

“Creating an Interactive Virtual Companion to Support and Enhance Mental Wellbeing”

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Abstract

Health and wellbeing have always been crucial aspects of life. Rapid advancements in technology seen in the last decade have caused huge societal changes that can impact individuals overall wellbeing. This was only worsened with the recent events of the COVID-19 pandemic and lockdowns. We have been left to feel the consequences of these societal changes in every aspect of our lives including our mental wellbeing. There has been a consistent rising number of mental health issues in the younger generations [1]. Proving that this is an issue that needs addressing. Awareness of our own individual mental wellbeing can be key to us learning to manage the stress that this ever changing world can cause. Awareness of self can be extremely challenging and daunting to do on our own, however if we had a virtual companion to help us learn and encourage us to be more positive, it may make the daunting task more manageable.

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Introduction

Mental health is an extremely important part of our lives, it can impact the quality of life we experience and can shape the world around us. This can affect our connections that we share with people, and as the world becomes more connected following the role that technology has taken in our society it seems that naturally, we will look at technology and how it affects individuals differently. Applications that we use on a daily basis can have a negative effect on our mental health and wellbeing [7]. Examples of negative effects on mental health and wellbeing are increased anxiety, lower confidence levels and increasing cases of depression.

It is clear that technology can have a detrimental impact on mental health and wellbeing, however, can an application be used in a way to have a positive effect on its user's wellbeing? That is the main question that this project will explore with the aim of creating a mobile application that will make users aware of their mental wellbeing, and help users deal with any stress they might face.

There are many applications that are readily available online that are centred around trying to improve users' wellbeing. To differentiate this application an interactive virtual companion will be used to help make users more conscious of their own mental wellbeing. The interactivity of the virtual companion will be through dynamic changes that the companion will experience based on how the users use the application. The companion will encourage the user to complete exercises that will help improve the users' awareness of their mental wellbeing. Using a companion to make users engage with the application and its features is something that other similar applications have not considered, as found when researching the existing solutions. Another feature of the application will be screen time, meaning that the application will not be usable to a user once they have spent more than their set duration. Duration will be customisable by the users, but including a screen time feature means that the application is not overused, as so many current applications are [6]. Overuse of applications can be linked with poor mental wellbeing [20] so it is ideal that this application is not overused.

Awareness of individual wellbeing is crucial for this application. Having a support group for mental wellbeing is proven to be useful [29]. As a result of this the application will also contain social features to encourage the users to create their own supportive group of friends to help them.

The user base for this application will not be limited to a specific group of individuals as wellbeing is something that will affect every person in a different way. If there were to be a specific audience for this application, it would be users who want to become more aware of their mental wellbeing.

Aim of the project

From all the information given in the introduction, it is also important to outline the overall aim of the project. This will help identify if the project is a success when it is completed. The aim of this project is to create a mobile application that will make users aware of their mental well-being, and help users deal with any stress they might face. The application will guide users through the process of becoming more mindful through a variety of different means, simplifying these methods so that all are able to get the benefits of using the application.

Objectives of the project

- Creating a way to help users become mindful.
- Make users more aware of their own mental wellbeing and how to improve it.
- Having users interact with friends who can be supportive of their mental wellbeing.
- Providing exercises for users to complete that helps them manage their mental wellbeing.
- Supplying techniques and tools to users who might be feeling stressed in a simple and easy to understand way.
- Educate users on the importance of mental wellbeing and how it can be affected.

Background

Mental well-being has continued to take centre stage the more connected as a society we become. A study taken in 2017 found that 10.7% of individuals suffer from mental illness [8]. The study estimated that around 792 million people lived with a mental disorder. This is a huge proportion of the population, proving how large a problem mental health truly is. Those that struggle with mental illness, are encouraged to seek professional help where they can use tools and techniques to help them manage their illness. Professionals also help patients by using different forms of therapies which vary depending on what the patient needs. An example of this can be Cognitive Behavioural Therapy or CBT, this form of therapy is commonly used to help those who struggle with anxiety or depression [15] By these individuals seeking help, they become more aware of their own mental illnesses and how they can start to manage them in their personal life.

Although not everyone has their own mental illnesses that they need to manage, everyone does have their own emotions that they will deal with on a day to day basis and this can contribute to an individual's overall mental health or wellbeing. Mental health can be described as: "is a state of well-being in which an individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community." [19].

Therefore mental health and wellbeing is something that we all share. Due to this, it is crucial to look at what day to day activities affect our own mental wellbeing. This is an individual issue that will impact us all very differently as we are all unique. However, with technology becoming a larger part of everyone's life, questions about its impact on our collective mental health and wellbeing are necessary. It is not only the physical impacts of technology to consider but also what particular software could be harmful to mental wellbeing. Younger generations are now more than ever at the risk of being exposed to damaging algorithms from social media applications such as TikTok, Instagram or Facebook, that could negatively impact their own mental health and wellbeing [17]. Prolonged usage of social media can lead to negative symptoms such as depression, anxiety and stress [21]. Due to these sorts of applications, it is becoming more evident that younger people are needing to become more aware of their own mental wellbeing [23]. The evidence above is enough to suggest that the awareness of one's mental wellbeing is becoming more and more necessary in today's society.

As mental well-being is a huge topic the project will face constraints. The major constraint that will be faced is time, as we will be limited in the time that we have to complete the solution. Due to this time constraint,

it will be necessary to outline the functionality that will be achieved in a hierarchy, ensuring that the aim of the project can still be met even if time becomes more of an issue.

Another consequence of the size of the topic area is that there are existing applications that try to tackle the problem that I have laid out. Not all of these applications are the same but many of them are intended to help enhance the users' mental wellbeing. In order to produce the application that meets the aim of the project that I have set out, it will be important to go through a few of these existing applications and discuss where they might be relevant to assisting a final solution, they will also help to inform the design of the application.

Existing Solutions

Below are the examples of existing solutions to the problem outlined. There are many different variations on how to deal with the outlined problem, however, I have chosen these 4 examples as they all tackle the problem in a slightly unique way and it also highlights how many variations of solutions there can be. These applications were selected as they are either popular with users or most like my solution that I am trying to develop. I have selected two popular applications and two applications that are similar to my proposed solution. By collecting this information we are able to see how my solution will differ and where it might be similar. Collecting information on these applications could also help in guiding my final solution

Reflectly

Reflectly is most like the application that I intend to create. It is a reflective application with the ability to upload voice recordings and images. The key functionality is the ability to record your mood for the day and take notes on what made you feel the way you did. The clear purpose of the application is to prompt the user to become more reflective regarding their moods, for this reason, this application is the most similar to what my intended solution will be. However this application does not allow the user to journal regarding their day, it focuses more on the mood. Another negative of this application is that there is a paid subscription for more features, which does not make the application inclusive to all users [22].



Figure 1. Reflectly UI

Fabulous

Fabulous is a popular habit tracker application that intends on creating positive habits for its users. This would help to enhance the users' mental well-being if they were able to create these positive habits. The application does not provide any mood tracking functionality or journaling functionality, and because of this, the application is not very relevant to this project. Fabulous does require users to pay a subscription to even use the application and therefore is not inclusive to all users [12].

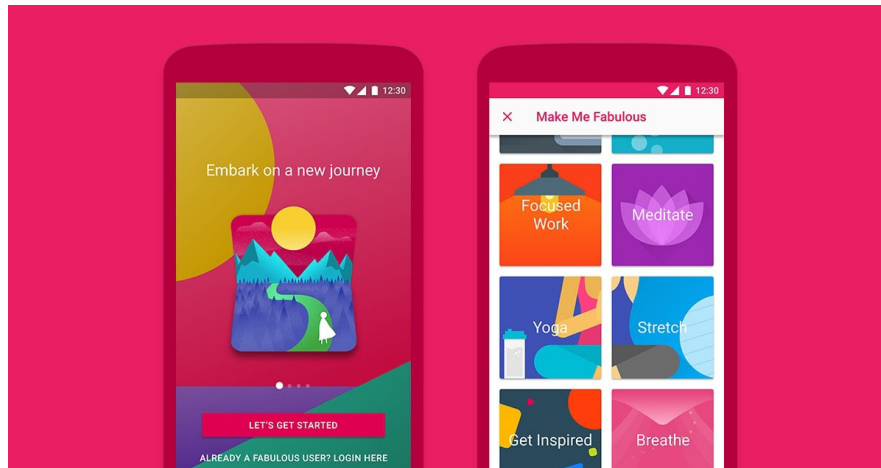


Figure 2. Fabulous UI

Calm is another popular application with the intention of enhancing users' mental wellbeing. The main focus for calm is mediation, the application can also be used to help users who may struggle with sleep. This could be something to consider however, my initial plan for my solution was not to create a mediation application. There could be many hurdles involved and ultimately this is a space where many applications already exist [11].

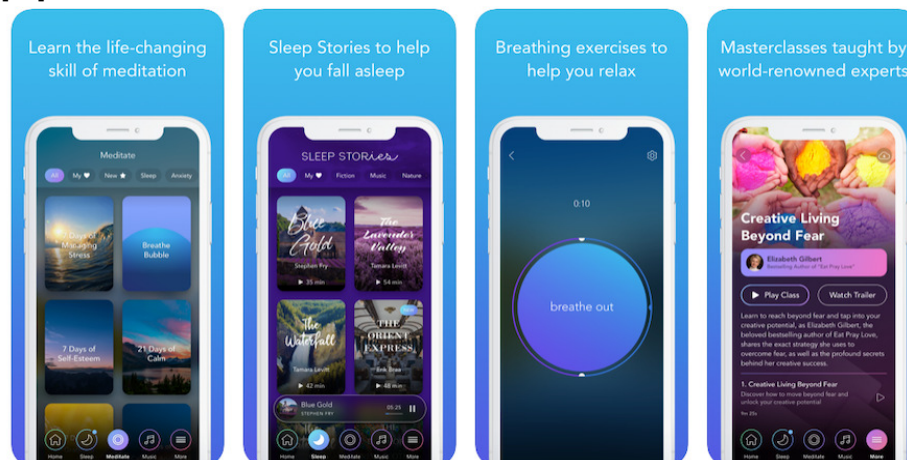


Figure 3. Calm UI

MoodFit

MoodFit is a mood and gratitude journal that provides tools to its users to improve their mental wellbeing. The application is not visually appealing and looks very confusing to use. However, MoodFit can be helpful as they have a large variety of tools that they offer for the user to help enhance their mental wellbeing. Although, I feel that this application is similar to my solution it does differ slightly as it does not allow the

user the ability to add any friends. Once again this application requires a paid subscription in order to use so is not easily accessible by all users [27].

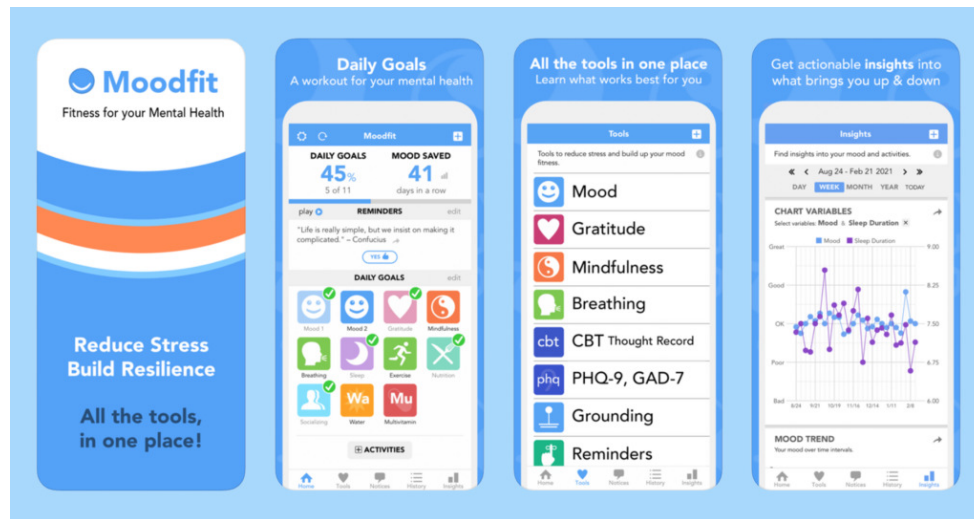


Figure 4. MoodFit UI

Initial Research

In order to begin the process of designing an application, it is first necessary to conduct an initial round of interviews to gather participants' personal view on mental wellbeing and how it affects them. Doing so will in turn help to guide the design process. Participants were asked a series of questions relating to mental wellbeing, and their thoughts on mental wellbeing and society. An example of the questions that were asked during the interviews "Describe what environments you think would be beneficial for your mental wellbeing?" and "Have you used or are you aware of any tools and activities that can boost your mental wellbeing if you are having a difficult day?". The full set of questions can be found in Appendix 1 under the user research protocol section. These types of questions allowed me to collect enough of an initial reaction to how the participants viewed their own mental wellbeing and how they interpret society's reaction to mental wellbeing. In order to be able to interview these participants I had to undergo a process of ethical approval, this process ensured that all the questions asked were ethically appropriate. The participant information sheet for the interviews and participant informed consent forms templates can also be found in Appendix 2, and Appendix 3 respectively.

These questions allow us to gather information on potential users for the application. It allowed us to see trends and themes from the participants, what sort of views and outlooks are similar throughout. In order to find the themes from the participants' answers, and a way to find these trends is to conduct a thematic analysis [5] on the information. The thematic analysis allows us to better understand the qualitative data that we have collected from these interviews. The process involves coding the initial data from the interview, with parses that best represent the data you received, once we have the initial codes of the interview we are able to find the sub-themes. Each code belongs to a specific sub-theme, these sub-themes allow us to better represent the code. There can be many sub-themes that make up the results, as a result of this we then need to collect the sub-themes into either one theme or multiple themes that better represent the results we have received. I believe that the thematically analysis will give us a better insight into how participants view mental wellbeing and the gathered results will assist greatly with the direction of the project.

