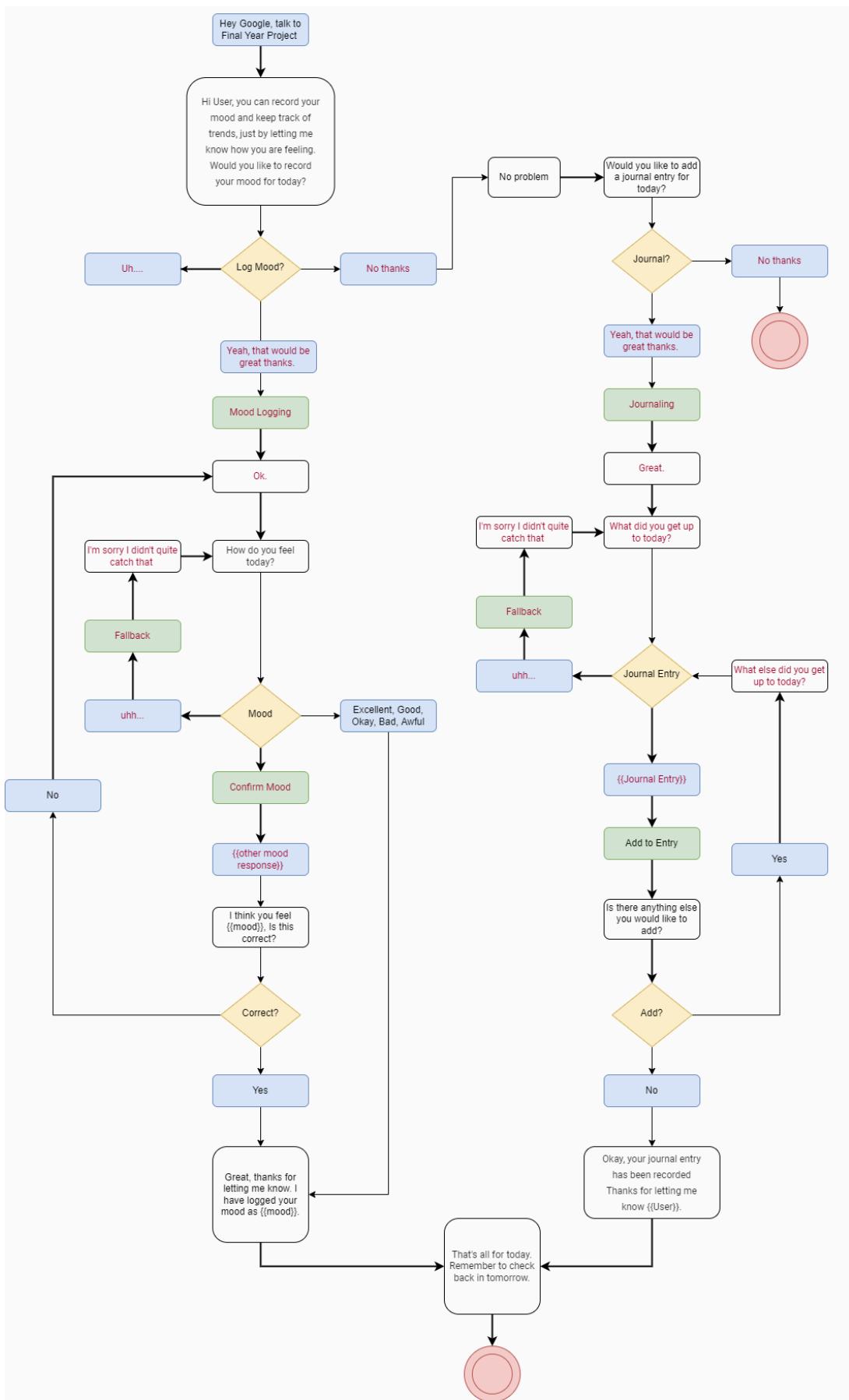
Key



Global Intents



Conversation Flow



I used a VUI design tool called Voice-Flow to map out the conversation visually before I built it in the Google Actions Console, which is used to create voice apps that run on Google devices. This was helpful because it allowed me to interact with what I had designed before getting stuck into the technical aspects of scenes, intent types, and managing information between the front and back end. I used Voice-Flow to build up the conversation and include fall-backs for when the system's NLP fell short.

The conversation has two main flows: the mood logging flow and the journaling flow. The user will first be greeted by the system and reminded of the system's intended use. The user will then be asked whether they want to log their mood.

When asked whether they want to log their mood, if the user answers "No" or any variation of "No" that Google's NLP model recognises, they will skip the mood logging flow. If the user answers "Yes" or an equivalent answer, they will be asked how they felt today, and their response will be analysed. If they responded with any of the suggestion chips, which are "Excellent", "Good", "Okay", "Bad", and "Awful", they will not be asked for confirmation as it is clear how their answer should be classified. Otherwise, the system will deduce which of the five options best fits the user's input and then seek confirmation. If the system correctly interprets the user's input, they will answer "Yes" to the prompt. "I think you feel {{mood}}. Is this correct?". Otherwise, the user will be asked for their mood again until the system correctly interprets the user input.

The user is then thanked for letting the system know about their mood and asked if they would like add a journal entry. If the user answers "no" the system will thank them for their time and remind them to check back in again tomorrow before ending the conversation. If the user answers "yes" they will enter into the Jornaling Flow.

This flow asks the user open ended questions about their day such as "What did you do today?" any input is valid at this stage of the conversation and the system will listen until the user stops speaking. Once the user ceases speaking the system will acknowledge their speech and ask if there is anything else that they would like to add. If there is, the user will repeat the same process as before where they speak freely about their day until they have nothing else to add. This way the system can record everything that the user has to say without leaving the microphone open for a long period of time. The user can also take a moment in between adding journal entries to reflect further.

When the user is finished adding journal entries the system will use Googles entity analysis API to extract key entities from the text. These entities will then be saved to a database along with the raw journal entry text. The user is now finished with the primary flow through the conversation. They are thanked for informing the system and reminded to come back tomorrow to interact again.

At any stage during the conversation a user can say "help" or "stop". The help command allows the user to leave the part of the conversation that they are currently in and are reminded of the purpose and capabilities of the system. The stop command ends the conversation and relinquishes control of the device back to the Google Assistant. There is also a default fallback intent which is activated when the user's input is invalid or missing. In some cases the default fallback response is overwritten to provide a more appropriate reply.

3.9 Fall-backs and Multiple Responses

If the user input is not detected, the systems will reply with a variant of the message “Sorry, I didn’t quite catch that. Can you say it again?” and that phase of the conversation will restart. If this happens more than once, the user will enter the fallback intent, which reminds the user what the system is capable of and their options. At all times, the user can say “help” or “cancel”, in which case the system will leave the current intent and provide guidance or end the conversation.

Multiple variants of responses at each stage of the conversation can make the conversation feel less repetitive. It was clear that variants of CA speech were essential as the application is designed to be used daily; meaning that users could quickly become familiar with the set responses. Alternating between different sentence variants could make the conversation sound more natural and keep the conversation fresh over multiple iterations.

I created as many variants as I could for each conversation component, often combining them in compound sentences to increase the number of speech possibilities. Once the user logs their mood, the CA will i) confirm the mood has been saved “I have logged your mood as {{mood}}” then ii) thank the user for informing them, e.g. “Thanks for letting me know {{username}}” and finally iii) ask the user if they would like to add a journal entry, e.g. “would you like to add a journal entry for today” I aimed for each part of the conversation above to have five variants meaning that when combined randomly there are 5x5x5 or 125 different ways the CA’s turn of speech can sound.

3.10 Frontend

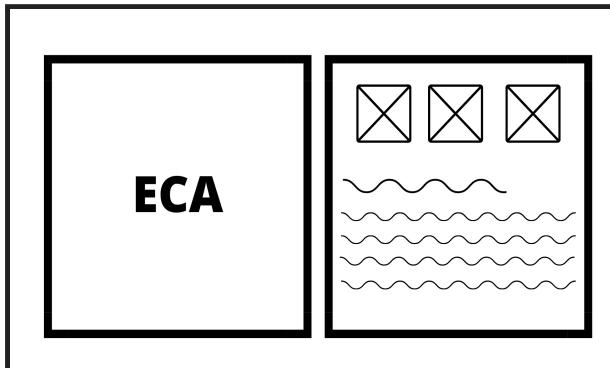
Once I had a concrete understanding of how the CUI would be implemented, I began to design the GUI. I included a visual front end primarily because of recommendations in the literature that suggested an ECA could increase the user experience. The user research that I conducted highlighted that people who used mood loggers preferred to have visualisations such as a calendar view to help them reflect on their moods.

Smart displays are often compared to tablets or phones as they share many of their characteristics; however, there are two reasons why smart displays reside in a unique category of devices. 1) They are voice-operated and run by The Google Assistant. And 2) They are stationary and generally placed in a kitchen or bedroom.

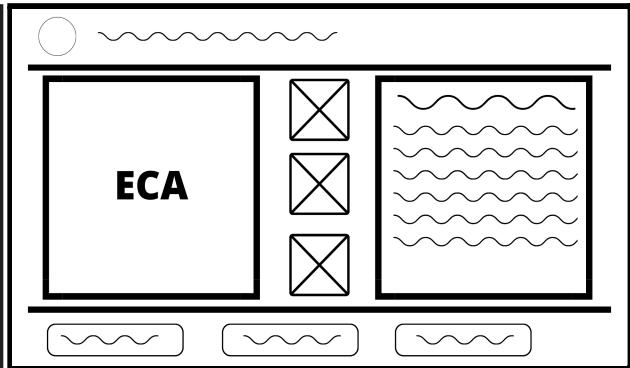
For these reasons, users are often not near the devices when operating them, and they are often multitasking. When designing GUI for such devices, these unconventional usage circumstances must be kept in mind. Developers cannot always rely on users to be able to touch their devices, and so the application must be capable of proceeding solely on voice input. I, therefore, designed the CUI first as I wanted the application to be voice-first and feasible, irrespective of the presence of a visual front-end as recommended by Google's Developer Guidelines

3.11 Wireframes

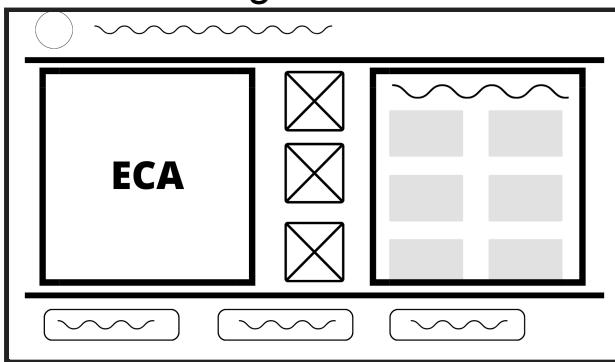
Original Design



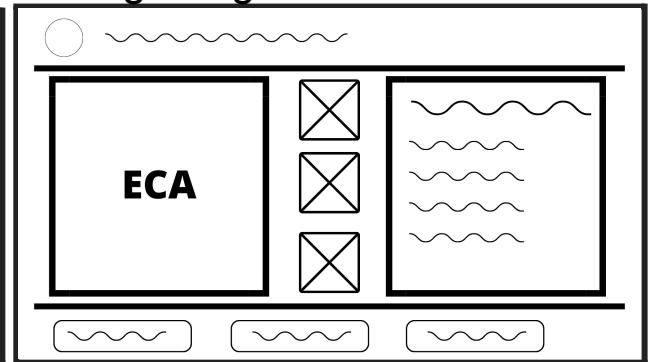
Journal Page



Calendar Page



Settings Page



I needed to have a strong skeleton of the design as Google's Developer Guidelines recommend that the front-ends be single page websites; therefore, all webpages must have the same layout. I cut out sheets of paper to the dimensions of the Google Nest Hub screen (1024px x 600px) and then iteratively created multiple wireframes converging on one design. The final design had the least unused space and allowed for the largest font possible. This was important because I wanted the text and ECA expressions to be visible across a room.