After collecting the initial codes from the interviews we are able to start identifying some of the sub-themes, these will have codes that are related to them. The codes will all share a similar theme and that will become the sub-theme. Collecting the codes into the sub-themes start to give a clearer indication of what we can take from the results.

We need clear indications of what the users believe Mental Wellbeing to be in order to create an application that can support and enhance their wellbeing. From the transcript quotes above there is a range of different answers that have been provided, as a result of this we will be unable to draw any concepts from these answers without the use of themes. The sub-themes will guide us to finding the overall themes from the interview.

The thematic analysis process, involving the creation of codes and sub themes can be found in Appendix 4 under the section thematic analysis on initial research. We make reference to the sub-themes generated from the codes in figure 5 below.

Main Themes and their relations to the sub-themes

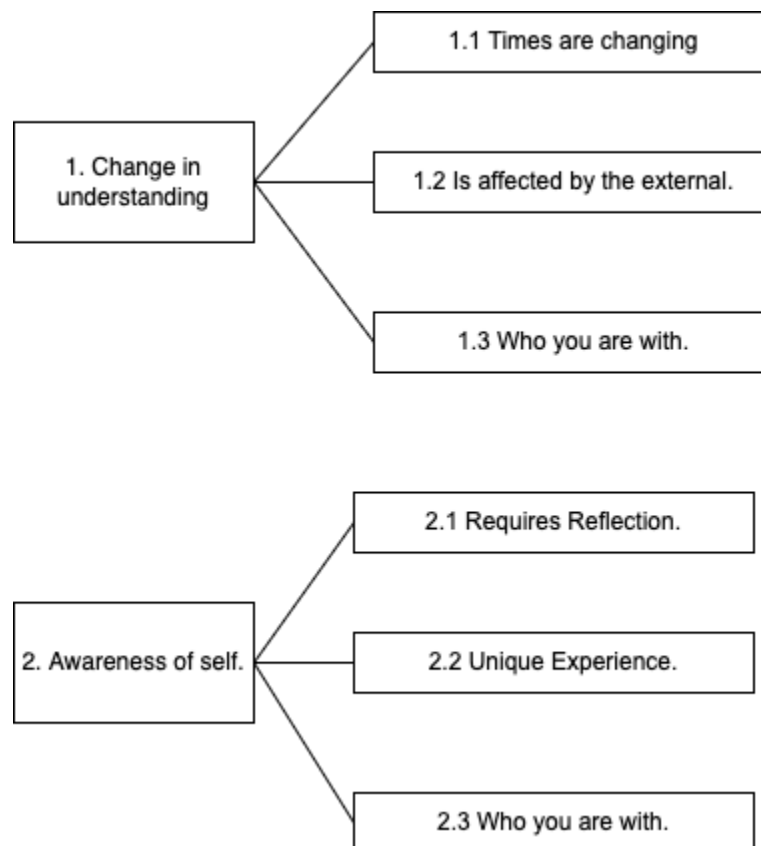


Figure 5. Relationship between the sub themes and main themes for the initial research

Definition of Themes

Figure 1 showcases how the derived sub-themes of the interview are connected to large themes. These themes are clear when looking at the answers that were received in the interviews. However further justification and clarification of themes are necessary in order to help influence the direction of the project and application.

Change in Understanding

Focusing on a change in understanding surrounding mental wellbeing. Aiding with the connection that has come with the internet, it has caused topics of mental wellbeing to become more commonly spoken about compared to the past. It seems to have taken place in what can be described as a society shift which has taken place in the last few years that have led to people becoming more understanding of themselves. Potentially aided by our ability to communicate with people easily we have become more responsible for our own understanding it seems. There seems to be a general acceptance that mental wellbeing is relevant and is required to be a main focus in our lives, and is clear from participant 13's statement *"It's been going this way for the last sort of 10-15 years"*. Comparing our understanding to the past is where this shift can be evident, participant 13 said *"It's definitely something that you can see. Generationally you've got my grandad, and he's emotionally like a plank."* This shift in our understanding regarding our own feelings and emotions is important for the focus of this report.

For the report to be able to reach any of the aims that have been set, we need to ensure that an application surrounding mental wellbeing would be something that people are interested in. Regarding this change in understanding and acceptance of the importance of mental wellbeing I believe it is fair to say that such an application would be of interest to the majority of individuals.

Awareness of Self

When analysing mental health and what it means to others there is a clear need for individuals to be aware of their own emotions. Awareness is crucial in trying to understand the feelings and emotions that we experience on a daily basis, especially so we can shift our focus and change our mood should we need to. From the definitions given about mental wellbeing many participants described it as how you feel emotionally and psychologically. For the application to enhance individuals mental wellbeing a base level of awareness is required, however, when looking at the codes and sub-themes it seems that there is already this base level of understanding, as participant 8 said *"I would describe mental well being. As for me personally, yeah, being aware of your thoughts and your language."*

Considering that this base level of awareness is already present it is now a focus of the application to increase this awareness through reflection on individuals' days and their feelings. I believe from these themes we can gather that potential users are aware and know the importance of their own mental wellbeing, this is ideal as it means the focus of the application can be more on enhancing and supporting rather than being educational around the field of mental wellbeing.

Requirements Specification & Design

In order to outline a design that will help reach a sufficient solution, user and system requirements should be analysed. These requirements should be able to better help us understand what features of the application are necessary and what features are not, ensuring that features of the application serve a meaningful purpose.

Requirements Analysis

User Requirements

These have been categorised using MoSCoW technique [16] as it helps to clarify the required parts of the system, including a rating next to each requirement allows us to ensure that we have all the necessary requirements.

1. Have users create and log in to their own accounts. Rating: Must have

For these requirements, users need to be able to create their own accounts and log in their accounts. Their password and email must be used to sign in to their accounts and this must be securely stored on the application's database. The password should be encrypted when stored.

2. Users must be able to edit their login details. Rating: Must have

If users want to change their password they should be able to do so. The password change must require two matching passwords and must also be hidden from the user by obfuscation to allow for a secure change of password. The users must also be able to change their email addresses. There should be valid verification for this so that a non-email should not be able to be entered. Both of these fields should be updated in the database, and must also allow for the user to log in using the new details.

3. Users must be able to edit their personal details. Rating: Should have

As users will be selecting a username and name for their profile they should be able to edit both, and it must also be updated in the database as users do so. When editing their personal details users should see what their existing username and name are set too, to help prevent users from changing their details to what they are already.

4. Have users be able to create a journal entry from their account. Rating: Must have

This is the basis for the application and is how the project can meet its aim. Users should be prompted when creating the journal entry as this will help them become more reflective about their day and how they feel. This should again be stored on the system database.

5. Have users able to log a mood entry. Rating: Must have

Users should be able to log how they are feeling and what is making them feel that way. This should be interactive as it will help engage the user and once again encourage them to be reflective on not just their

day but their emotions and how they are feeling. This mood entry should be stored in the database so that the interactive companion should encourage the user depending on what their entered mood is, and also so that the entry can be re-displayed to the user.

6. Have users share images from their devices. Rating: Must have

Uploading from a photo gallery and taking a photo directly from the camera should be the options for the user. The user should then be able to add a title to the image and then both the image and title get uploaded to the database.

7. Be able to view all the journal entries. Rating: Must have

The user should be able to view all their entries for the day, and all the past entries that they have recorded.

8. Be able to edit past entries. Rating: Must have

Upon initial consideration, the users were not going to be able to edit past entries as I felt that it could lead the users editing entries based on what their friend's entries are like. However, I did feel that the users should be able to edit the entries as they may have made a mistake when posting the entry. These updates should be updated in the database too although the original time of the entry should remain the same, so users can edit a past entry without it seemingly becoming a new entry.

9. The interactive companion should change states based on the users' addition of journal entries. Rating: Must have

This will be the focus of the application and really help the application achieve its aims. The companion should be reacting to the user's engagement with the application. This can be done in multiple ways. The initial thought was to have the companion mimic the user. So if the user recorded their mood as sad the companion would too be sad. The idea was that if the user was feeling upset or down they might not do anything to feel better, but if they saw that they were affecting others they could be more open to doing activities to increase their moods, there are studies that suggest happiness comes from making others feel good rather than yourself [26].

However, there are potential consequences to this, if a user was in a bad mood and they saw that their companion was too this might not assist them, but instead, worsen the mood as they may feel they cannot do anything right as their own digital friend is also upset. Therefore the companion must react in the opposing mood to the user. This means should the user be upset the companion must be playful or happy to encourage the user to become happier themselves. Although the companion must also react depending on the user's interaction with the application if the user has not used the application then the companion must be upset, the reason for this is to try to make the companion feel more realistic giving the impression that your engagement on the application affects the 'mood' of the companion itself.

There are multiple ways of tackling this part of the system and will be outlined more in the implementation section. For now, the basic idea is that this interaction can be done through an algorithm that collects information on the user from the database. Potentially giving the user a score and depending on the score a particular state will be displayed to the users.

10. Users are able to search for other users. Rating: Must have

Users' search should allow them to search the application for other users. Users should also be able to visit each other's profiles through the search system. Viewing other users' posts and their individual characters. Their character should be shown in the state of that particular user. Meaning that if your companion is happy the other user's companion is not restricted to being in that same mood, this will give more realism to the application as each companion will be different due to how the users will affect their companions differently.

11. Users are able to add friends with other users. Rating: Must have

The adding of friends should be done in the search for other users. Users should be able to view the requests that they have received and sent. They should also be able to delete requests that are sent and received as well as remove any friends that they no longer want to be friends with.

12. Users can chat with friends on the application. Rating: Must have

This will be specific for only the friends of the given users meaning that users are not to chat with users they are not friends with. This will be because of privacy and also the nature of the application, as the focus of having a chat feature is because users should be able to reach out to their friends if they see their friends are not having a good day, and the other way around. Having this as a requirement will help with users trying to create their individual support circles, and will also encourage conversation around how users are feeling.

13. Time limits that of activity for the user. Rating: Must have

The default limit of the user should be set to 2 hours. This means that the application will become unavailable to the user after their activity for the day hits two hours, the users will have an option to 'receive more time' the reasoning for this is that they might still need to use the application itself so by allowing an option for more time will just help users become more aware of how long they are spending on the application.

The idea behind this requirement is to prevent the users from being on the application for longer than they need to. Screen time is a problem that many mobile phone users struggle with [25] and considering the focus of the project, it is important that this application does not encourage more screen time on the application.

14. Users can adjust the time limit to suit their personal needs. Rating: Should have

Allowing users to adjust the time limit of the application will put them in charge of how long they intend to spend on the application in a single use. This requirement allows for the users to become more aware of their screen time as it now is something that they are able to adjust. Hopefully making users feel more responsible for how they use the application, and allows them to feel that they do not need to keep using the application if it is not something they want to do.

15. Users can follow exercises using the application. Rating: Must have

Exercises that the user will be able to complete are breathing exercises and a calm walk. For users to become more aware of their mental well-being it is crucial that they are given the tools to do so. Starting with two exercises should mean that the users do not feel overwhelmed when it comes to trying to become more reflective and self-aware of their mental wellbeing, it should make them feel like it is manageable and something that they can do. The application can of course be made to accommodate further exercises for future iterations.

The reason for doing the chosen exercises are as follows; breathing is crucial for individuals to become more conscious of their wellbeing [18] and using the following 4-7-8 technique should help users feel more relaxed as this is a proven method of calm breathing [9]. When using the breathing exercise the devices should vibrate on the inhale and vibrate on the exhale, the user should be holding a button while following the exercise in order to feel the vibrations. Following on from the breathing is the calm walk. This was chosen as walking is another method of helping those who may be struggling with anxiety and depression [14], the application will track the steps duration and calories that the user burns during the walk. The user should also be able to view past calm walks so they are able to see how often they use the exercises.

In order to help users feel that they are not alone, the companion will also be present with the users during both exercises. During the breathing, the companion will inhale and exhale with the user, and with the walk, there will be a walking animation of the character as the user walks.

16. Users can log out of their accounts. Rating: Must have

Users should be able to log out of their accounts. The logout time of the user will be recorded and stored in the database in order to use for the status of the user.

System Requirements

1. The application should be easy for the user to use.

In order to ensure that the solution created meets the aim set out the overall solution needs to be easy to use, this will be evaluated at the end of the project through a final evaluation session with participants where they can give feedback on the application. Participants will also rate the solution using a System Usability Score questionnaire.

2. The application should be easy for the user to navigate.

Following on from the ease of use of the overall application, navigation will also be important. The application's navigation system should also make sense to the user. It should be clear and intuitive on how to navigate to and from pages and features.

3. Features of the application should be easy to use for the user.

The use of the functionality of the system should also be easy for the user. They should be able to use each feature with no problems.

4. The text of the application should be easy to read.

The text must not be too small for the users, and must also not be too large. Fonts that are used must be clear for the user and must also make sense with the design of the application.

5. It should be clear to the user who they are friends with.

The users should be able to see a list of friends that they have, and it should be easy for users to delete friends and add friends. Privacy of the user posts should also be made clear to the user to understand.

System Design

When looking at the requirements we will need a system that connects to an external database, and a system that can allow for authentication of users. There are key components that will make up this system in order to find the components further investigation will be needed so we can better understand what exactly the components are and why they are needed. Beginning our further investigation we can use diagrams to showcase the use cases, this will give a better indication to how the system and the needed database should be structured for the most effective way of retrieving data and adding data from the application.

Use Case Diagram

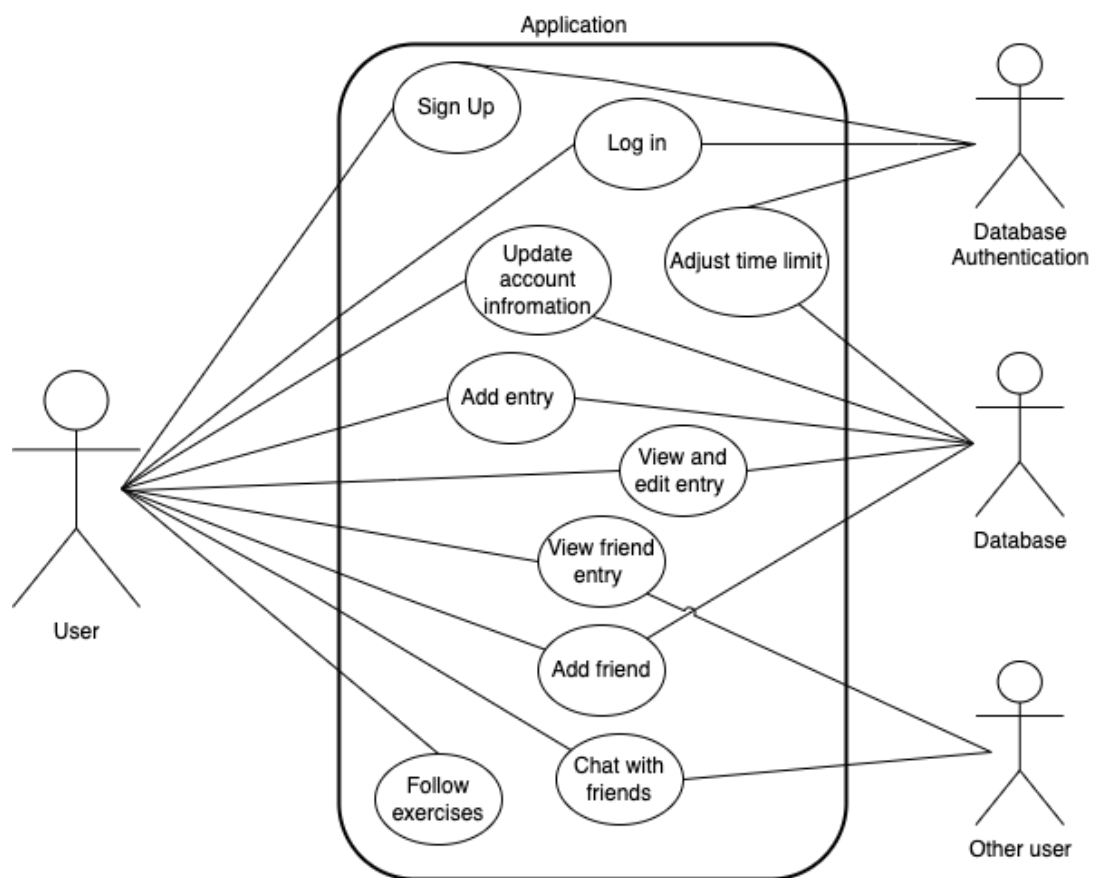


Figure 6. Use Case Diagram

Use Cases

Below is the first use case which can be shown as an example, the application has a total of ten test cases. All the completed use cases for the system can be found in Appendix 5 under the use cases section.

Use Case No. 1	Use Case Name: Sign Up	Rating: Must have
Purpose: Users must be able to create an account so they can log into that account.		
Main actor: Current user.		Secondary Actor: N/A
Pre- conditions: <ul style="list-style-type: none">• Users must have the application downloaded.• Users must be on the Sign Up screen.		
Trigger: When the user selects the sign up button on the login page.		
Description: The User must: <ol style="list-style-type: none">1. Enter their username for the new account. No spaces in the username and it must not be taken.2. Enter their name for the new account: No limit for the name of the user.3. Enter their email for the new account Must be a valid email with the correct format style.4. Enter their password for the new account. Must be greater than 6 characters.		
Extension: Users could create an account with Google, Facebook or Apple accounts. Users could name their companion on the create account screen.		
Alternative Flow: N/A		
Related Use Cases: Use Case 2 – Log in		
Post-Conditions: <ol style="list-style-type: none">1. If an account is created, the user is now able to log in.		

Activity Diagram

A way to visualise the flow of use cases is to use an activity diagram. Due to the nature of activity diagrams I felt that it would be appropriate to use one to highlight the full flow of the system. This way we are able to

better represent the order in which use cases should be done. It also provides an opportunity to logically assess the flow of the system, ensuring that all features and components

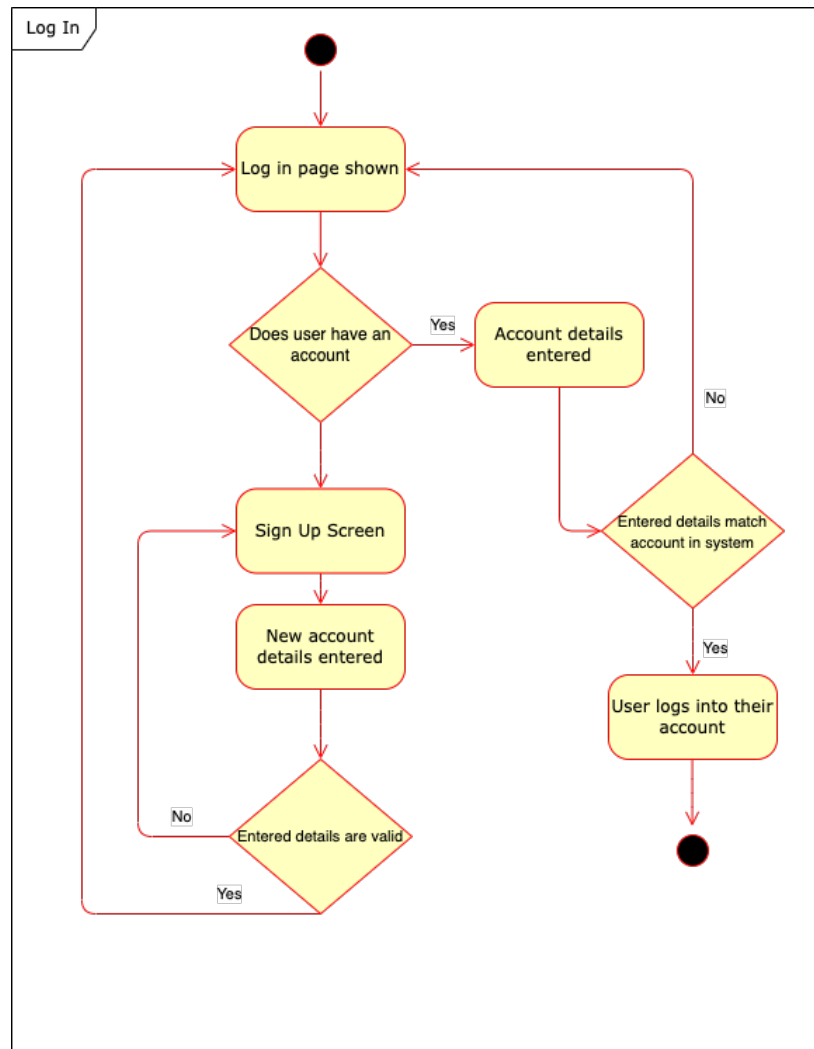


Figure 7. Login Activity Diagram

Figure 7 above shows the activity diagram for the login use case. As you can see there is only one end point in the flow and that is when the user logs into their account. This diagram helps to represent the intended flow of the login feature and also ensures that there have been error trapping considerations that have been taken into account when creating the feature.

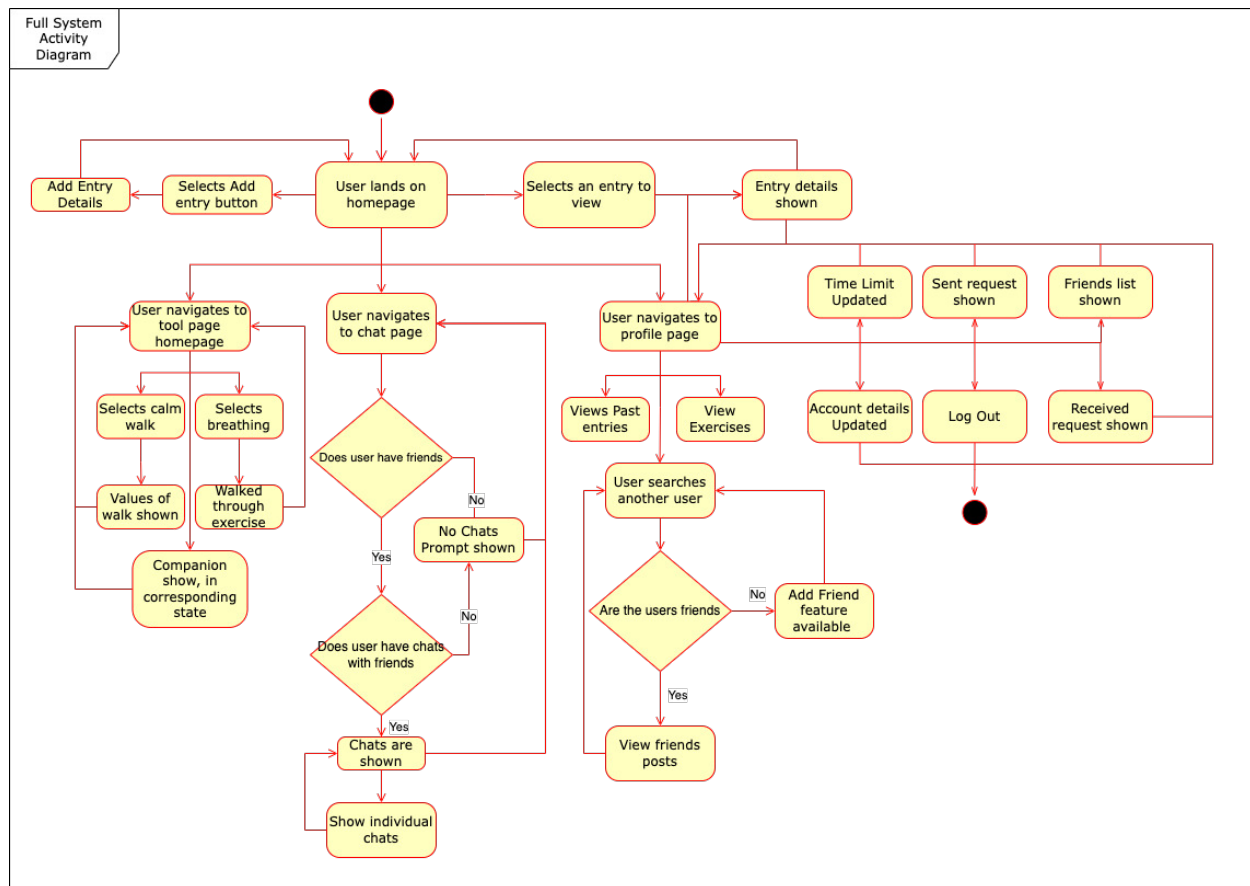


Figure 8. Whole System Activity Diagram

The figure 8 above is the full system activity diagram. This will begin once the user has logged on. The only end point for this system will be if the user logs out. Otherwise the flow of the system should allow the user to always navigate back to the home page, this diagram better represents how the application as a whole is expected to function. There are notable exceptions which is the absence of the companion feature, because its inclusion would over complicate the diagram. The companion is not needed as the diagram has the intention of representing the activity flow of the system taking into account the use cases, which the companion is not considered as one.

For this project there are a total of 38 classes. The large number of classes meant that it was extremely difficult to showcase all the classes in one single diagram. As a result of the size, the class diagram is at the end of the report, shortened into sections. Below in figure 9 you can see a section of the classes that were used in the application. From the diagram you are able to see how the classes interact with each other.



User Interface

The user interface is the bridge between the machine and the human. It was very crucial that the interface was clean and easy to use, as this would mean that the users would be more likely to engage with the application and its features. As most of the features of the application are focused on enhancing the wellbeing of the user, their engagement can be what helps them improve their overall wellbeing. Therefore if the interface is not easy to use and professional in its design it may impact not only the application's effectiveness but the user's overall wellbeing. Components of the user interface are also important, a big component of that is the colours that the application uses.

Colour of the interface

Colours can influence an application greatly. Emotions are often linked to colours, blue being sad and yellow to signify happiness. Studies have also been conducted into colour psychology, with the aim of researching how colours can affect human behaviours. This is why in particular for my solution the colours were important. I kept a constant theme of colours throughout the application as a means of keeping continuity. It also allows the user to keep engaged. It was important to select a colour that could have a positive meaning behind it, considering that colours can affect and influence human behaviour, I found that it would be important to try to find a colour that has a positive association to it. For this reason, I selected a shade of purple as the main colour of the application. Purple is often linked to Wisdom, creativity and bravery [4] I felt that this would be a good colour for the application. Spirituality is also often associated with the colour purple.

Besides using the main colour of purple for colour psychology reasons, I also used it as the other applications within the wellness sector do not use the colour purple. I find that purple makes the application different to others. The colour is utilised most on the login and sign up pages, as most applications do not have colour on their login or sign-ups pages. This again was a way of differentiating the application to existing work.

Another colour that I used within the application was grey. Grey can often be associated with emotionlessness and loss, so the grey used was a lighter shade of grey. Light grey is said to be soothing and I felt that this would be appropriate for my application.

Navigation of the interface

Navigation of the application is also extremely important and because of this, there were iterations throughout for the correct style of navigation and changes in the importance of pages. At the start of the project, I had intended to only have two pages able to access from the bottom navigation bar of the application. However, when I began working on the application I found this to be inconvenient for the user, so I increased the navigation bar to include five pages. This was to be the homepage, friends page, adding a new entry, chats page and a profile page. I stuck with this design for most of the project until I came across a package called `dot_navigation_bar` that allowed for a floating navigation bar. I felt that this design for the navigation bar fit more of the style I wanted for the application. It was minimalistic and very different to most navigation bars of applications. I decided to go with the floating navigation bar and this had a huge impact on the look and feel of the app. I restructured the navigation bar to fit only four pages.