Wireframing also allowed me to establish the site navigation very early in the design process. I found that quickly placing user interface elements in different locations helped me catch problems and make revisions early in the design process. I realised early in the wireframing process that I needed to reserve space at the top of the screen as any user interface elements within 120 dp of the top of the screen would be covered by the text to speech visualisation that Google provides. My initial wireframe design had poor use of space with duplicate information on the screen and blank spaces.

3.12 Brand Identity and Animation

Google's developer guidelines recommend that smart display actions for The Google Assistant have a brand identity.

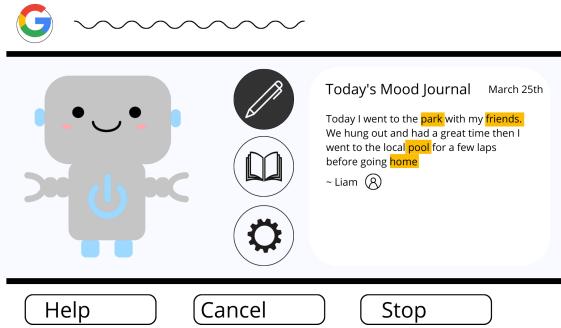
I designed the conversation and graphics to be clean and simple yet interesting and engaging. I tried to promote an engaging experience by incorporating bright colours to highlight information or bring the user's attention to elements. I also used fonts from Google Fonts API that were clean, smart and highly legible but not too formal.

I created a dark mode theme for the application inspired by the scenario I wrote where Sean uses the application at night time just before he goes to bed. It also helped the application tie in better with the native Google assistant interface, which has a "dark mode" which automatically turns on at sundown. Users are asked to manually set their view mode the first time they use the application; however, they can change their view at any stage during an interaction on the settings page.

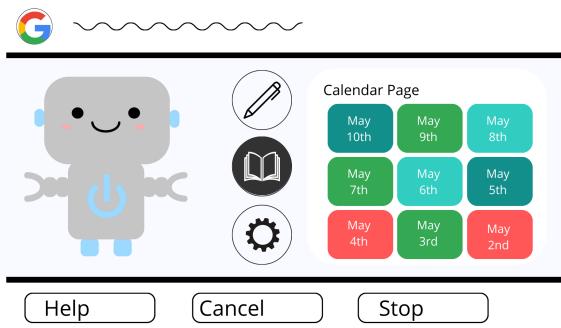
I believed a colourful and emotive ECA could help drive engagement. To make the ECA as accessible as possible, I attempted to make it seem empathetic, friendly, patient, and helpful but not too playful to appear childish. I made the ECA three dimensional as I thought it added a sense of depth to the application that added to the impression that someone was there listening. His "speak" and "listen" animations are intended to make him appear interactive and empathetic. I hope the ECA is attentive and focussed, someone that can be counted on.

3.13 Mock-ups

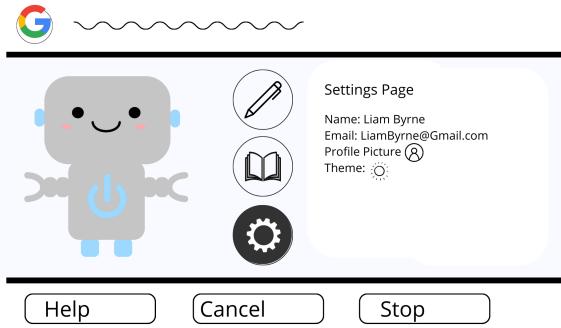
Today's Mood Journal Page



Calendar Page



Settings Page



I created mock-up images of the user interface, which was built on the skeletal foundation of the wireframe. By creating a more detailed image of how the user interface would appear, I could experiment with different fonts, text sizes, colour schemes and icons without changing CSS and HTML. I left room for the ECA on the left-hand corner of the screen. I was not sure how the final ECA would appear during the mock-up stage, so I used a graphic of a bot as a placeholder where the ECA would later appear. The ECA I designed had better use of colour and made the application more appealing to users.

Smart display applications must be designed with a specific viewing distance in mind. This viewing distance depends on the size of the room in which use is predicted; however, it typically ranges from three feet to ten feet, according to Google Developer Guidelines. These guidelines recommend a font size of at least 32pt for primary text and 24pt for paragraphs or other text.

I aimed to reduce the user's cognitive load by keeping the content presented on the screen neat and concise and avoiding placing any important information at the bottom of the screen, as suggested by Google's Design Guidelines.

3.14 Prototyping

As I had already designed the conversational path and utterances and created a mock-up for the user interface, the prototype I developed was mainly for proof-of-concept and to ensure that the interactions I had developed, both touch and voice, would work well together. The prototype was low fidelity compared to the mock-up as I did not see the utility in recreating the design of my mock-up in great detail. Instead, I focussed on ensuring good button placement and the ability to navigate around the interface seamlessly and intuitively. I used the tool “marvel.io” to run the GUI prototype as it offers a very simple, straightforward process. By running through the prototype of the GUI, I realised that because the page for today's journal entry was identical in structure but different in content, it would be beneficial to the user to highlight the button for the page that the user was currently on which could help reduce cognitive load.

I used the conversational design tool “Voiceflow.io” concurrently to prototype the voice interaction. Voiceflow allowed me to see the conversation graphically as a flowchart and make any necessary edits to the conversation. By running through the prototype conversation, I noted multiple points where syntax errors occurred, such as commas and full stops being beside each other where CA speech was chained or repetitive use of language.

Section 4. Implementation

4.1 Google Assistant vs Alexa

In order to create an embodiment of my CA and avail of all the benefits of ECA's that are suggested by the literature, I needed a front-end design framework that was flexible and offered a high degree of control over what was being presented on the smart display. My options for implementing the front end were Alexa Programming Language, Google's Rich Response Prompts or Google's Interactive Canvas. Alexa's Presentation Language had the most sample applications; however, the sample displays were low quality compared to my prototype. Google's Rich Response Framework is a way of providing user interface elements such as lists, carousels and pictures by sending user interface prompts directly to the user device with conversation data. This offered me a way of controlling the graphical display from the Google Actions Console without the hassle of creating a separate code base for the front-end, which appealed to me. However, I quickly realised that I would need greater control and flexibility to implement the ECA than this choice could offer me.

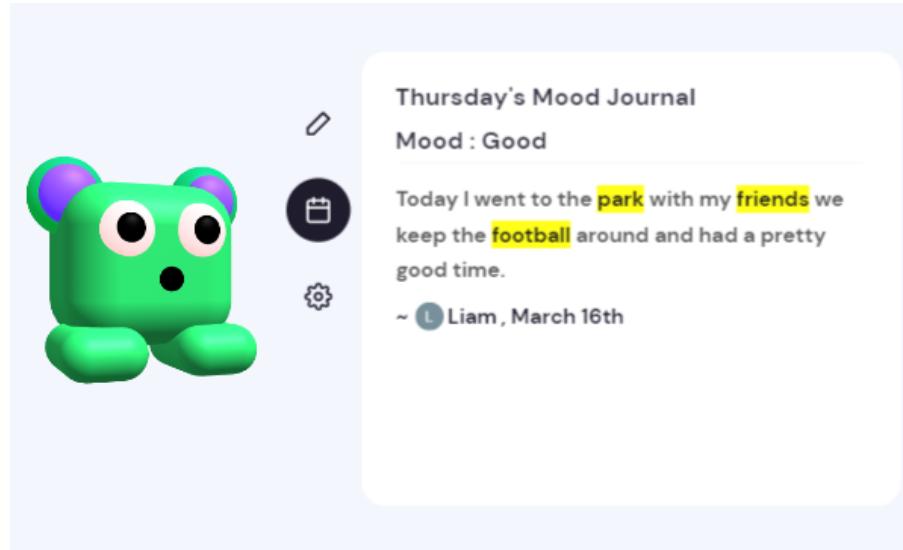
Using web technology such as HTML, CSS and JavaScript opened up the possibilities for ways to implement the ECA. Google's Interactive Canvas framework was a good choice for the project because it used standard web technologies with which I already had some experience and was far more flexible than the other two options. Google Actions can avail of the Interactive Canvas Framework, which, despite being a relatively new feature, is well documented. Its biggest flaw was a lack of tutorials that I could reference for the project, as the developer community around the tool is still growing. In addition, Interactive Canvas has not been completely rolled out yet, and only actions published under the categories of "Family" or "Games" will be approved for deployment by Google. This was not an issue for this project as I did not intend to publish the application; however, future work should check whether this limitation is still in place.

The realisation that interactive canvas was the most suitable front-end framework for the project encouraged me to build the application through Google's Voice Ecosystem. However, I still researched to ensure the conversational element would not suffer. Competition is fierce between The Google Assistant and Amazon Alexa. The battle to win developers over has even been called "the next big app store battle", as both sides have significant draws. My research concluded that both Alexa and The Google Assistant were technically more than capable of understanding user intents and processing them efficiently to deliver my application. One limitation of The Google Assistant that I considered minor was the reliance on an internet connection to work (which Alexa does not require).

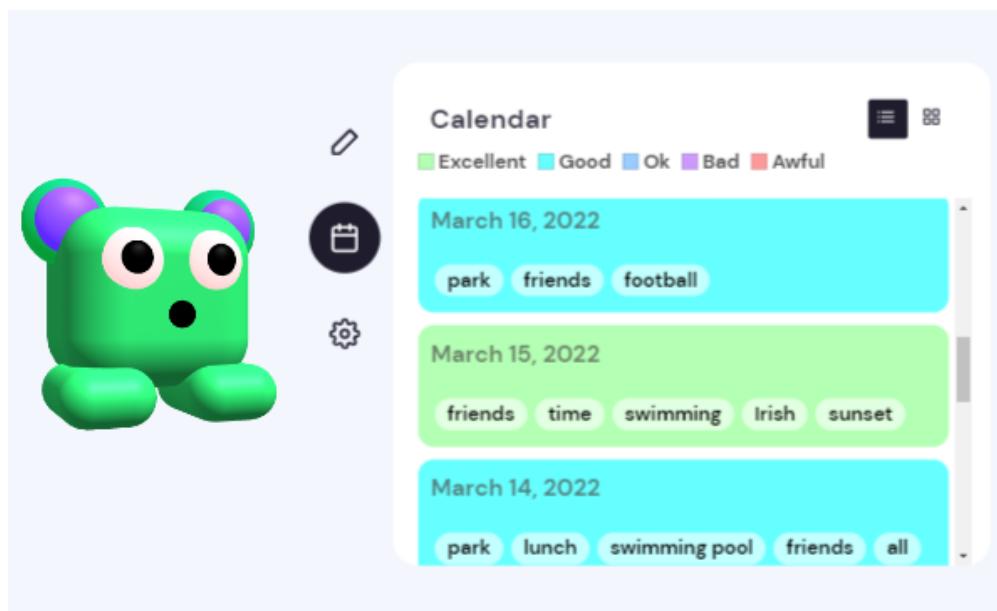
I also looked at the prevalence and usability of devices. As the goal of my application is to deliver the greatest possible public good, it must be able to reach as many individuals as possible. Amazon's devices only run Alexa, and Google's devices only run The Google Assistant; therefore, choosing which VA to develop for limits the application's range.