These were; the homepage, tools page, chat page, and profile page. Reorganising the navigation bar meant that the exercises that are an important aspect of the application were now easy to access. However, there were many pages that the application consisted of and I had to also make them easy to access. I added a navigation drawer to the profile page. The application drawer was added using the built-in flutter widget of `Drawer`. This now meant that all the pages were easy to access.

Designing Exercises To User Enhance Wellbeing

In order for the application to meet its aim, we needed to design a system that could help users to become more aware of their wellbeing. Ideally supporting and enhancing their mental wellbeing while increasing awareness. There were many ways to go about this particular problem. For this application, I have mentioned exercises that will help users increase wellbeing and their awareness of it. Due to time constraints, I selected just two exercises to focus on. These were breathing and calm walks which I

mentioned earlier. I selected these two exercises as I felt they were the best and easiest for a user to do. The breathing exercise follows the 4-7-8 technique, while the calm walk use the device sensors to track the steps, calories, distance and duration of a walk. These exercises should act as a starting point for both the user and the application.

When designing these exercises the experience that the users would have while using them were also very crucial and as a result of this I decided on including the character, the character would join in with the users as they did their exercises. This was a design decision that was done with the idea of increasing overall user engagement with the application. I believe that the character will prove to be an essential part of the application, so including the character in as many screens as possible would only increase the user's reaction to the character. I also believe that it would give the effect that the user has a friend joining in on the exercise, this should help to ensure that the user does not feel lonely.

Designing the Companion

When it came to the actual design of the companion I looked through different models in Rive and Blender just to gain inspiration for how the companion should look. I found a character that was shared on the Rive community that I liked the look of. It was important to create a character that was friendly and because of that, an animal design is what I was searching for. I liked the idea of using a bird model from the start of the project, I felt that it would allow users to feel they had a virtual pet of sorts. When coming up with the character's purpose a virtual pet was the first idea, taking inspiration from Tamagotchi. I felt that by creating a virtual pet users would feel more inclined to return to the application. Upon further ideation, I considered making the companion a larger part of the app. The companion would serve as a reflection for the user, mimicking the users' emotions. For reasons surrounding potential ethical challenges that were discussed earlier, I decided to change the purpose of the companion. With the companion being the opposite of what the user's emotions were, the character becomes the main focus of the application by encouraging the user. I felt that this was necessary, especially when looking at other related work and how they approached the problem. I found this idea of integrating a character into a wellbeing focused application to be different to most of the related work that I looked at.

Now that the companion was to play a major role in the application I needed to come up with the states the character would have and how they would work. I considered making achievements for the user, this would act as another way to ensure the user kept coming back to use the app. An achievement-based system would prompt them to interact with the application by getting different items for their companion to use. I decided against this idea as I did not want the achievements to take away from the application itself. I want the companion to be a part of the user's experience in trying to become more aware of their mental wellbeing and by adding achievements I felt that it would become a distraction from the helpful content of the application. However, achievements could yet be something that the application could use in any future iterations. Once I decided on not including achievements I then planned to have fifteen different states of the character. Of which only two would be emotions, being happy and sad. The other 13 states were to be the different animations of the companion doing different activities. This again felt like the wrong use of the character. I finally decided on having seven different states, three states to be emotions of Happy, Sad and Playful. The other four states are actions, sleeping, reading, walking and breathing. Walking and breathing actions are for the exercises, the companion having these states means that the user can complete the exercise along with the companion.

Now that I had all the states of the companion and the basic idea of what I wanted the character to look like I was able to get to designing the character. As mentioned earlier I used a free to use model as inspiration.

As I was working for a limited period of time, and due to my lack of knowledge around graphical design, I then sent the original model to a graphics designer with instructions to increase the eyes of the character and remove the overlap of the eyelids. I felt that this made the character come across as grumpy. This was important to fix as I needed this character to look friendly. Below is a comparison of the original and final versions of the character.

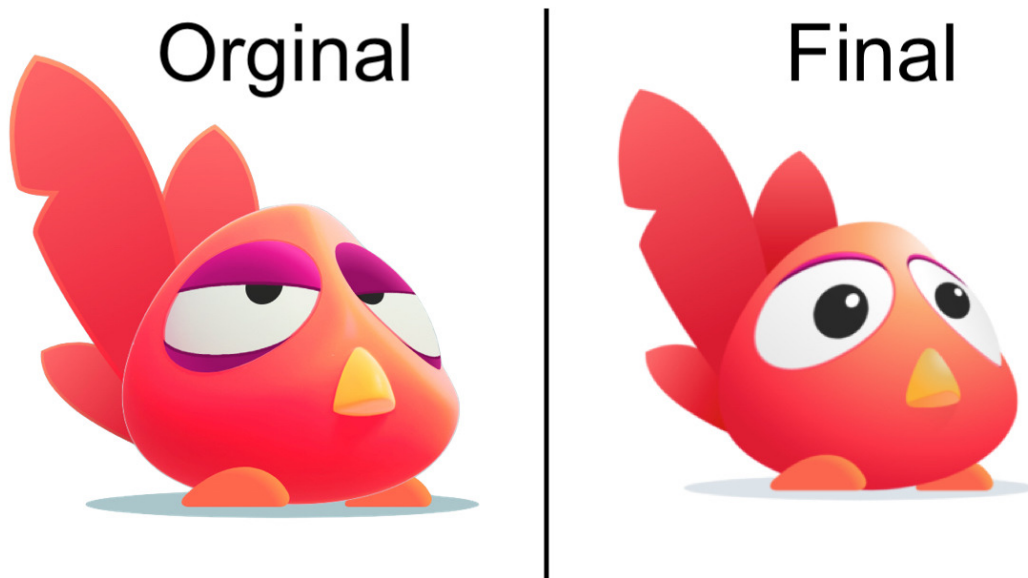


Figure 10. Original and Final Companion Designs

Figure 10 showcases the differences in design compared to the initial companion and the one that was used in my application. The original companion is the one listed as original, and the companion listed final is the one that was used in the application.

Software Architecture

When designing the architecture of the system, we have six main components that make up the application. Starting with the application front end, this is the user interface and what is shown to the user. We then have the main engine of the application called the feature engine. This is responsible for handling the inputs from the user and from the other components, this is called the feature engine as it is the engine that allows the features of the applications to run. This feature engine handles four inputs. Two of them are external and they come from the firebase collections and firebase storage. These two methods of storage allow us to store valuable data of the system. The other two inputs come for other system components and they are; time limit check, and state of companion. These two components are responsible for checking the time limit of the user and checking the state of the companion respectively.

Once the feature engine makes sense of the responses from the other components it can send them to the user front end, which in turn is shown to the user.

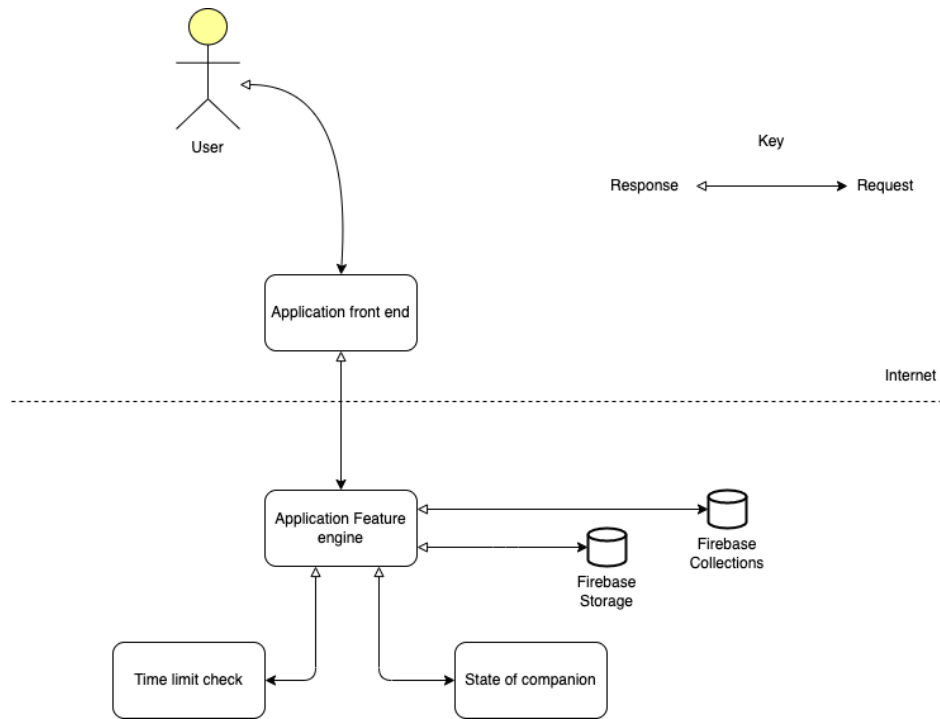


Figure 11. System Architecture Diagram

Above in figure 11 we can see the system architecture diagram, highlighting how the key components of the system work together.

User-Centred Design Approach

In order to ensure that the aims could be met, I conducted iterative design feedback sessions with participants, which allowed the design of the final solution to be heavily influenced by potential future users. Once the iterative feedback sessions had been concluded users would be invited to take part in a final evaluation session of the application. In this session feedback on the final version of the application was given, and participants were asked to complete a System Usability Score or SUS questionnaire. Collecting SUS scoring from the participants provides conclusions on whether the application has had a positive effect on a user's wellbeing, and also gives insights into how useful the application would be.

The outcome that we hoped to achieve with this project was to create an interactive virtual companion and explore its potential to help enhance mental wellbeing. However, the final test may not have been enough to assess that the application had enhanced the users mental wellbeing as that would need a long term study. So instead we focused on if the users found the system usable, these results were collected in a final evaluation session with participants.

1st Round of Design Feedback

For the first round of the iterative design feedback, I had three participants give feedback on the design of the application. I asked 15 questions centred around what they liked about the design and how they think the design of the application could be improved. Conducting these feedback sessions provided an insight into how users felt about the application, this proved to be extremely useful as suggestions were made that overall can help the design direction of the application ensuring that each design choice that was made had a purpose and that the users felt it made sense. Between the three participants for this first round there were suggestions made on where the application could be improved from. In order to find out what improvements would be the most beneficial for the application we needed to conduct a thematic analysis on the results that we received. It is worth noting that not all of the applications final features were working as intended during this round.

The thematic analysis process, involving the creation of codes and sub themes can be found in Appendix 6 under the section thematic analysis round 1 design feedback. We make reference to the sub-themes generated from the codes in figure 12 below.

Relationship Between Main Theme and Sub-themes

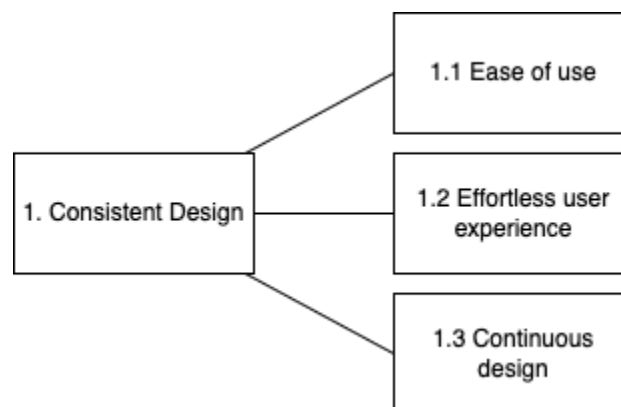


Figure 12. Relationship between the sub themes and main themes for this round of the design feedback

Definition of Main Theme

As we are using the feedback to help guide changes made to the application, I felt it appropriate to look for one major theme and focus the changes around that specific theme. Only having three participants for the first round does limit the feedback and in turn will limit the extent of the changes that can be made within the areas that the user suggested. As you can see in figure 10 we have been able to map the three sub-themes to the main theme. This main theme will be our guide for the changes that will be made this round.

Consistent Design

Consistent design is the main theme that we have selected for this round and this will mean that any changes we make this round should be done with the idea of keeping the design consistent. There were many suggestions that were put forward for changes and due to this it was important to prioritise the changes that were required and those that were not necessary. When prioritising these changes I kept the

theme of consistent design as the measure of whether or not to do the specific changes. For this iteration only three changes were made to the application.

The first change that was made was changing the back buttons, this is so that they could all match. In the first iteration of the application the back buttons were not consistent, this was not ideal, and when building an application that's purpose is centred around the user, it is very important to give a positive user experience. I felt that this change was also keeping with the theme of this round.

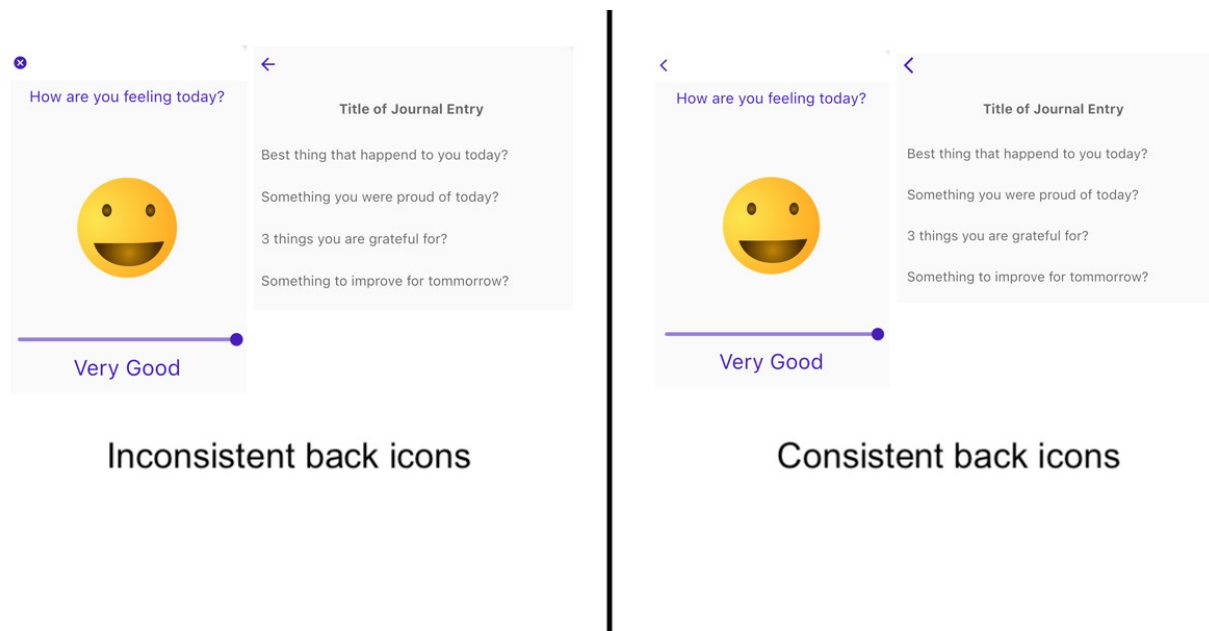


Figure 13. Back Icon changes.

The next change that was made was a small one but was to change the circular progress indicators colours. By default flutter sets the theme of your application to blue, in doing so objects such as the circular progress indicators are also coloured blue. Changing these to the main colour of the application made the indicator more in line with the design choices for the application. Changing just these two parts of the application helped to give it more of a consistent flow, and this in turn should improve the experience that the user will have when using the application. As the aim of the application is to increase users' mental wellbeing awareness their experience with the application is crucial.

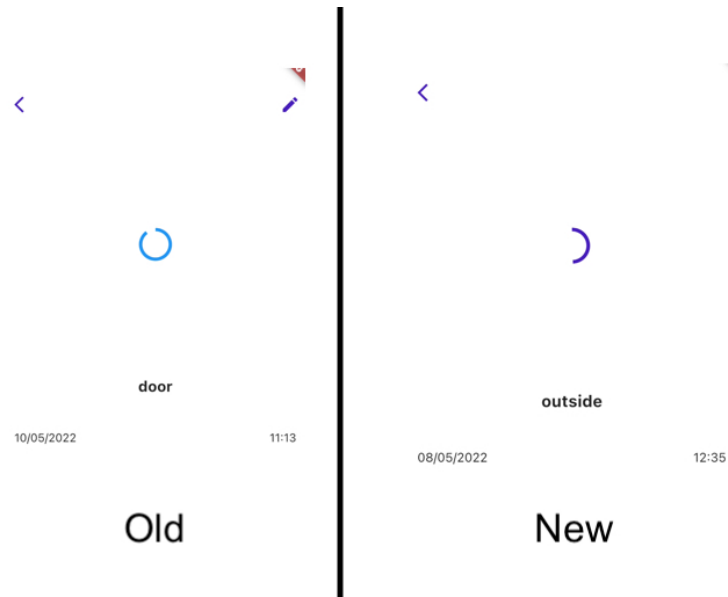


Figure 14. Circular Indicator Changes

The figure 14 shows the slight change that was made to the colour of the circular progress indicator, this change should help with keeping the design constant and inline with the theme of purple that we have chosen

The final change that was made at the suggestion of a participant was to make the users accounts always private. With a lot of news about how social media companies are violating the privacy of the I felt that this would be appropriate and that it would keep with a consistent design, as the application is about trying to enhance user mental wellbeing, letting anyone view private information it would be violating the very aim of the application.

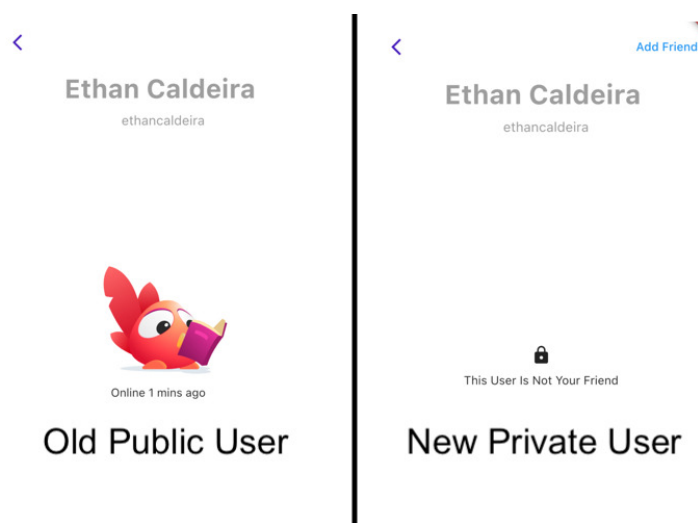


Figure 15. Private User Changes

In the above, figure 15 shows the change that was made to ensure that all users are private, and that their data cannot be seen if they are not your friend. Below the last activity of the user would be all the users posts. To keep privacy and trust we have removed this now, and you are only able to see your friends activity and your friends posts. This prevents individuals from having potentially sensitive information seen by people they do not know.

2nd Round of Design Feedback

After the first round of the design feedback, I was able to recruit more participants, improving from three participants to five. Having just three participants for the first round was a limiting factor, as it meant that we did not receive a variety of different changes that could be made. By improving to five participants we were able to get more of a general feedback on how the application was coming along. Between the first and second round of feedback the bugs that the code had been experiencing had been sorted, and we also were able to have the character fully working. Meaning we were able to receive feedback on the actual character this round.

The thematic analysis process, involving the creation of codes and sub themes can be found in Appendix 7 under the section thematic analysis round 2 design feedback. We make reference to the sub-themes generated from the codes in figure 16 below.

Relationship Between Main Theme and Sub-themes

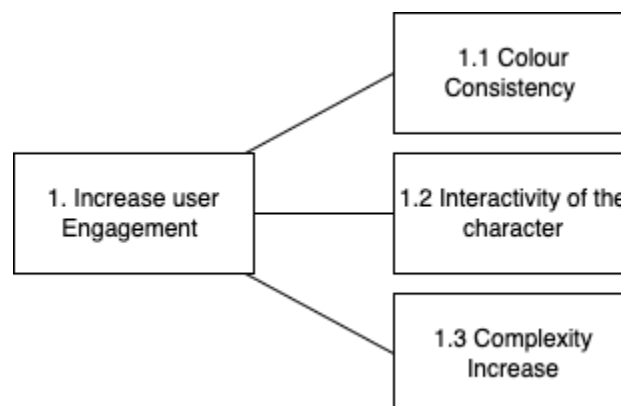


Figure 16. Relationship between the sub themes and main themes for this round of the design feedback

Definition of Main Theme

Increase User Engagement

Most of the participants praised the application and found that the character was the best feature of the application as shown with what participant 3 had to say; *“As I said, the changes of the character I think are really helpful and I think it gets across the awareness and just the point of being reflective on your mental well being.”*. From the sub-themes we are able to deduce a theme to focus on for this round. That theme is to increase user engagement, the relationship of this theme can be shown in figure 16 .Many participants said that they personally would use the application. This was encouraging however we need to ensure that there are enough features so that the user can get the most out of the application.

This application is dependent on how the user will engage with the content on the application, that will be the only way to truly have an positive impact on users mental wellbeing, therefore by focusing on trying to improve user engagement for this round we are able to ensure that users are getting the best experience using the application, and that they feel the want to come back and use the application. In this round of feedback we had more participants and we were able to get a better sense of what improvements the applications could do with. As a result of this we made three large changes for this round.

The first change was simple yet I feel has an impact on the use of the application, that is changing the colours of the entry previews. These were initially all purple, they also had more of a 3D effect, however it was becoming difficult to tell the different types of entries from one another, so by changing each entry colour we were able to not only improve the appearance of the application but also improve the user experience which was shown in the third round when a participant said *“The colour change is good, helps to make clear which entry is which, in comparison to last time I think it makes more sense.”* This was encouraging as it meant the changes made to the application were overall positive.

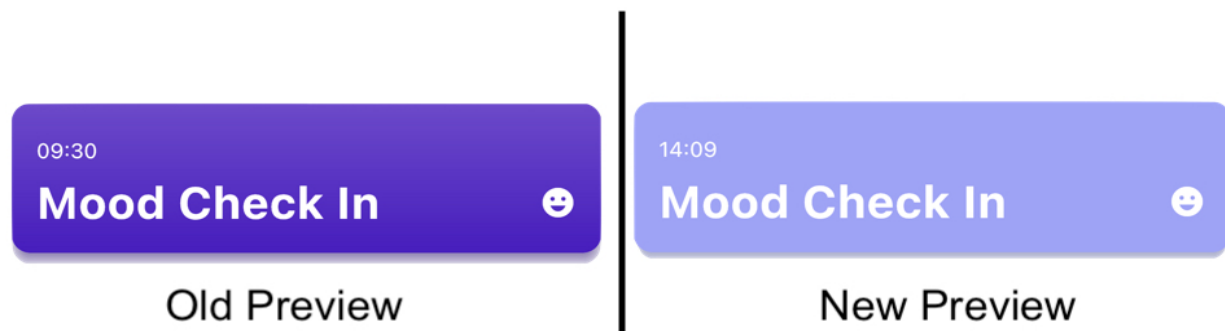


Figure 17. Preview Colour Change

Figure 17. Showcases the changes made to the entry previews, where the colour was adjusted and the 3D effect was also altered. Prior to the update all the previews had the same colour and effect as the old preview however this has now been updated to give each entry its own colour, which is shown later in figure 26.

The second change that was made was around the interactivity of the character. One change suggested from a participant was the key focus and that was to allow each user to name their character. This was very easy to do so from an implementation point of view, but for the design we needed the user to be able to see the name of their character, so we had a message displayed to the user. This also helped to address another point made by a participant *“Uh, maybe on an initial usage, just some more information as to what the colours of the moods are, and which state is which.”*. By displaying a message to the user we were able to avoid having to break down the mood colours but still having the user be aware of what the states of the character actually meant. In making this change we are helping to improve the engagement that the user has with the application.

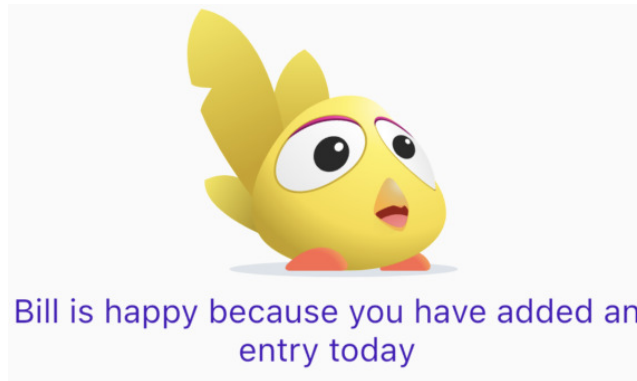


Figure 18. Companion name and message change

The above figure 18 shows the character in a happy state. It shows the name of the companion and why they are in the corresponding state.

The third change that was made was the inclusion of an audio entry. There were many suggestions of features that could be added to the application but I felt that an audio entry made the most sense. Including this new entry type will help to improve the users engagement with the application, before we implemented the audio entry there were only three types of entries that a user could do, this limits the experience that the user can have with the application. Including this feature also gives users the chance to quickly use the application to make a voice note on how they are feeling, further increasing the ease of use. In implementing this new feature we faced some challenges, these challenges will be highlighted in more detail later in the report.

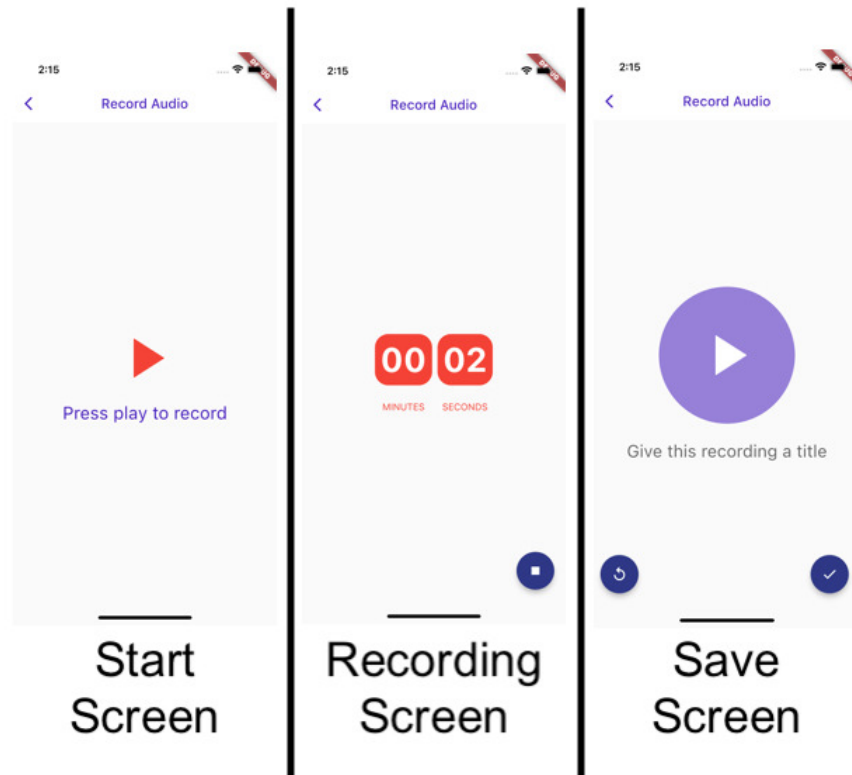


Figure 19. Add Audio Screen

The above figure 19. Showcases the third change that was made which was to implement a record audio screen, allowing users to record a voice entry. The figure shows the different screens involved with this feature.