4.2 Entity Analysis API

I used the entity analysis API to analyse the user's journal entries for known entities and return information about those entities. The reasoning for this was twofold 1) This would help bring the user's attention to factors that could have influenced their mood, and 2) It helped pick out key pieces of information from the journal entry so that users could quickly tell what happened a specific day.



Take, for example, this basic journal entry from March 16th, "Today I went to the park with my friends. We kicked the football around and had a pretty good time". An analysis of the key entities in this sentence would reveal that "park", "friends" and "football" were the key entities. Therefore, when the user is reflecting on their past moods at a later date, they will see that on March 16th, they were in a good mood and spoke of "park", "friends" and "football". They will also be able to see that they were in an excellent mood the day before when they also spoke of swimming. (see image below)



Using the analyzeEntities method of Google's Natural Language API text can identify proper nouns such as the names of people, organisations, locations or events, amongst many other types of entities. Analysing user input like this and displaying it for the user helps the system simulate an understanding of the user's open-ended input. The Entity Analysis API also returns other information about the entities, such as Wikipedia URLs to the entities page. Salience (the importance of that entity within the input text) and other mentions.

4.3 Tools

The Tools that were used throughout this project.

Development

- Google Nest Hub
- Google Actions Console
 - Google Actions Builder
 - Google Actions Console CLI
- Google Firebase
 - Firebase CLI
 - Firebase Hosting
 - Firebase Cloud Functions
 - Firestore Databases
- Google Natural Language Processing API
 - Entity Analysis API
- Google Interactive Canvas API
- GitHub2
- Visual Studio

Design

- VoiceFlow
- Draw.io
- Figma
- Marvel
- Canva
- Spline
- Code
 - Live Server

Languages

- JavaScript
- HTML
- CSS
- Vue.js

Because I was already using Google Actions Console for building the conversation Google Natural Language API for extracting entities from the journal entry and Google Nest Hub to run the application, I decided that keeping all tools in the same ecosystem would be the most straightforward option.

Although not strictly necessary, Google encourages developers to use their cloud services in conjunction with conversation tools. This project was built using Google Cloud's Firebase service, which provides all the tools necessary to develop a web application with in-depth documentation and tutorials on how to integrate a web application with the Actions console. This project implements Firestore Databases, Firebase Hosting and Firebase Cloud Functions. These services allow the application to scale quickly and progressively roll out new features. Firebase also provides an analytics console for measuring user engagement and retention such that application infrastructure can be scaled up to meet demand.

Firebase is designed to be friendly for developers who have less experience and many of its features are simplified extensions of what Google cloud platform offers except that overly complicated niche features not needed for small web apps have been pared away making it an attractive alternative to Amazons Cloud Services or the full Google Cloud Platform.

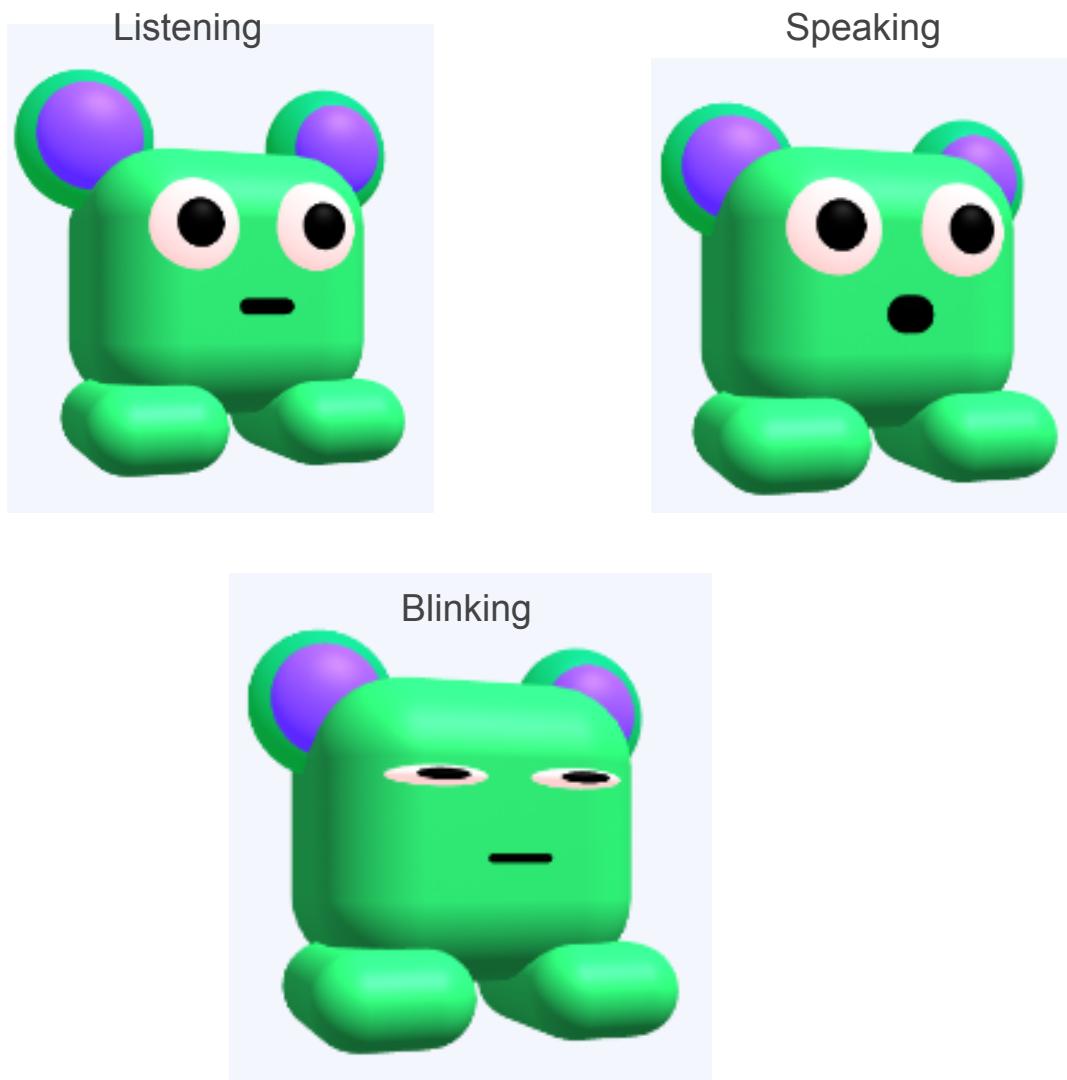
4.4 Vue.js

Vue.js was chosen for the frontend framework of the project. Vue.js is a state-of-the-art framework with compact file sizes (18 - 21kb) and fast performance because of its ability to control HTML already rendered by the server, unlike “React”. The framework also boasts better load times than many other frontend frameworks. The framework's performance was the most important factor in choosing Vue.js as the project's front-end framework, as the speed is a common critique of the Google Assistant's Performance. In addition, Vue.js offered flexibility and ease of use that other frameworks, like Angular and React, do not. Vue is very user friendly and does not have a steep learning curve. It also has extensive documentation and support. In addition, the framework allows languages such as JavaScript, HTML and CSS to be written in one file.

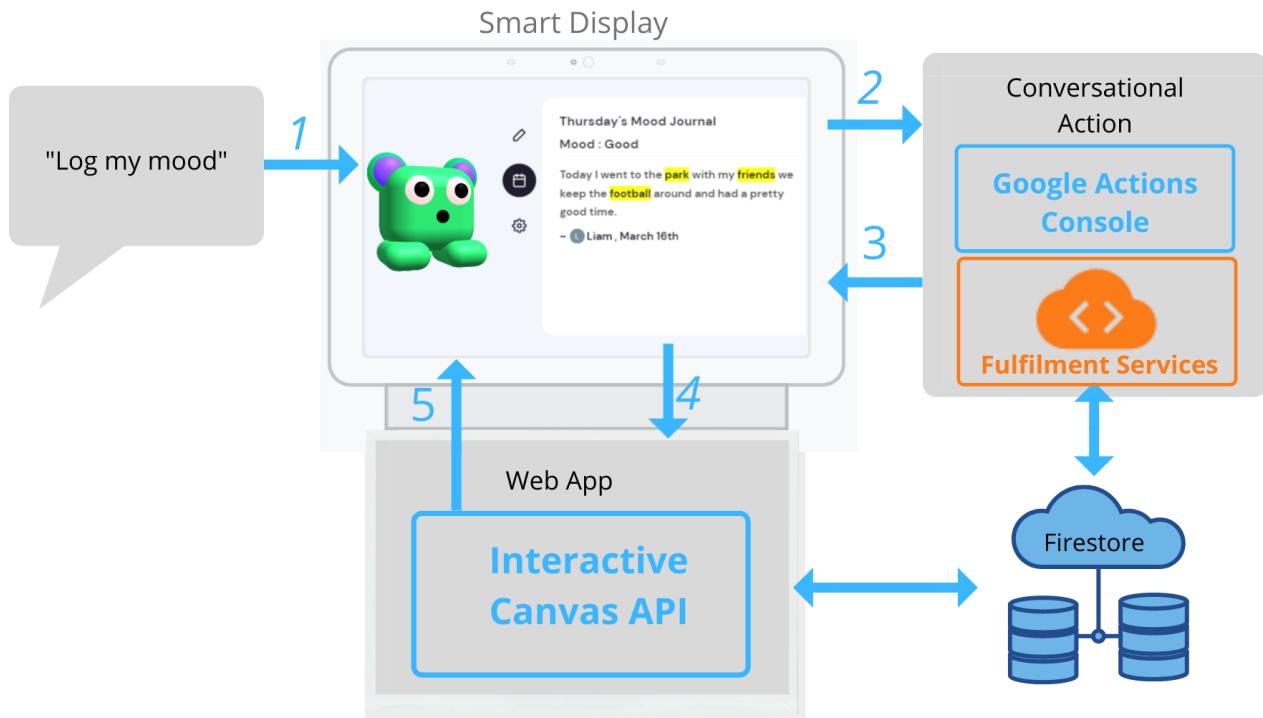
4.6 ECA: Spline

Google's design guidelines recommend lightweight javascript animation tools such as three.js or GSAP to create animations; however, I chose to try a 3D design tool called Spline to model and animate the ECA. I was apprehensive as to whether the Google Nest Hub devices would struggle with the computational load of rendering a 3d animation; however, this was not the case, as adding the ECA did not add significantly to the load time of the web app.

Spline was exceptionally convenient as it is a no-code tool that allowed me to create animations that keypresses could trigger. As there is no keyboard attached to Google Nest Hub devices, I could programmatically simulate keypresses that would trigger emotions. For example, when the conversation sends the “mic open” prompt to the GUI. I could catch this and simulate a key-down press on the L key triggering the “listen” animation on the ECA, giving the impression that the ECA is listening. Likewise, I wrote code that would simulate the “L” key being pressed when the GUI received the text-to-speech prompt. This was an effective workaround that allowed me to avoid learning a 3D animation Javascript framework; however, future projects would likely not be bound by the same time constraints and may benefit from taking another approach.



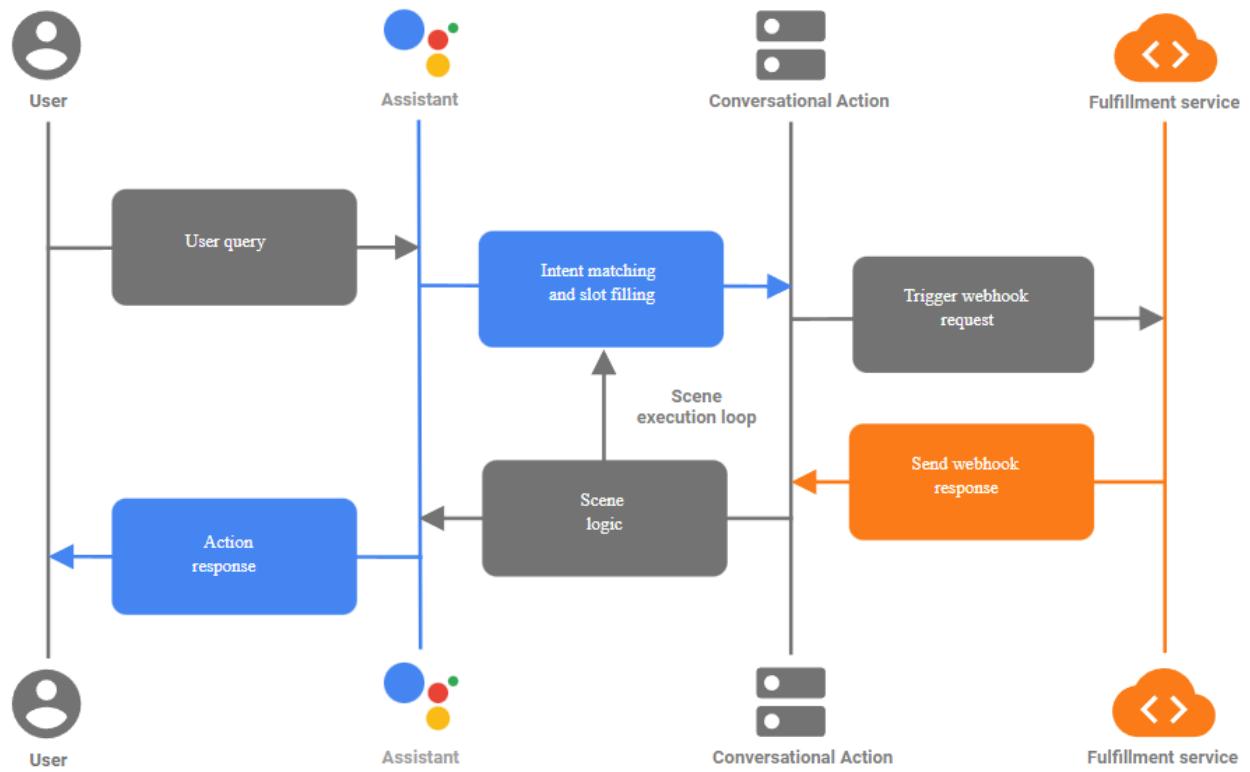
4.7 Data Management



1. User asks the system to use mood logger
2. The Actions On Google platform matches the user's utterance to match an intent.
3. The Actions On Google platform matches the intent with the action scene. If a webhook call has been specified in the scene logic then the conversational action will trigger the webhook. Webhooks are used to complete backend tasks. This results in a canvas prompt being sent to the device. If it is not already loaded, the device loads the URL contained in the prompt.
4. When the website loads, it registers callbacks with the Interactive Canvas API. If the canvas prompt contains data, this will be passed into the registered onUpdate callback, which implements custom logic. e.g. the canvas prompt contains the data mood: "Good".
5. Custom logic will make the defined changes when the web app receives the data prompt. For example, the custom logic in the onUpdate callback will change the GUI to display the mood as "Good" when the mood data value is passed in as "Good".

4.8 Webhooks

Google actions work by having intents trigger scene changes and each scene has specified logic for how the conversation will progress depending on the user input. For example scenes include logic such as loops if statements, slot filing and passing data to the screen. If the developer wants a complex back-end task to be completed during a scene then they must offload the code to a webhook to be executed online.

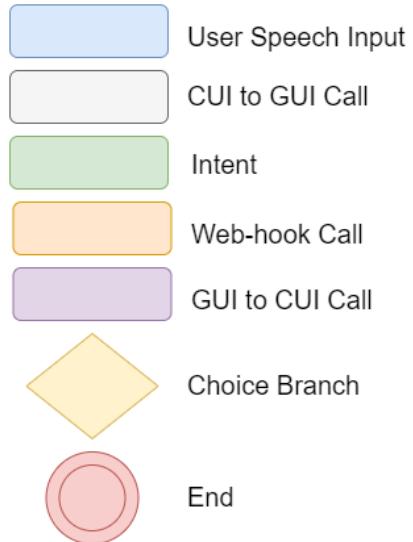


In this system, webhooks logged users into their Google Accounts, set and retrieved user preferences such as viewmode and set and retrieved user data such as moods, journal entries and mentioned entities. The cloud computation services for this project are provided by firebase cloud functions. The webhook call must be specified in the conversational logic to be called during runtime.

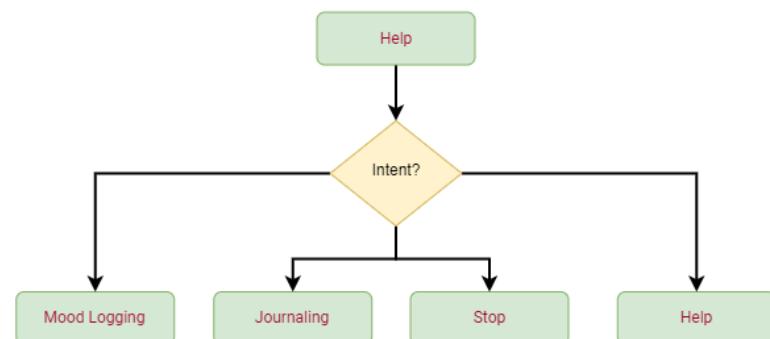
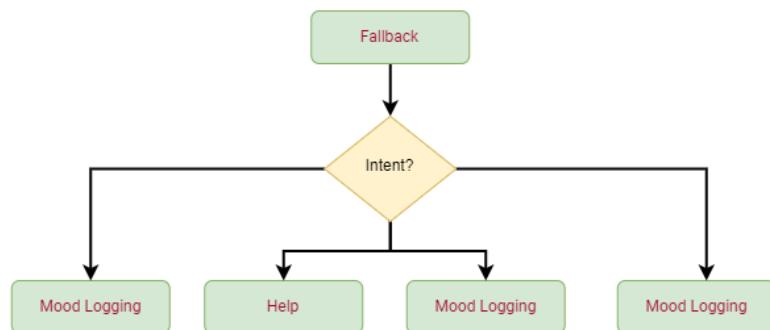
Section 5. Created System

5.1 Conversation

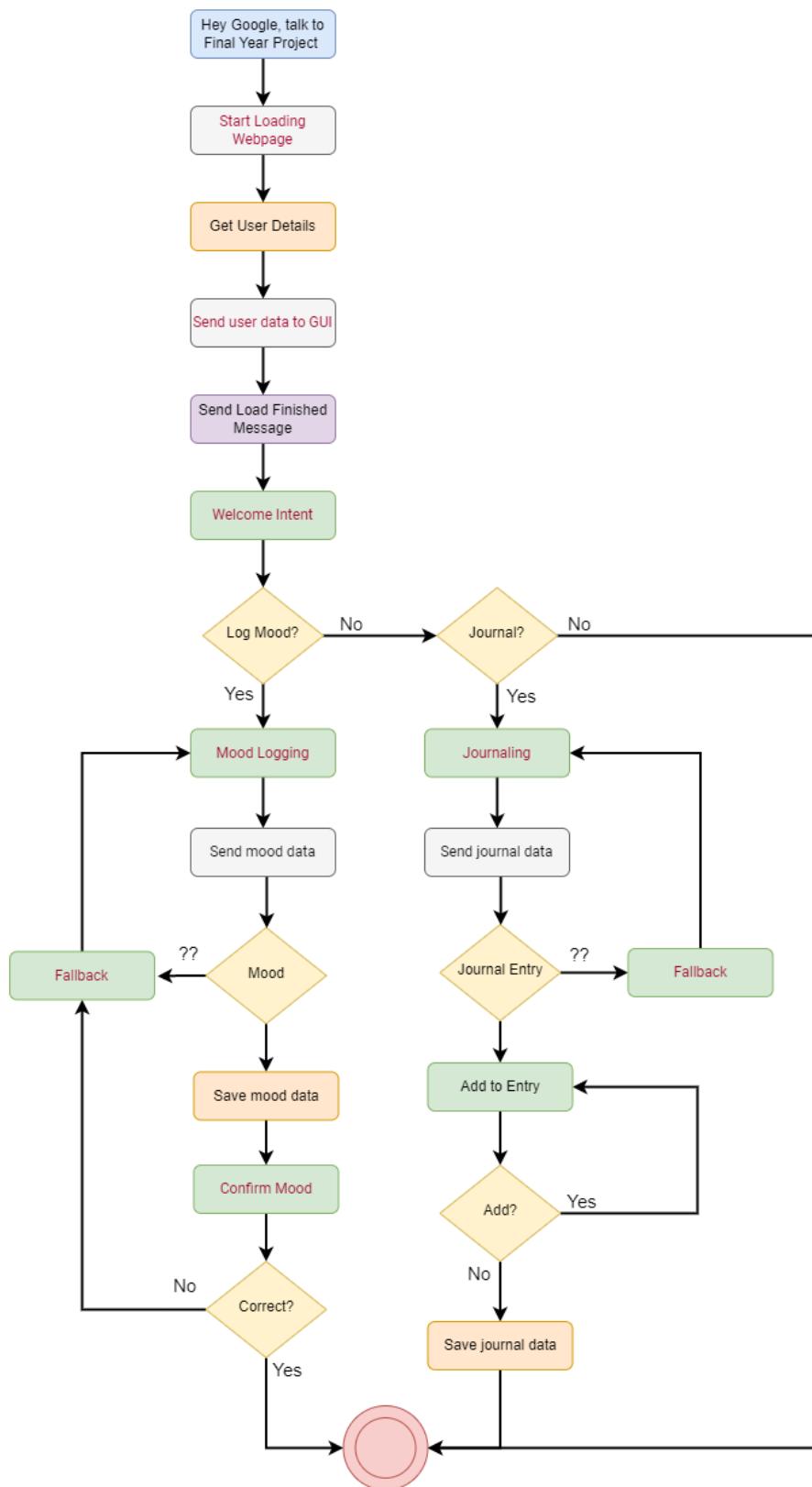
Key



Global Intents



Conversation Flow



An interaction with the application begins when the user asks Google to “Talk to my Mood Journal”. The actions on Google Platform will match the users request with the main invocation for the Mood Journal action. The Google assistant will say “Okay, Getting the test version of Mood Journal” and switch to running this application.