3rd Round of Design Feedback

For the third and final round of the design feedback we had the same participant as round 2, this was useful as it offered continuity between the two sessions. At this point the application was nearly complete, the features were working as intended, and the improvements that were suggested in the previous sessions were all completed. In this feedback session we were looking to see if the users were satisfied with the design, and if they could give any more recommendations.

The thematic analysis process, involving the creation of codes and sub themes can be found in Appendix 8, under the section thematic analysis round 3 design feedback. We make reference to the sub-themes generated from the codes in figure 20 below.

Relationship Between Main Theme and Sub-themes

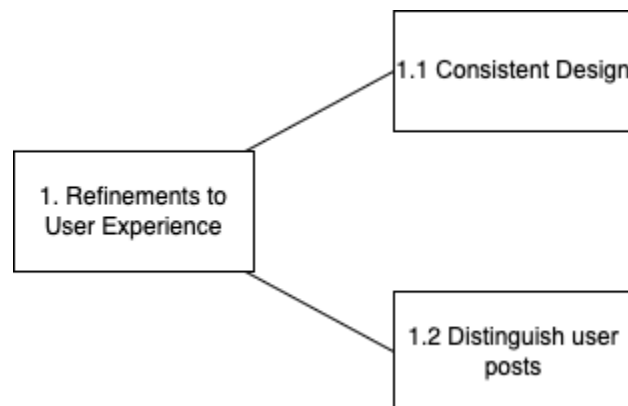


Figure 20. Relationship between the sub themes and main themes for this round of the design feedback.

Definition of Main Theme

Refinements to User Experience

For the third and final session we were able to get a sense of how users felt towards that application. Overall the feedback was positive with all of the participants saying that they would recommend the application to their friends or family. We managed to get some final feedback on what improvements need to be made, in general these were smaller improvements when compared to the other rounds, however, many participants said that they felt the application did not need any improvements, for example participant 2 said *"I don't think there's anything further that needs to be done with it. It looks good and for the most part is very consistent."* This was encouraging. As a result of the improvements we were told to make we could deduce a general theme of refinements to user experience. This again is crucial the application is centred around the experience that the user has, and it is important that the user feels they are using a high end application, this will improve their experience, and in turn the impact that the application will have on them. Following the theme of refinements to user experience we made two small design changes for this final round.

Firstly we changed the colours used for the friends posts, this was at the request of participant 1 who said *"You could have different colours for the friends posts."* When making this change the type of colour we wanted to use would be important, it needed to work with the existing colour choices that we made for the users post. So we went for pastel green colours, we had each entry type be a different shade of pastel green and as a result it is clear which posts are by the user and which are by their friends. It adds to the overall experience by making the application more vibrant.

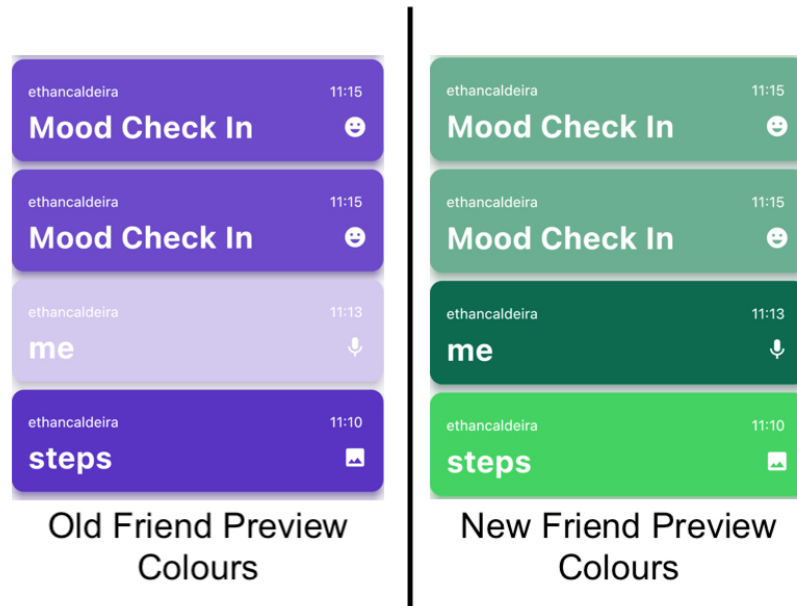


Figure 21. Friend Preview Changes

In the above Figure 21 it shows the changes made to the friend entries preview colours. The colours were changed to green to stand out against the user's entries preview colours which are different shades of purple.

The only other change that was made was changing the back button on a specific page. This was seen by a participant, so it needed to be updated to the back buttons that we had for the other pages. Only one page needed this change and this one page was not changed in the first feedback round. Although it is a small change it is needed for the application flow from one page to another.

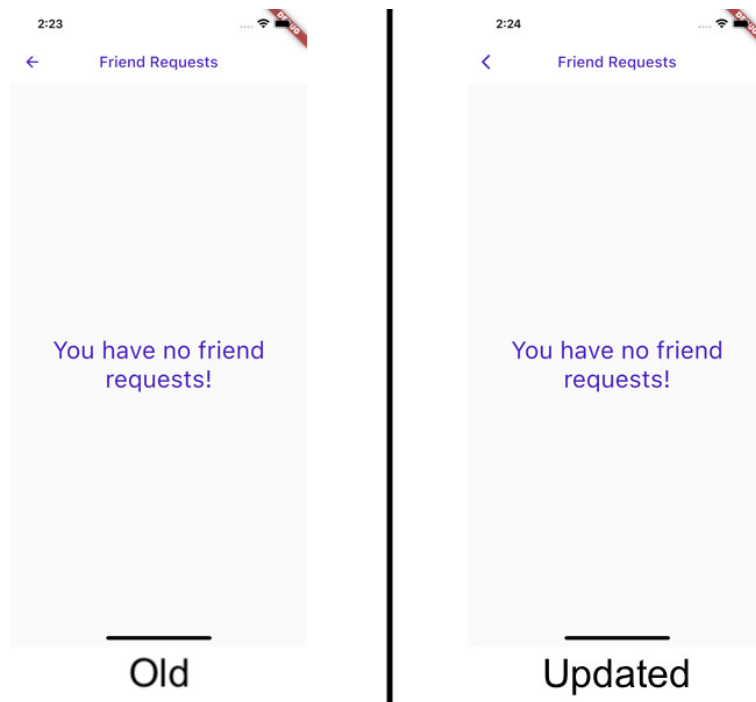


Figure 22. Back Icon Update

In the above figure 22. Shows the changes made to the friend request page. The top left hand button needed to be updated to the same icon as the other pages.

Now that all the rounds of design feedback sessions have concluded, The final evaluation session is the next time that the participants will see the design of the application, where the participants will have a chance to use the application for themselves and rank its usability using a system usability scale, this will inform us of how easy the application is to use. The results of this session will be discussed more later.

Implementation

Programming Language

As mentioned, the solution that I intend to create is an application. In order to create an application that meets the aims outlined, I will be using Flutter to create the solution. Flutter is a software development kit created by Google [10]. Flutter uses a programming language called Dart, this programming language allows clients to develop mobile or web applications. "Dart is an object-oriented, class-based, garbage-collected language with C-style syntax" [13] I have chosen dart and flutter as I believe it will allow me to deploy my solution to both IOS and Android software, it is also a programming language that I feel confident in my ability to learn as I am very familiar with object-oriented languages and it is a development kit that I have used once before. I will also need to use a database to store user information and my choice for this is Google Firebase. Firebase is a database service that will allow us to store user information and provide user authentication through email and password sign-ups. The reason for selecting firebase is because it is a service that I have used before.

Using flutter to create the solution provides the ability to create a solution that can be accessed on IOS and Android devices, this will ensure that future users are able to get access to the system regardless of their personal devices. From a technical perspective, it means that only one coded solution is necessary in order to deploy the solution to multiple platforms. This will mean that only one programming language is needed rather than having to code in two different languages, this is beneficial as it will allow for the whole solution to be completed within the time frame specified in the initial report.

Flutter Vs React Native

I have already discussed that flutter is my programming language of choice and made points as to why it is the option I plan on going with, the biggest one being the ability to deploy to multiple platforms with one single coded solution. However, there is another choice I could have gone for which offers more or less the same deployment as flutter but is coded using javascript, and that is React Native. In order to select Flutter, I did look through all that React Native had to offer. I found that most of the comparisons between the two frameworks highlighted that React was helpful if your application contained calculation-intensive tasks. This would be a problem for the application I intended to create but it was an indication of the capabilities of the two frameworks.

One of the major reasons for choosing flutter over react native is that flutter is better for creating applications with the focus being on UI, this is in part because of the large library of widgets that the flutter SDK possesses. I wanted UI to be a big focus for this application as it was important to me that the application looked minimalistic. The reason for this is that if the application was cluttered and busy it can often be more difficult to navigate, another reason is for the user experience. As the application is focused on making users more aware of their mental wellbeing creating a busy cluttered experience may lead users to feel more stress when trying to use the application.

React Native has been available for longer and because of this there are often more reviews favouring React Native. Another reason for selecting Flutter was because it should be easy to learn the programming language Dart when you are familiar with java. Due to the fact that both languages have an object-oriented approach. I would have lacked this advantage when using React Native as it is coded using javascript which I am not as familiar with as compared to Java.

Database Selection

In the background I mentioned that the database I was going to use was Google's Firebase. A cloud storage database that will allow us to conduct authentication as well as store data from the users, entries, chats, and exercises. However, there are many cloud database systems that offer exactly what is required for this solution so it is worth looking into which ones could be better. I decided on the cloud database option instead of using a built-in database as the cloud database offers scalability for the application. It will allow many users to use the application at once and will also make the application independent of a single machine. Having the database remote also means that the access should be quicker when the system scales up, although it means connections need to be made to the firebase for every pull and push to the database. However I felt using cloud databases would also make the application more realistic, in the sense that most applications that are on the Play Store or App Store will use cloud database systems.

When looking for a cloud database, there were other options that I could have used such as AWS Amplify and Back4App which offer mainly the same services as Firebase does. packages are still needed to establish connections to the databases, but this will be the same for all of the cloud database options. What made me pick Firebase was not only that I had experience in Firebase, which meant that connecting the application to the database would not take particularly long, but also that Flutter is made by Google. Due to this, the integration between the two systems was particularly easy.

When using the firebase package, authentication for users is made easy by using the built-in functions, this was another reason for selecting Firebase. I felt that the package would be very useful and overall for the database I was looking to create it was likely the best option. I had experience before using Firebase and the authentication system, this will be beneficial as the authentication of users will be an integral part of my application and by having used the authentication before I feel that it should not take long to set up for the application.

Adding data to the cloud database is also simplified using the package, and in turn, this makes it easier to understand how the database system works altogether. Firebase is a NoSQL database as a result the classic SQL terminology is adapted to NoSQL terms. As I am more comfortable with SQL this terminology change made the initial set-up of the database slightly confusing. Deleting specific fields in Firebase is also simplified with the package. Firebase gives multiple options and different services that the package is able to take advantage of.

There is a real-time database that can be utilised, however I opted to use their Cloud Firestore database as I felt that it applied more to my needs. The real-time database allows for the application to automatically sync to the database for any changes that are done, this was Firebase's first database. Cloud Firestore builds on top of the existing real-time database that flutter uses, the cloud Firestore is also mainly aimed at mobile development, hence the reason for opting with Cloud Firestore.

Another reason for selecting Cloud Firestore is that it requires less denormalisation [3]. One of the requirements for the application is allowing users to upload images as entries, this can be done using firebase storage. Allowing us to upload the entire image into a collection and reference it with the entries collection inside the Firestore database. I had previous experience with using the storage of Firebase so this was not too challenging to set up. Firebase is free to use on a standard plan and offers all the services that are required for the running of the application. Firebase also has a pay as you go plan which allows for more features such as integration with google cloud and increased storage options. This is not needed for my solution at this stage.

Animation Software

When choosing to create a virtual companion for users to interact with, there were many options I could have gone with. I eventually decided on using an animation software library called Rive. However, I did consider using Unity to help model and animate the companion, as I wanted a 3D character for the users to interact with. By using unity it would have allowed me to load a pre-built model or create one using the modelling software Blender, and animate the model on a very specific level. Unity is a game engine that allows users to create games, and because it is a game engine Unity also supports animations of models, typically this is used for game environments, making an environment more interactive with the player's actions which helps to create dynamic worlds for the players to explore. Due to the size of Unity, I was initially interested in creating my companion using the Unity platform and integrating it into the application.

For the integration part, this is an existing package for flutter that allows users to embed Unity projects into their applications. This seems ideal for the virtual companion as the package will allow for commands that

can trigger animations inside the Unity project. When researching I found an example of this in a virtual car model, that through using the package was able to have its wheels move. The Unity package was the route that I thought would be the easiest, however, I came across an alternative with Rive, this platform was focused fully on animation.

Rive allows you to create an animation with built-in states, what this means is that when adding a Rive animation to your assets folder in Flutter, there would be no need for multiple files depending on the state. The one file contains all the states of the animation. These states are able to be triggered or looped, allowing for an idle state to bring the character to life, small movements such as blinking or small vertical movements to mimic the breathing of the character help to convey to the viewer that the character is interactable. After seeing a few of the default models I knew that Rive was the system I wanted to use. Rive also works really well with Flutter. There is a package needed to bring the animations to life in Flutter but it is really simple to use.

Animation controllers are used to trigger the set states of the character. This is ideal for my solution as it will allow for an algorithm to set off particular states of the character based on what is gathered from the database. There is also a feature within Rive that allows users to create a state machine, this state machine can make changes to the animation without triggering specific animations, this has the potential to be used for the character. However, the state machine works by starting off the chain of states, and this is not exactly how the character was meant to be implemented. Due to this, creating other animations and triggering those animations through a function is the best approach to use. This function can also be used for any user as it will take a parameter of id which prevents the need of having two separate functions which would query the database with two separate ids for the current user and any of the users friends, now this function can be done altogether.