The Actions Console sends a canvas prompt to the device running the application which tells it to start loading the web app at a specified URL. While the GUI is loading, the conversational back end will log the user into their google account by triggering the linkAccount webhook and executing custom code hosted in firestore cloud functions. Now that the user is logged in the system has access to data such as their name, email address and google picture. We can also access user storage which is conversation data stored from the last time they used the system such as their preferred viewmode.

When the GUI is finished loading it triggers the “Welcome” intent which matches with the “Welcome” scene. Starting the interaction between the user and ECA conversation back end to let it know that it can proceed. Without this step the conversation would proceed without the GUI having fully loaded meaning the ECA’s speech could be heard without any embodiment or without the correct animations corresponding to the state of the conversation.

The welcome scene first sends another canvas prompt containing the users details and preferred viewmode to the now fully loaded front end. This data is registered by the onUpdate callback of the Interactive Canvas API which calls a Vue.js method set up to make the appropriate changes to the webpage. In this case the Vue.js code updates the name and photo displayed on the Mood Journal and Settings page and updates the current viewmode to match the data sent.

Any conversation data specified in the welcome scene also gets sent from the actions console to the users device. In this case the conversational data says “Hi {{user}}, you can record your mood and keep track of trends, just by letting me know how you are feeling. Would you like to log your mood for today?” starting the conversation between the user and ECA.

From here the conversation progresses according to the Conversational Flow Map in section 3.8. The user is greeted and then states if they want to log their mood and then does so if desired. Their understood mood is then sent to the screen in a canvas prompt which is caught by the interactive canvas’ onUpdate callback so they can see it infront of them when they are asked if it is correct. If it is correct the mood is saved to database.

Once Mood logging is complete (or skipped) the user is asked if they want to add a journal entry. If so the system will accept any input to open ended questions about their day until they stop wanting to add more to their journal. Every time the user adds to their journal entry the text of their cumulative input is displayed on the screen. Once the user is finished adding journal entries the system will save and analyse their input for key entities and save the raw text and entities to a database. For more detail on the conversation refer to the diagram labeled Conversational Flow Map.

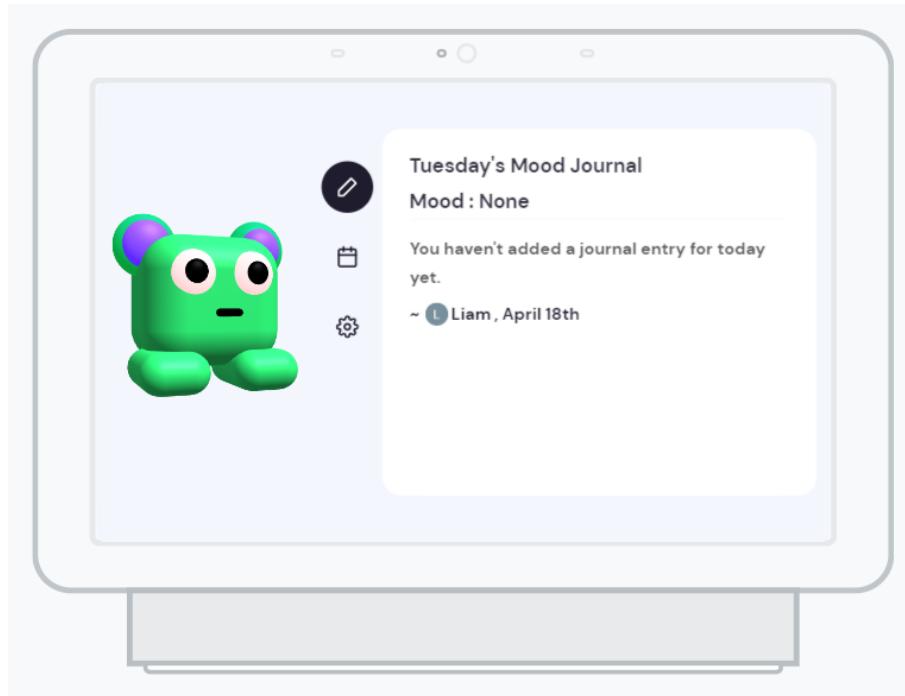
5.2 Graphical User Interface

All of the pages on the GUI have the ECA and buttons occupying the left side of the display and the page content displayed on the right side. Splitting the rectangular display in half like this allowed me to give nearly equal screen room to each user interface element. I positioned the ECA like this for two reasons 1) I wanted it to be constantly visible while the user was navigating through the interface and 2) I wanted the least amount of unused space as possible which meant displaying the embodiment off to the side and letting page content fill the remaining amount of room .

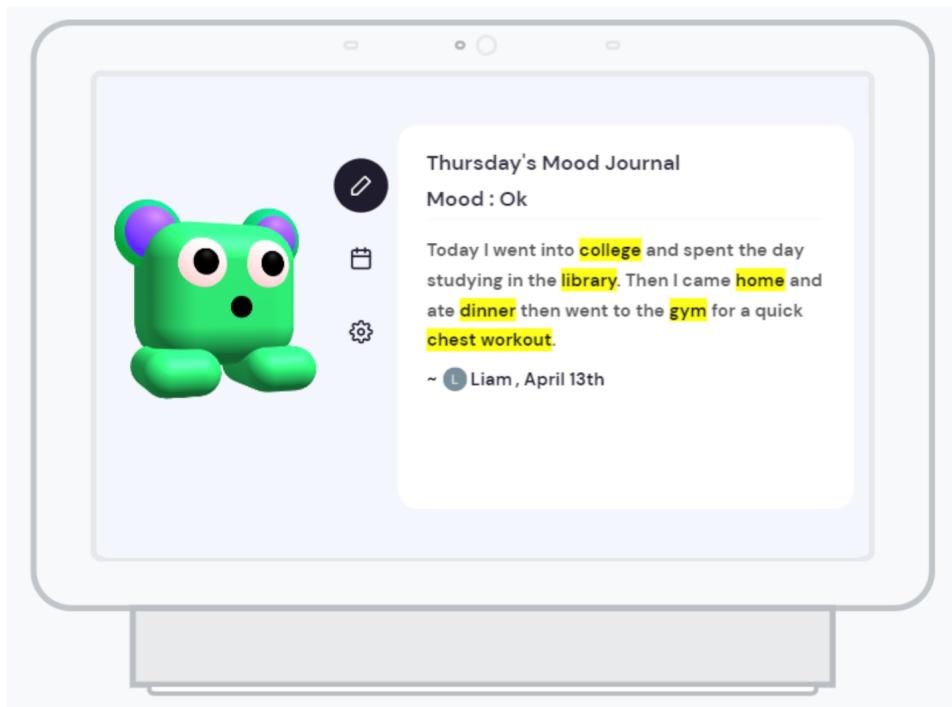
All elements on the screen have smooth rounded corners and good contrast between the text and backgrounds. Bright colours were used to bring the users attention to the most important elements on display.

5.2.1 Mood Journaling

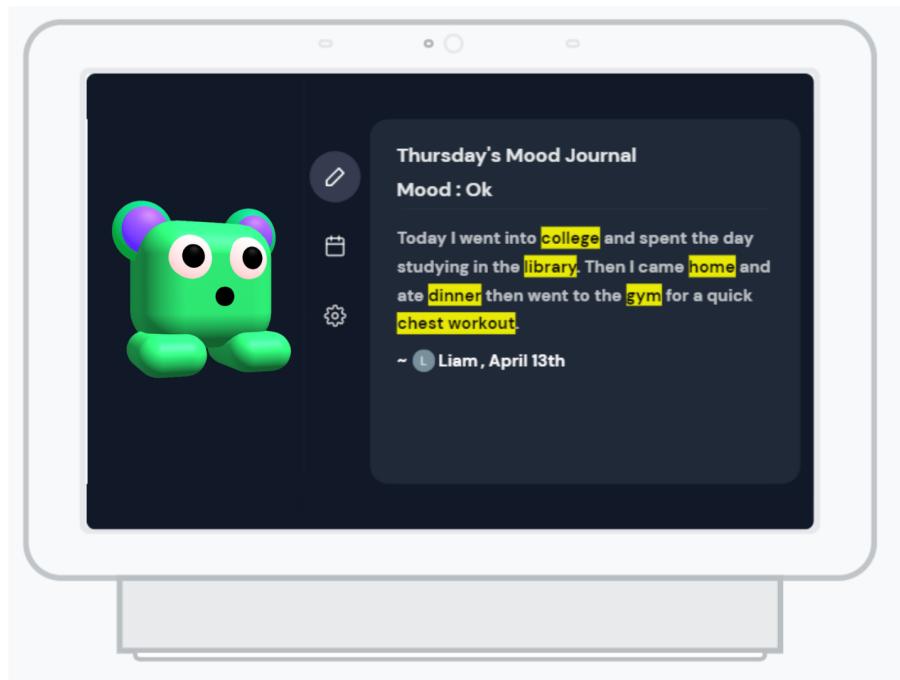
Before Mood Journaling



After Mood Journaling



Dark Mode



The Mood Journaling page is what is on display when the user first opens the application and when they are logging their mood or adding a journal entry. The user is on this page when the button with the pencil symbol is highlighted. The mood journaling page has "{{Day}}'s Mood Journal" as the header. Initially on the mood journaling page the user is informed that they are yet to log their mood or add a journal entry for today. If the user has navigated through the system already that day then underneath the title they can see their

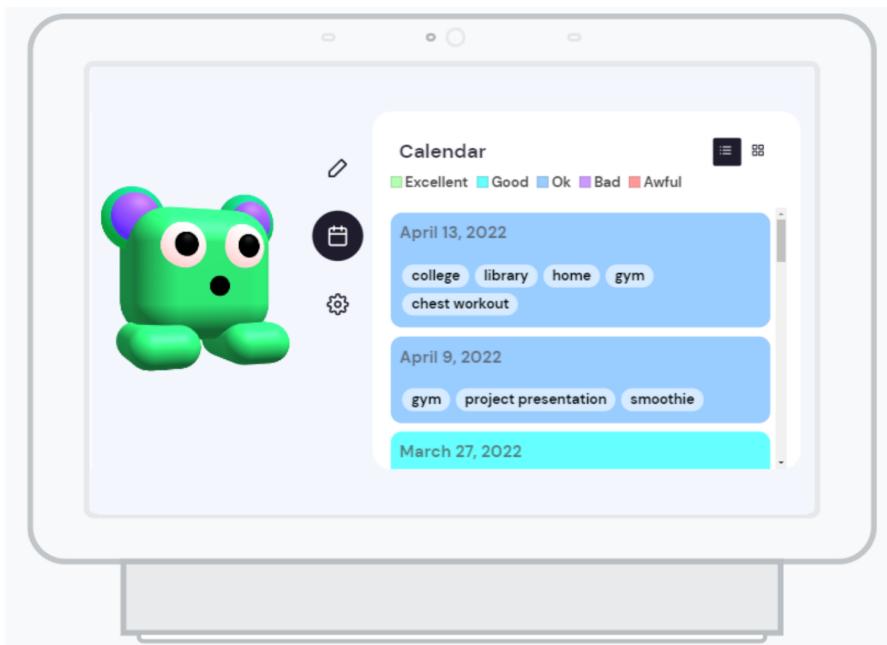
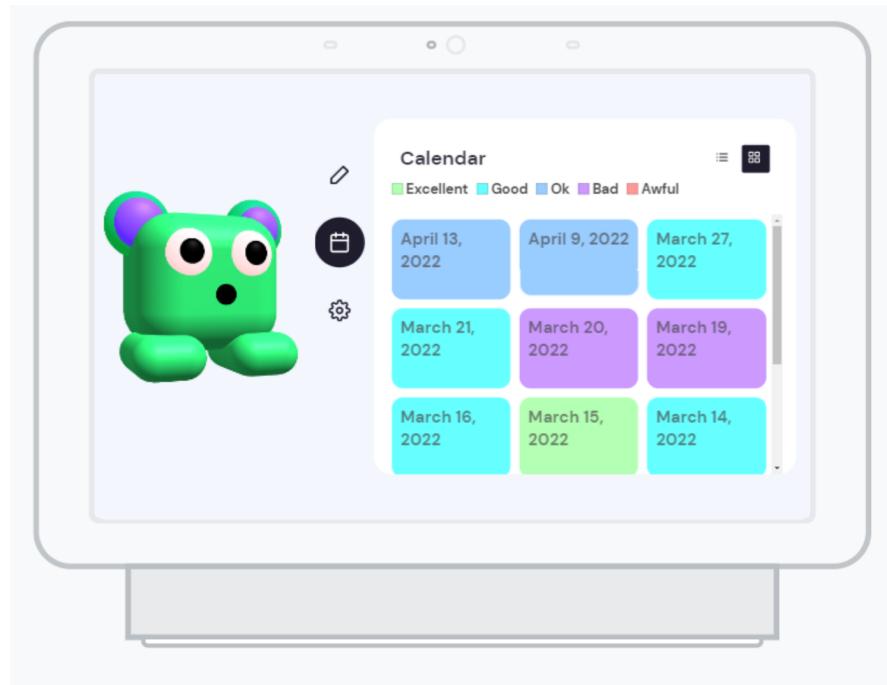
mood for the day, if they have logged one. Under their mood the user can read their journal entry for that day, if they have recorded one. The highlighted words in the journal entry are the entities extracted by Google's Entity Analysis API

The webb app highlights entities within the text as they are the key pieces of information on the page besides the mood. Highlighting the word for the mood with a colour that corresponds to that mood (like highlighting Good with Green or Bad with Red) was considered, however in an attempt to avoid users perceiving judgement being made this was not included in the design. In hindsight, while I still think that having the ECA react in any negative manner to low mood could have negative impact on users I do think that it would have been acceptable and to colour the users mood with a corresponding colour as it would likely make the information more easily understood at a glance.

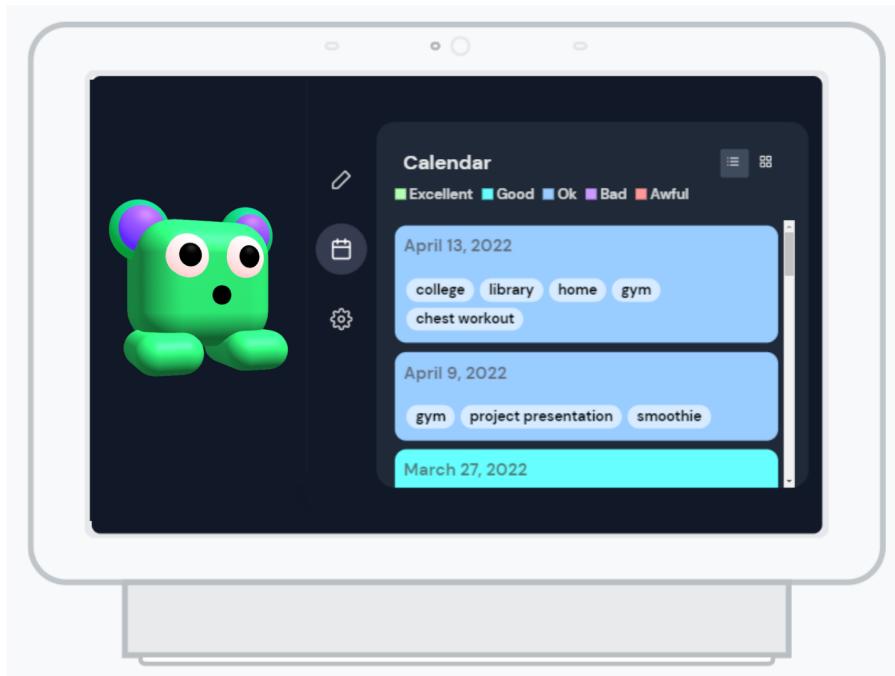
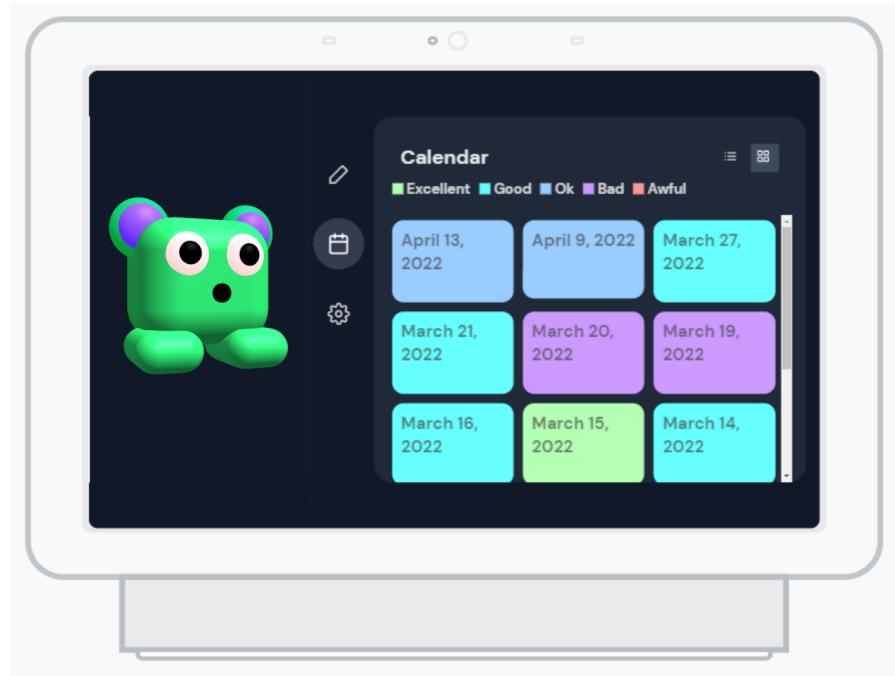
The sign off at the end of the journal entry “~  Liam, April 18th” was designed to look like a quote or to mimic the signoff one might have if writing a journal entry traditionally with pen and paper. I included the users profile image as well as the user research suggested that personalisation on the web page was appreciated by mood logger users. The image on display here is their google profile image so if the user has set this to an image of themselves this will be displayed here. If the journal entry is longer than the height of the page then the user can scroll through their journal entry using the touchscreen.

5.2.2 Calendar Page

Light Mode



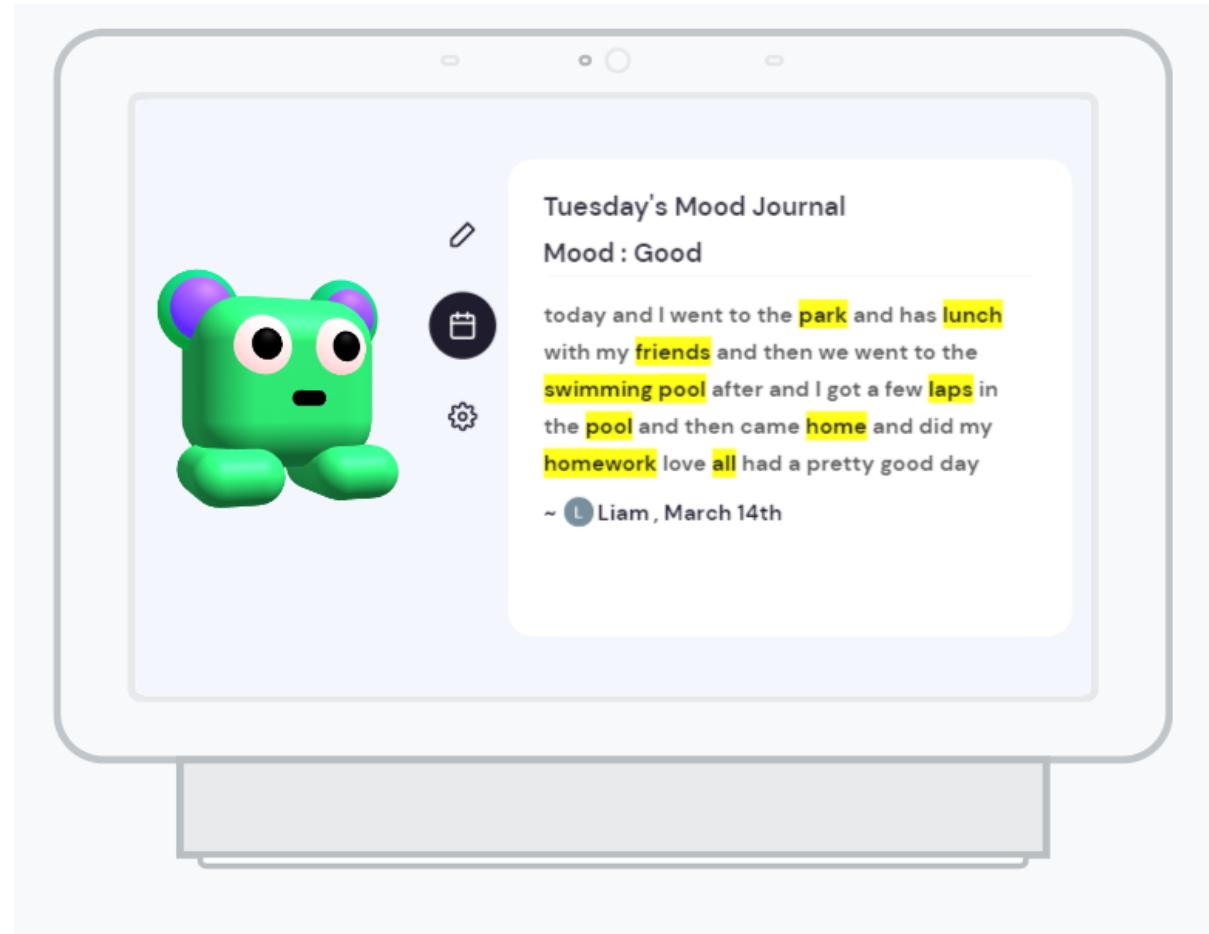
Dark Mode



The calendar page is where users can see all of their past mood journals and reflect on the entities they mentioned on that day. The user can navigate to it by tapping on the button with the calendar icon which will then be highlighted and the page changed. Moods are colourcoded to allow for convenient reflection on mood trends. Excellent days are green, good days are turquoise, Okay days are blue, Bad days are purple and Awful days are red. Users can see this in a small legend at the top of the calendar page.