When comparing the two options of animation software I found that Rive was easier to use than Unity. I also think this can be attributed to the fact that Rive is an animation software and Unity is mainly for creating a game. I was unfamiliar with both software options however as I wanted the companion to be different to standard models I would have needed to create the model using the system blender. I did try to use this system but found I was spending too much trying to understand how to use it, and because of this, I opted to use Rive. I was able to find a pre-built Rive character that was along the lines of what I wanted for the companion, and because of this, I was able to start on the workings of the character relatively quickly. Further work on using Rive and the animation process will be discussed in the Implementation section.

Firestore Database

Database Design Diagram

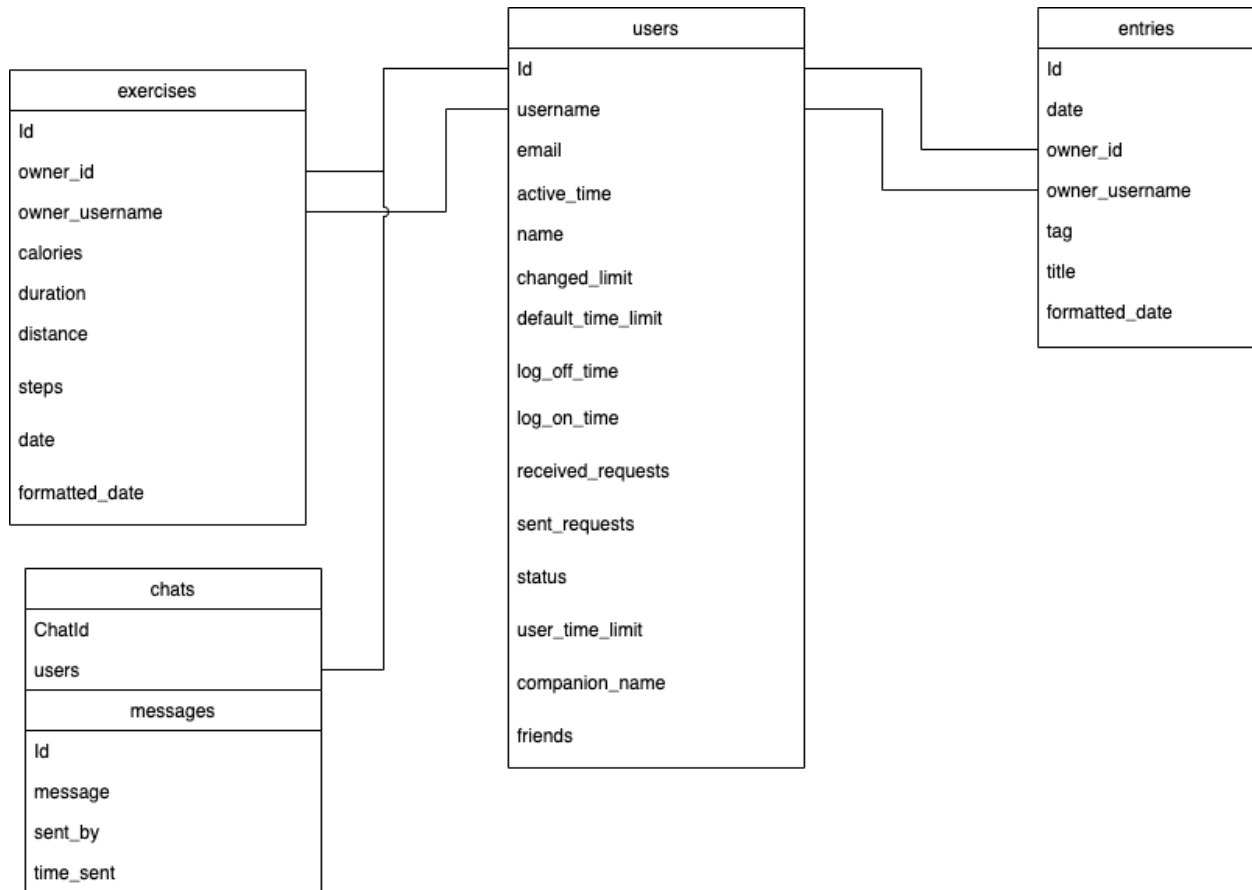


Figure 23. Database Diagram

Above in figure 23 you can see the design of the collections we are using. For the entries collection there are added fields depending on the type of entry that is being created. For the diagram above I decided that it would make more sense to just include the required fields of each collection, rather than all the potential fields that a collection could have.

Connection With Firebase

A major part of the application is its connection with the database. The database stores all the information needed for the application to work, this starts at the very beginning of the application with the login screen. Establishing a connection with Firebase was a large part of the initial setup required before any code could be written. To establish this connection I followed the process outlined by firebase itself. As I intended for the application to run on both IOS and Android I followed the step up steps outlined for both. They varied slightly with what was needed but both required the package or bundle id for the project. Once that was provided the next step was to download and add a configuration file to the project. Then I needed to download the Firebase SDK into my project, and then the connection was able to be established. Once the connection was established I could manage the connections using the firebase console, which is an interface that displays the state of your connection and the database itself. This would prove very useful as the solution progresses. Once I had access to the console I was now able to use the firebase services, this was needed through packages. I have multiple services from firebase, starting with the authentication service.

Authentication With Firebase

Authentication was essential to the project as this would help to verify whether a user had an account or not. Luckily this was also able to be handled through firebase which offers authentication with email and password. The emails are stored in the authentication section of the Firebase console, the passwords however are not visible in this section. You are only given the option of resetting passwords, this sends an email to the user and allows them to reset their password. The resetting of the password is handled by firebase auth package, an email is sent out and the user is able to change their password from that email. This is a huge positive as it keeps the security of users' passwords unknown to whoever is managing the database, this will be needed should this application be published on App Stores. Another option through the authentication section is the ability to delete accounts or disable accounts, these are not features that were needed for the creation of the application, with the expectation of having to delete test accounts, but are more useful for the long term.

What I found using this built-in system was that although there was an automatic way to verify the email and passwords of a user there was no collection to store any other user information. This was a problem as I needed to store a variety of information for the user. Due to this, I needed to create a collection manually. I followed online tutorials to walk through creating a user collection with the authentication of Firebase. I was to create a method that would be used once the user was able to successfully register their account. Having this collection now allowed me to store the user's name, username, and email, I did not store the user's password in this collection as there was no need. This collection is an entity that was needed later for the project, as I would eventually store the friends, sent requests and received requests under the corresponding user document. It was also important to have unique identifiers for the user, this was done automatically with `createUserWithEmailAndPassword` method so this id needed to match the id within the document of the user. Documents also receive unique identifiers as a way to refer to the correct document of the collection. Due to this, I ensured that the document id was not automatically generated but instead was the same id as that used for the user once they register the account. Having the user-id also be the document id made the query calls for the rest of the application easier, as all that was required was a method to obtain the user's id and then you would have the id needed to query the right document with the collection.

Adding to Data Firebase Collections

Within the solution, there are a lot of instances where information is added to a collection with firebase. Mainly when the user posts an entry. The addition to the database is so important and frequent within the application so it was important to understand the best and most effective way of adding to the firebase collections. This was done by using the package of `firebase_core` as it allowed us to create an instance of `Firebase` and reference directly to the collection that was needed and using the method of `set` we were able to set information within the collection. Other methods such as `update` were also used, the main difference between the methods of `set` and `update` is when to use the methods. `Set` is better when you intend to set data within your collection and `update` is more beneficial when you want to update a specific field within the document.

Both need the data that is being set or updated to be done in dictionary syntax, as the data that is retrieved from the collection itself is in dictionary syntax. This makes sense as the key will be used as the reference to the field in the collection and the value will be the data we intend to store under the corresponding field.

Reading From Firebase Collections

Not only is adding to the database and collections important but retrieving the information is a key component for the application to work as expected. Retrieving the information from the collection allows us to display the users' entries from themselves and from friends; it also enables the algorithm that is responsible for state changes of the character. In order to retrieve the data from the collections, a correct reference is needed. These references are essentially the queries of the database in the same way that to collect information from an SQL database you need a specific query. You are also able to refer directly to a document inside the collection by using the `document` method that takes the id of the document as a parameter. In order to get the information after the query, the `get` method is used.

However, something that I encountered that I was unaware of is that when querying the database it works asynchronously with the other code that is shown as the data return is often returned as a `Future` and then the value of the data. This is needed as there is a delay in accessing the data from the collection and when it can be used within the code, this provided a new challenge that I was not expecting as I had to convert the futures into the necessary data type. When looking for information on this problem I discovered that a method of `then` can be used. The method allows for the query to run, and then after the code will execute instructions. This is how the algorithm for the character state change was managed. However, this method does not work with displaying the information within the body of an application screen, for that, I needed to implement a future builder. The future builder works by taking a future, this can be a method or query of any kind, and then allowing that to be displayed on the screen. How the future builder deals with the problem of the delay is using an `if` statement. This `if` statement allows the future builder to return a widget or block of code if the future provides no value. This works perfectly as there is a class called `CircularProgressIndicator`, this class displays a loading circle as a progress indicator. So when the future builder is waiting on the data from firebase it displays a loading indicator. Once the data has come through it appears and the loading indicator disappears as there is data present from the future.

This loading indicator is particularly useful for the homepage, as there is a delay from when the screen is first initialised to when it is populated with data. Without using the future builder widget I would be unable to display any of the data from firebase on the screen.

Algorithm for Companion State Changes

A large part of the application is focused on the interactivity the user has with the virtual companion, because of this the algorithm for state changes of the companion is a crucial part of the system. I had originally planned to have the algorithm create a score for each user, this score would be based on the information collected from Firebase. This score would then determine the state character would be in. This idea was what I used initially, however I found that I was only trying to change the character into 8 states, and using a score excessive for what is actually required. I decided to opt for a more simplified approach, I would create an algorithm that retrieved data from the collections in firebase and if that data was equivalent to another value a certain state would be returned. Although a more simplistic approach I found that it made more logical sense. There was no need for a score based algorithm as there were only 8 potential states. The next step was to decide what information to use from the user. I had decided in advance that the number of entries for a particular day should dictate the moods, however, that felt too simplistic.

In order to add to that, I decided to use information from an entry with the tag mood check-in to be more realistic to the character. This now meant that if a user's latest mood check-in said that they were feeling down the character would be in a playful mood in order to try to cheer up the user. Along with that, I made sure that if the number of entries from the user within the day surpassed 4 that the character would go into a reading state. This state was representing that the companion was reading all the entries from the user. I did not want the user to be spending too long on the application as I felt that this would be counterintuitive to the purpose of the application itself, because of that I added another if statement that would put the character into a sleeping state once the hour had passed 9:00pm in the evening, however, I also needed to ensure that the character would wake up again so the if statement was; `else if (DateTime.now().hour >= 21 || DateTime.now().hour < 6)`. With this statement, it meant that the companion would not be sleeping once the time passed 6:00am in the morning.

Another state that was added later was a walking state, for this state we would have to use the accelerometer, by doing so we could tell if the user was walking or not. If the user was found to be walking we would need to update the state of the character accordingly, this indeed would add to the interaction between the user and the companion. More details on how this was implemented will be under the use of built-in sensors. For the sad and happy states, these were dependent on if the user had posted any entries for the day. If there were no entries the companion would be sad, and if there were entries the companion would be happy. The breathing state is only used for the breathing exercise.

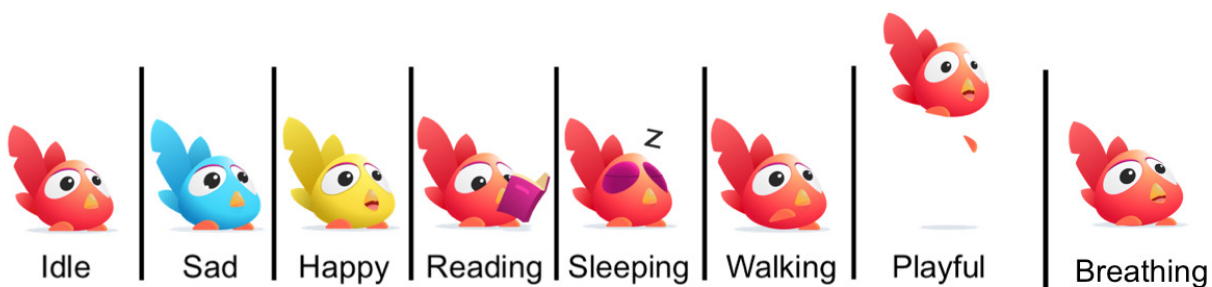


Figure 24. All States of the Companion

Above in figure 24 you can see all the seven states that the companion can experience. These states are dynamic, so in the application the states are animated. Thus improving the interactivity with the companion.

When increasing the interactivity between companion and the user, a participant from the design feedback session suggested breaking down what each mood colour meant and what each state actually was. To avoid having to overload the user with information, I came up with the idea of having a display message to the user. This meant that the user was able to know what the character was actually doing and why they were doing so, this further increased the users interaction with the companion and considering that the applications key feature is the companion I felt that this was a good addition.

```
,
//If the user has not ever created an entry.
else if (entriesTotal == 0) {
    //The companion will be sad as the user is not using the app.
    String message =
        ('$character is sad, because you have not added any entries'); //We can save a unique message for the user.

    //We then need to create a list that will store the feeling of the companion and the message.

    List stateList = ["Sad", "$message"]; //SAD STATE
    //stateList[0] is the state of the companion.
    return stateList; //Return the list.
}
//If the user has not created an entry today.
else if (entriesToday == 0) {
    //The companion will be sad as the user has not been using the app for the day.
    String message =
        ('$character is sad, because there are no entries today'); //We can save a unique message for the user.
    //We then need to create a list that will store the feeling of the companion and the message.

    List stateList = ["Sad", "$message"]; //SAD STATE
    //stateList[0] is the state of the companion.
    return stateList; //Return the list.
}
//If the user has been posting entries today, we need to check the mood of the user.
else if (userMood == 'down') {
    //This mood is only for the latest mood check in.
    //The companion will be playful if the user has said they are feeling down.
```

Figure 25. Companion Code

The above figure 25 is a code snippet of the `calculateState()` method. This method will return a list as seen above. From that list we are able to create the state of the companion by using the first value inside a `SimpleAnimation` class. We can then extract the message and display that back to the user.