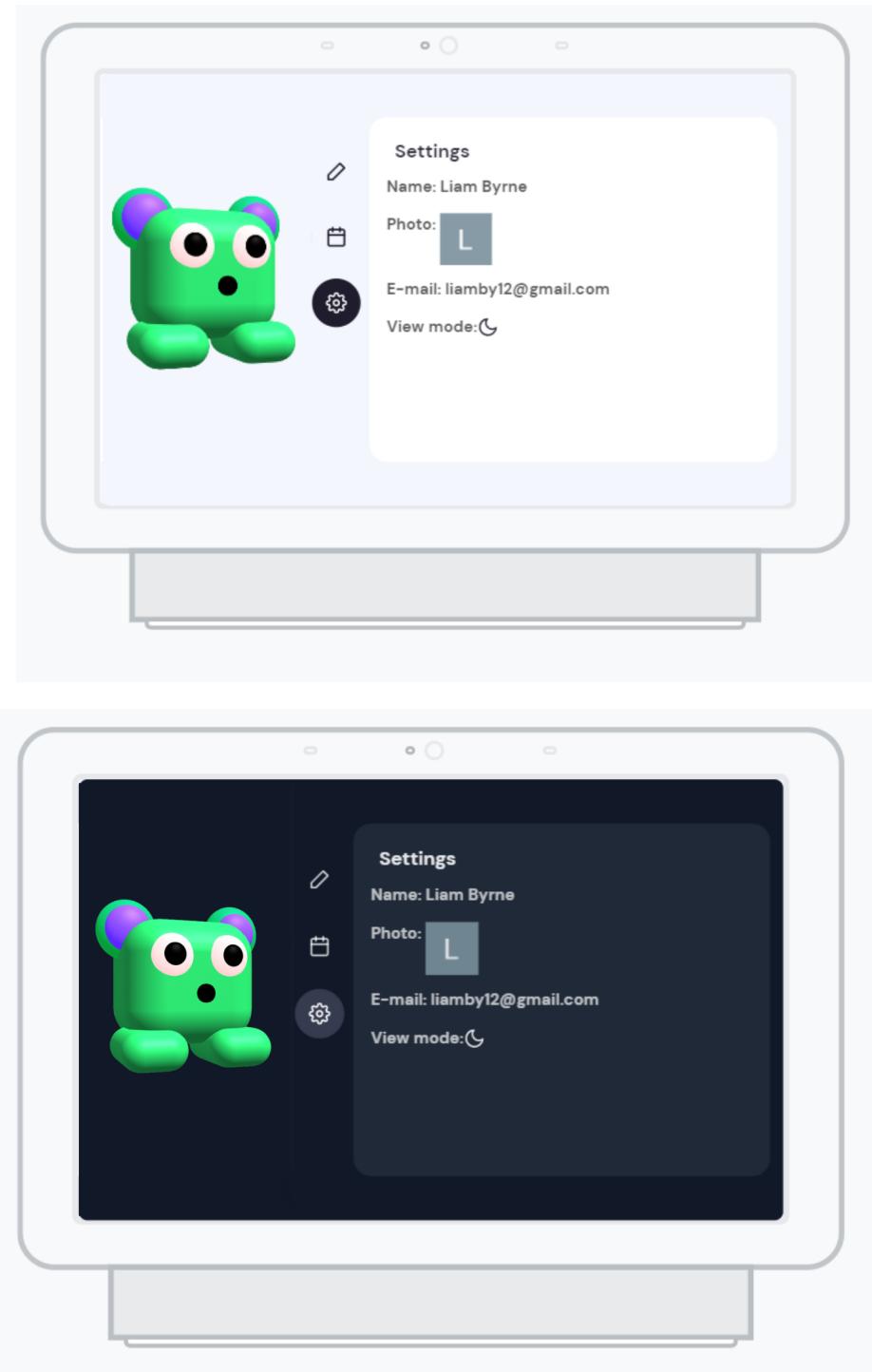
According to user research on mood loggers, people liked applications that provided visualisations in the form of calendar views. I provide two ways that the user can look back over their moods 1) list view and 2) grid view. Users can switch between the two view

modes by tapping the  icons at the top right of the screen. When viewing their calendar in the list view users can see the entities mentioned on that day giving them a quick insight as to what they spent the day doing that might have affected their mood. When looking at the calendar page in grid view users can see more journal entries however they cannot see the entities. In both views If there are more calendar entries logged than can fit on the page, then the page can be scrolled via touch and if the user taps on a day then they will be able to see their entry for that day on a page identical in structure to the mood journalling page only the page will be populated with information from the selected calendar entry and the highlighted button will remain the calendar button. See the image below.



The user can navigate back out of this journal entry to the calendar page by tapping the calendar button again.

5.2.3 Settings Page



The settings page simply displays the user details such as their name, photograph, and email address. When the user is on this page, the button with the settings icon is highlighted. The only interactive element on this page is the viewmode button whose icon is a crescent moon. Tapping on this button changes the viewmode from light to dark and vice versa. The system remembers the user's preference.

Section 6. Discussion

6.1 What Worked

The Application is able to successfully engage the user in mood logging and journaling conversation. By using discrete and open ended dialogue strategies the ECA can obtain self report data from the user in a quick and natural way, which I hypothesise is more engaging and elicits more disclosure thanks to the incorporation of an embodiment. The application can successfully extract key entities from open ended speech allowing users to more accurately express themselves and have factors that could impact their mood extracted from this speech.

The process of formulating responses for questions about their mood and activities that day promotes an awareness of one's own mental health. The application allows users to explore a visualisation of their last moods in the form of a calendar which can be viewed in two modes. The interactive calendar visualisation promotes active reflection on past moods by the user, an important step for improving wellbeing.

The application interface and delivery method is more engaging than that of traditional self-monitoring techniques plagued by low adherence. This is attributable to the GUI's simple and engaging design allowing the user to easily navigate around pages and investigate calendar visualisations. Using voice as the primary delivery method for the application should make the application more engaging for users.

The application was designed in accordance with Google Design Guidelines for voice and multimodal applications. The GUI is also clearly visible when used from across a room and the Primary path through the application can be navigated solely with voice. The conversation has a robust design regarding response variants, fallbacks, help intents and error situations.

The Interactive canvas framework worked excellently throughout the project despite concerns about a lack of tutorials and community support. This project could therefore stand as an example of the capabilities of the framework as, to my knowledge, there are no examples of an interactive canvas applications that include an ECA. This application could also be extended to delve deeper into CBT practices (See Sect 6.3).

6.2 What Did Not Work

When loading in the test console the applications performance was good however the loading time increased significantly when running the application on the Google Nest Hub device. This is attributable to the nest hub having less computing power than what was available to the console. A loading spinner had to be implemented on completion of the project to compensate for the slow response time. A better solution to this problem could be restructuring the backend data management to ensure that data retrieval from the cloud database is performed as little as possible to cut down the initial load time.

The current emotional range of the ECA implemented in the project is quite small. The ECA only has listening speaking and idle, or blinking animations. Endowing the ECA with animations to respond to error states (such as a spin animation) and processing states (such as a thinking animation) would have improved the Quality of the ECA. The ECA was intentionally not given the ability to react to happy or sad emotions so as to not give the user the impression that their responses were being judged.

The progress on the project was slow at times due to certain tools. Voiceflow for example was intended to be the main back end driver for the conversational user interface however, its capabilities fell short of the mark for response times and integration with front end technologies like the interactive canvas. Voiceflow provided utility as a tool for planning, visualising and prototyping the conversation however had to be dropped as an option for back end implementation as it was not efficient enough.

The lack of tutorials and good examples showing specifics of the interactive canvas framework slowed the project significantly also. Thankfully Google's documentation for interactive canvas is extensive so issues could be resolved when they arose. However, progress at times could be very slow particularly when errors arose in the code and there was not a strong community of developers there for reference. Any project working with interactive canvas should be aware of this shortcoming however new tutorials are constantly being added by google developers and this will not remain an issue for long.

Overall the project achieved its goals. There were, however, more features that would have been added to the project scope in the absence of time constraints. Such features include The ability to ask about past moods in conversation, the inclusion of a statistic page to help users make sense of the data they generate, the ability to delete all journal entries in settings and the ability to clear a specific journal entry.

6.3 Suggestion for Future Work

I chose not to venture into sentiment analysis over the course of this project, instead choosing to implement a system for self-monitoring that could help the user build an awareness of their mood, an important first step in improving wellbeing. Therefore, I chose to ask the user how they felt and make them reflect on and vocalise their feelings. I believed it would be inappropriate to run a sentiment analysis of the user input and display that information to the user. This would have likely negated the positive effects of using technology on the fear of judgment, so I avoided using sentiment analysis in this manner.

However, the AnalyseEntities method can be configured to return the aggregate sentiment expressed for an entity with values ranging from -1 negative to +1 positive. There is also an analyzeSentiment method available for use within the NaturalLanguageAPI which is already being used for this project. I believe this opens the possibility for the application to branch into providing CBT.

CBT focuses on the relationship between thoughts, feelings, beliefs and behaviours. Negative or inaccurate thoughts are challenged and restated in positive logical terms. Sentiment analysis tools could be applied to the journal entry part of the application to identify strongly negative thinking and help users recognise it. Once negative thoughts have been identified by the application, the user could then be prompted to rephrase these thoughts as positive statements. The user could then receive positive reinforcement for rephrasing their statement, encouraging them to continue doing so in their everyday life. This would be a relatively straightforward way to extend the current application to mimic the role of a therapist with tools already in use by the application.

Section 7. Conclusion

There is a lot of interest in developing mental health supports due to the high demand yet low supply of mental health services. This project endeavored to explore the capabilities of VUI devices for mood logging. Over the course of this project a mood journaling application was designed and developed with past research and the goal of providing the greatest benefit to the general public in mind.

Over the course of this project an embodied conversational agent was developed which can support users self-monitoring through providing a quick and natural way to log one's mood and keep track of trends. The application that was developed can scale to reach vast numbers of people and provide them with mental health support capable of improving their awareness of their mental health, the first step in improving wellbeing. The Application was designed with students in mind as most mental health disorders have their first onset before the age of 24. The application is informed by and incorporates ideas from past research such as the inclusion of an ECA, which, to the best of my knowledge, is not present in other mental health applications for consumer VUI devices.

I believe the application provides utility beyond what is already present in literature as it combines multiple factors not contained in other research, that could improve user retention such as: the scalability and convenience that is provided by at-home smart displays. Enhanced user experience, rapport, and retention provided by including an ECA. an engaging conversation experience that promotes disclosure by combining discrete and open-ended dialogue strategies.

References

2022. *Technology and the Future of Mental Health Treatment*. [online] Available at: <<https://www.nimh.nih.gov/health/topics/technology-and-the-future-of-mental-health-treatment>> [Accessed 19 April 2022].
- Abd-alrazaq, A., Alajlani, M., Alalwan, A., Bewick, B., Gardner, P. and Househ, M., 2019. An overview of the features of chatbots in mental health: A scoping review. *International Journal of Medical Informatics*, 132, p.103978.
- Anders, G., 2022. "Alexa, Understand Me". [online] MIT Technology Review. Available at: <<https://www.technologyreview.com/2017/08/09/149815/alexa-understand-me/>> [Accessed 19 April 2022].
- Bickmore, T., Gruber, A. and Picard, R., 2005. Establishing the computer–patient working alliance in automated health behavior change interventions. *Patient Education and Counseling*, 59(1), pp.21-30.
- Clark, L., Pantidi, N., Cooney, O., Doyle, P., Garaijalde, D., Edwards, J., Spillane, B., Gilmartin, E., Murad, C., Munteanu, C., Wade, V. and Cowan, B., 2019. What Makes a Good Conversation?. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*,.
- Crisis Text Line. 2022. *Crisis Text Line*. [online] Available at: <<http://www.crisistextline.org/>> [Accessed 19 April 2022].
- DeVault, D., Artstein, R., Benn, G., Dey, T., Fast, E., Gainer, A., Georgila, K., Gratch, J., Hartholt, A., Lhommet, M. and Lucas, G., 2014, May. SimSensei Kiosk: A virtual human interviewer for healthcare decision support. In *Proceedings of the 2014 international conference on Autonomous agents and multi-agent systems* (pp. 1061-1068).
- Dear, B., Zou, J., Ali, S., Lorian, C.N., Johnston, L., Terides, M., Staples, L., Gandy, M., Fogliati, V., Klein, B., & Titov, N. (2015). Examining self-guided internet-delivered cognitive behavior therapy for older adults with symptoms of anxiety and depression: Two feasibility open trials. *Internet Interventions*, 2, 17-23.
- Google Developers. 2022. *Design guidelines*. [online] Available at: <<https://developers.google.com/assistant/interactivecanvas/design>> [Accessed 19 April 2022].
- Fitzpatrick, K., Darcy, A. and Vierhile, M., 2017. Delivering Cognitive Behavior Therapy to Young Adults With Symptoms of Depression and Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Controlled Trial. *JMIR Mental Health*, 4(2), p.e19.
- Fulmer, R., Joerin, A., Gentile, B., Lakerink, L., & Rauws, M. (2018). Using Psychological Artificial Intelligence (Tess) to Relieve Symptoms of Depression and Anxiety: Randomized Controlled Trial. *JMIR Mental Health*, 5.
- Hone, K. and Graham, R., 2000. Towards a tool for the Subjective Assessment of Speech System Interfaces (SASSI). *Natural Language Engineering*, 6(3&4), pp.287-303.

- Support.google.com. 2022. *Introducing Google Nest Hub*. [online] Available at: <<https://support.google.com/googlenest/answer/9136909?hl=en>> [Accessed 19 April 2022].
- Kocielnik, R., Avrahami, D., Marlow, J., Lu, D. and Hsieh, G., 2018. Designing for Workplace Reflection. *Proceedings of the 2018 Designing Interactive Systems Conference*,.
- Levin, E. and Levin, A., 2006. Evaluation of Spoken Dialogue Technology for Real-Time Health Data Collection. *Journal of Medical Internet Research*, 8(4), p.e30.
- Lopatovska, I., Rink, K., Knight, I., Raines, K., Cosenza, K., Williams, H., Sorsche, P., Hirsch, D., Li, Q. and Martinez, A., 2018. Talk to me: Exploring user interactions with the Amazon Alexa. *Journal of Librarianship and Information Science*, 51(4), pp.984-997.
- Lucas, G., Gratch, J., King, A. and Morency, L., 2014. It's only a computer: Virtual humans increase willingness to disclose. *Computers in Human Behavior*, 37, pp.94-100.
- Ly, K., Ly, A. and Andersson, G., 2017. A fully automated conversational agent for promoting mental well-being: A pilot RCT using mixed methods. *Internet Interventions*, 10, pp.39-46.
- Maharjan, R., Rohani, D., Bækgaard, P., Bardram, J. and Doherty, K., 2021. Can we talk? Design Implications for the Questionnaire-Driven Self-Report of Health and Wellbeing via Conversational Agent. *CUI 2021 - 3rd Conference on Conversational User Interfaces*,
- Mohr, D., Duffecy, J., Ho, J., Kwasny, M., Cai, X., Burns, M. and Begale, M., 2013. A Randomized Controlled Trial Evaluating a Manualized TeleCoaching Protocol for Improving Adherence to a Web-Based Intervention for the Treatment of Depression. *PLoS ONE*, 8(8), p.e70086.
- O'beirne, E., 2022. *Ireland's mental health services won't be able to cope for much longer*. [online] District Magazine. Available at: <<https://districtmagazine.ie/counter-culture/irelands-mental-health-services-wont-be-able-to-cope-for-much-longer/>> [Accessed 19 April 2022].
- Provoost, S., Lau, H., Ruwaard, J. and Riper, H., 2017. Embodied Conversational Agents in Clinical Psychology: A Scoping Review. *Journal of Medical Internet Research*, 19(5), p.e151.
- Reid, S., Kauer, S., Hearps, S.J., Crooke, A.H., Khor, A.S., Sanci, L., & Patton, G. (2011). A mobile phone application for the assessment and management of youth mental health problems in primary care: a randomised controlled trial. *BMC Family Practice*, 12, 131 - 131.
- Schueller, S., Neary, M., Lai, J. and Epstein, D., 2021. Understanding People's Use of and Perspectives on Mood-Tracking Apps: Interview Study. *JMIR Mental Health*, 8(8), p.e29368.

- Stepanov, M., 2022. *Some stats about voice assistants*. [online] Medium. Available at: <<https://uxdesign.cc/some-stats-about-voice-assistants-1c292476584>> [Accessed 19 April 2022].
- Stone, A. and Shiffman, S., 2002. Capturing momentary, self-report data: A proposal for reporting guidelines. *Annals of Behavioral Medicine*, 24(3), pp.236-243.
- Rastogi, N., Keshtkar, F. and Miah, M., 2018. A multi-modal human robot interaction framework based on cognitive behavioral therapy model. *Proceedings of the Workshop on Human-Habitat for Health (H3) Human-Habitat Multimodal Interaction for Promoting Health and Well-Being in the Internet of Things Era - H3 '18*.
- Sui, L., Mawston, N. and Wu, Y., 2022. *Strategy Analytics: Half the World Owns a Smartphone*. [online] Businesswire.com. Available at: <<https://www.businesswire.com/news/home/20210624005926/en/Strategy-Analytics-Half-the-World-Owns-a-Smartphone>> [Accessed 19 April 2022].
- Vaidyam, A., Wisniewski, H., Halamka, J., Kashavan, M. and Torous, J., 2019. Chatbots and Conversational Agents in Mental Health: A Review of the Psychiatric Landscape. *The Canadian Journal of Psychiatry*, 64(7), pp.456-464.
- Wang, J., 2021. Informative Journaling Application (Unwind) for Ambient Awareness on Mood in Young Adults to Reduce Anxiety and Depression: A randomized, placebo-controlled trial. *Dartmouth College Undergraduate Theses*. 212, [online] Available at: <https://digitalcommons.dartmouth.edu/senior_theses/212/> [Accessed 19 April 2022].
- Why Talking Helps*. 2022. [DVD] Directed by D. Bates. Ennis Mental Health Association.

Appendix

User Personas



Age: 34
Gender: Female
Job: Housemaker

Description
Rebecca is a mother who loves her family. She is often busy with work and taking care of her children. Rebecca is under pressure and has little time to take care of her mental health.

Rebecca Doyle

Context

- Spending all day doing housework and taking care of her children, Rebecca doesn't have time to pamper herself, which makes it easy for her to generate negative emotions when facing her husband and children.
- Using her smart speaker to input and monitor the daily mood development in order to review the problems that lead to negative emotions.

Problems

- Mild emotional disturbances, or fatigue, boredom and anxiety
- Has less time to take care of herself than before she had kids.

Goals

- Control emotions thereby minimizing fatigue.
- Have time to take care of family home as well as minimize worries about problems in life.

Needs

- Needs a method to readjust personal emotions.
- Needs time to take care of and pamper herself.

Fear

- Fear of having to learn how to use applications on smart phones that are time-consuming.
- Dont trust apps on smart phones.



Age: 22
Gender: Male
Job: Student

Description
Sean is a college student in his early 20's. He's usually very busy with coursework and assignments. He is often stressed because of the pressure of maintaining good grades and a social life.

Sean Murphy

Context

- Spends a lot of time outside of the house in college and at work. He doesn't have a lot of time to check in on his mental health.
- Interested in journaling as a way of keeping track of what he's doing and how it's making him feel. Is also interested in using his smart speaker to input and monitor moods in order to review the problems that lead to negative emotions.

Problems

- Mild stress and anxiety. He is also usually tired.
- Has not taken care of his mental health due to a lack of time and structure in which to do it.

Goals

- Improve his awareness of mood trends so that he can proactively counter negative emotions.
- To better understand himself.

Needs

- A structured way to record emotions regularly
- Needs to improve his ambient awareness of his mental health and mindset.

Fear

- Fears the social judgement and stigma surrounding mental health issues.
- Fears His information being released or judgement by clinicians.

Sample Dialogues

Character Design SAMPLE DIALOGS

* Start *

Moodly: "Hi, I'm Moodly. I can help you keep track of your mental health by mood journaling. Would you like to log your mood for today?"
 User: "Yes please!"
 Moodly: "Sure thing, how did you feel today?"
 User: "I feel quite good today."
 Moodly: "I think you feel good today is this correct?"
 User: "Yeah"
 Moodly: "Great! Your mood has been logged as good. Would you like to add a journal entry?"
 User: "Yes"
 Moodly: "Sure, what did you get up to today?"
 User: "Today I went to the park with my friends and we played football. I had a great time and then I came home and did my homework."
 Moodly: "Is there anything else you would like to add?"
 User: "No thanks"
 Moodly: "Okay. Thanks for letting me know how you feel. Bye-for now!"

Character Design SAMPLE DIALOGS

* Start *

Moodly: "Hi hihiy! thanks for choosing me with me again. Would you like to log your mood for today?"
 User: "Yes, I would thank you!"

Moodly: "Great, how are you feeling?"

User: "I don't feel great."

Moodly: "I think you feel great is this correct?"

User: "No, it's not."

Moodly: "Okay lets try again. How do you feel today?"

User: "I feel bad."

Moodly: "I think you feel bad is this correct?"

User: "Yeah"

Moodly: "Okay, I've logged your mood for today as bad. Would you like to make a journal entry?"

User: "Yes please!"

Moodly: "Great, how did you spend your time today?"

User: "Today I went to the park with my friends and went to the swimming pool after but I got into a fight on the way home which turned the day

Moodly: "Is there anything else you would like to add?"

User: "No thank you."

Moodly: "Okay. You are all done for today. Remember to check back in tomorrow...!"