Time Limit

Considering that the application is focused on bringing the users more awareness of their mental wellbeing, and to help support their mental wellbeing I felt it crucial to ensure that users did not spend too much time on the application. Also, the requirements of 13, and 14 specify that the user should have a time limit that can be changed to suit their liking. In order to achieve this feature, I needed to have a default time limit. I selected the default time limit of 2 hours or 120 minutes. This was then saved into the user's collection table in firebase. Doing so meant that each user could have their own specific time limit. This was easy to implement by creating a class that would allow users to change their time limit to whatever they wanted. In

order to check the time the user was online, we needed a method that would be used on every main page of the application.

This method was called `checkTimeLimit(context)`. This method took a parameter of context, the reason for this was to allow us to push the user to a new page. The method worked by querying the user data for their specific time limit and calculating the difference from their log on time to the time limit in minutes. I also had the active time in minutes of the user added into the firebase collection. Storing the active minutes which are constantly updated when the method is called, will allow us to not time lock a user who has closed the application but is still logged in. Further work would see the active time used instead of the login time, as it would be more effective for getting the correct time limits. Currently, the method does time lock a user even if they are not active on the application, as we are using the `DateTime.now().difference(logOnTime).inMinutes;` statement, in order to fix this problem we will need a new field in the firebase user collection that will indicate whether a user has paused the application. By using this new field and the `active_time` field we can continue the time limit from where the user was last active.

Once the current active minutes of the user has surpassed their time limit we send the user to a time limit page. This page features the companion set into a sleeping state, to indicate the application will now go to sleep as the user has reached their time limit. This page also allows the user to keep using the application, in order to do this we reset the user `log_in_time` to the moment they click the 'More Time Please' button. We also need to reset the active minutes to 0. Doing so allows the method of `checkTimeLimit(context)` to still be used. The fields in the database have now been reset to new times so the user will be able to continue to use the application until they hit their time limit again.

Changing the default time limit is done using the `TimeLimitPage` class, this displays a page to the user for them to reselect a new time limit. For this, I created a method called `buildTimeLimitPicker()` this method returned the `CupertinoTimerPicker` this time picker allowed users to use a carousel-like picker which meant they could scroll to the time that they wanted. For this time picker, I had to set the mode to `CupertinoTimerPickerMode.hm`, allowing the user to only select hours and minutes. Once the user had selected their new time limit we had to change the duration into a string and store that in the database. The picker also meant that we were able to change the time limit on screen as they were selecting a new time. Some error trapping was used to ensure that the users selected a time between 10 minutes and 12 hours, as I felt that these were reasonable limits that a user would want to set. Anything more or less would affect the experience of the application.

Entries

Entries are the backbone of the application and a key feature for helping to support and enhance users' mental wellbeing. The application featured three different entry types, they all served a different purpose and were implemented in different ways. To be different from other applications and add a unique take on posts we created an entry preview. This was a card that was shown to give an overview of the application. This was able to be used by all different entry types and was used throughout the application.

Entry Previews

For the entry previews, I created a widget that could be reused throughout the application called `userEntryPreview` this widget took nine parameters which were; `context`, `title`, `timestamp`, `index`, `tag`, `postId`, `userId`, `isPastJorunal`, `isProfile`. Having all nine parameters meant that we were able to present a preview for whatever kind of entry was needed. The final two parameters are boolean values that are given true or false depending on if the widget is being used on the profile page, or the past entries page. These boolean values are also given when the `ViewAnyEntry` class is called. Through these values, we are able to show different information on the preview card. If both boolean values are false it means that the previews are being shown on the homepage, with that knowledge we do not need to show the date of when the entries are posted but rather the time, as the homepage only shows posts from today.

The parameter of `context` is used so we can push the user to a new page, as the entry preview is not a class but a widget and therefore does not have the context to push a user to a new page. All other parameters come from the Firebase and the entries collection. This entry preview widget is used within a `StreamBuilder` or `FutureBuilder` and allows us to send the widget the information from the database itself. This information is then displayed on the preview and even passed to the `ViewAnyEntry` which is important for viewing the entries.

It is also important to have entries for the friends of the users. Instead of creating another parameter for the existing `userEntryPreview`, we decided to create a new widget that could be used for the friends of users. This widget was called `friendEntryPreview` this widget also took nine parameters with the only difference being in replacing the boolean values for `name`, `isHomepage` with these two parameters all the necessary information for the friend's entry preview could be displayed. The `name` parameter was the friend's username, this was to be shown at the top of the preview, indicating that the entry does not belong to the current user but rather their friend. We then needed the bool value of `isHomepage` as we need to show the time rather than the date if it is on the user's homepage.

As mentioned in the user centred design section, originally all the entry previews shared the same colour and this meant that all the previews looked the same. From the user feedback, it was clear that users wanted variety in the colours of the previews, particularly on the homepage as one participant said *"Maybe you could have different colours for entries or as you navigate through the app maybe different sections could have different colours."* From this, the previews were further updated to give different colours for the three potential entry types. This was well received in the second round of feedback.

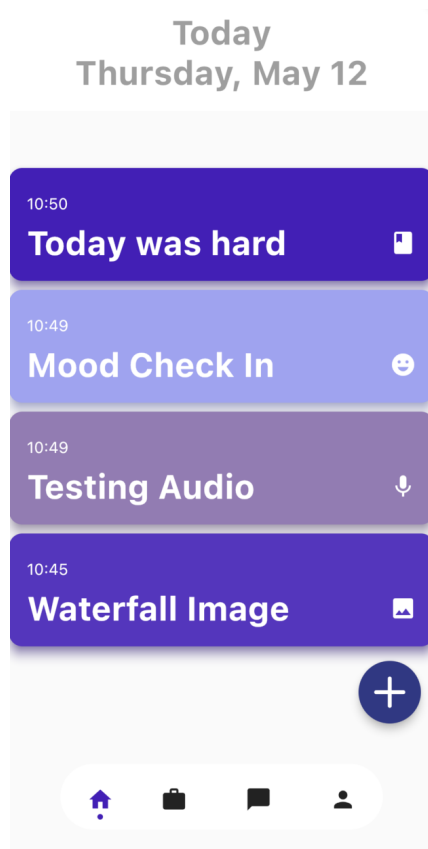


Figure 26. Entry preview colour changes

Above in figure 26, we can see a screenshot of the homepage, as you can see the different coloured cards represent the different entries, the figure contains the latest version of the application. The difference in colour for each entry is a result of the design feedback

View Any Entry Class

In order for the user to view the entry itself, we need to have a class that can show the entry. Originally I had multiple classes to show each entry separately. This was super inefficient and actually caused the application to take longer to build when debugging. When I came to refactoring the code, I began work on a new class that could showcase all three of the entries and leave support for an audio entry should it be added. The `ViewAnyEntry` class takes in six parameters which are; `entryId`, `userId`, `entryTag`, `isHomepage`, `isPastJournal`, `isProfile`. The first three parameters are needed for the class to query the database, and the following three are needed to indicate where the class should send a user if they want to navigate back to the previous page. Using `Navigator.pop(context)` would not work in this situation as we need to refresh the previous page when we send the user there. For the `ViewAnyEntry` class, we need the user to have the option to edit the entry if the entry belongs to them, this option should not be available if it was a friend's entry. It was easy to achieve this by creating a `checkCurrentUser` method to check if the user id given as a parameter matched the current user's id. This method would run in the `InitState` of the class and if the ids matched we could show the edit button if they did not we would hide the button.

For viewing audio entries we needed to initialise the audio player in the `ViewAnyEntry` class, and pass it onto the `audioEntryPage` widget as a parameter. Doing so meant that inside the `audioEntryPage` we

were able to play the audio, however there was an issue as the audio would not stop playing once the user left the page. The solution to this was that we would initialise the audio player and close the player inside the `ViewAnyEntry`.

This class's main focus was to query the database using the parameters and once the information was retrieved the widgets for the corresponding entries tag would be shown. They were given the needed information and displayed the information back to the user. This was done to keep the `ViewAnyEntry` code short and concise; we could have combined all the widgets for each entry into the singular class, but that would be too much for one piece of code, which would make the code harder to debug. It would also be ineffective to have large blocks of code that will be ignored if it is not required. Breaking down the entries into four separate widgets is more efficient, easier to debug and makes more logical sense to do.

```
//If the entry is not empty we can check its data.
else {
  //Saving the tag of the post.
  var tag = docs![0]['tag'];
  //Checking to see if the tag is a journal.
  if (tag == 'journal') {
    //Returns the journalEntryPage with the needed information if it is a journal.
    return journalEntryPage(
      context,
      docs[0]['title'],
      docs[0]['best_thing'],
      docs[0]['proud_of'],
      docs[0]['grateful'],
      docs[0]['improve'],
      docs[0]['date']);
  }
  //Checking to see if the tag is a mood entry.
  else if (tag == 'mood') {
    //First we need to check if the entry is a friends entry, as the bool value will be different.
    if (docs[0]['owner_id'] == _auth.getUid()) {
      //Returns the moodEntryPage with the needed information if it is a mood entry.
      return moodEntryPage(
        context,
        docs[0]['mood_from'],
```

Figure 27. View any entry code

Above in figure 27 is a snippet of code from the `viewAnyEntry` class. As you can see the code is checking the tag of the entries and returning the corresponding widget.

Prior to the refactoring and creation of the `ViewAnyEntry` class, we were not directly querying the entry with its corresponding id. Initially, the query was done in full and the class was given an index parameter to find the entry once it had completed its query. This was extremely inefficient and was further exacerbated when we began sorting the homepage by date. Sorting the homepage query list would mean that an index given out would not be the same as the index in the view entry class. As I was still learning the correct way of querying the Firebase collection I devised a short term solution to this problem, to make a view entry homepage class and a view entry class. However, this quickly made the problem worse when it came to creating the edit classes. It was clear that only passing the index for the particular entry from the query list was inefficient and creating potentially fifteen screens to deal with the problem was just poor code practice. In order to eliminate this problem in its entirety, I passed the entry Id into the view entry class, this meant

that we were querying the exact document rather than looking for the index from querying all the documents. This change caused a leap in performance when it came to building the application, the build time noticeably dropped and also meant that only needed classes were created, improving efficiency.

Friends

Another key feature of the application is the ability to add friends. When it came time to implement friends into the application I was uncertain about how to go about doing so. This is because there are a variety of different approaches that can be utilised. For this solution, the best way of adding friends capabilities was through Firebase. More specifically by adding a field into the documents of a user, this field was to be an array. Having this array allows us to store the ids of the user's friends in their documents, this in turn meant that to show the user's friend's posts we checked and needed to show the posts from those ids present within the user's friend array. By using the ids of users it meant that the friend feature would not fall victim to the same problem that the chat feature did, as the ids will never change and therefore the friends array will not need to be updated if a friend decides to change their username.

Using arrays proved to be an effective way of storing a user's friend. We could also take this approach when it comes to storing the requests that the user has received. Users need to accept a request from another user before they can be friends. Therefore we needed to include a received requests field so that we could show the users who sent them friend requests, and give them the option to accept the requests or deny the request. When implementing the received array, I realised an opportunity to implement a sent request array, that could store all the requests that the user had sent. This would allow us to show the user if they had already requested a user, and also allow us to show a list of the user's own sent requests. A sent request list is different to other applications, social media applications do not let the user see who they have requested as an overview, they only show the user if they have already requested a specific user. Knowing that, meant a sent requests list was a component of the application that would provide something different to the existing solutions. Having these three arrays made the process of adding a friend simplified. All that was required was to add a user's id to their desired friend received requests array and add the desired friends id into the user's own sent request array. When a user would accept a request, those two ids, the desired friends and the user's id would be deleted from the corresponding sent and received arrays and instead, the ids would be added to the friend array. If a user was to deny a request all that was required was the deletion ids from the sent and received arrays.

With the introduction of the friend feature, it was important to ensure that users who were not friends were not able to see each other's posts. Given the nature of the application and how the entries users make can be sensitive to them, I felt that it was absolutely necessary to ensure that by default users would not be able to view posts of a user they are not friends with.

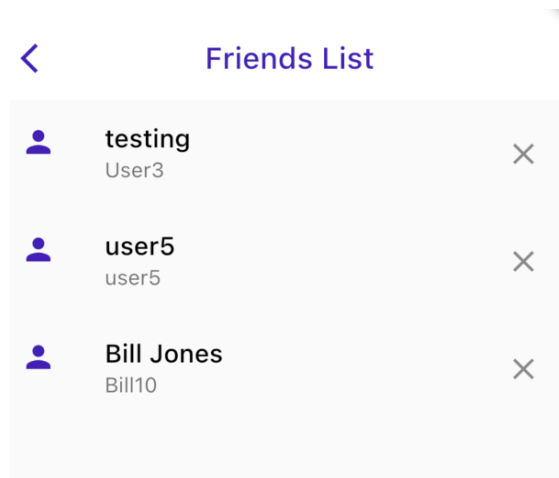


Figure 28. Friend list page

Utilising the existing firebase collection of users was an effective way to create the ability to add friends. I find that this approach was extremely effective and efficient. The effectiveness of the approach can be seen in the short methods required for adding and removing friends; it is also demonstrated in how quickly the application can update to show the user whether or not they have sent a request, or received a request from a particular user. The efficiency of the utilisation of existing firebase collections is exemplified in the lack of needing a new collection. The friends and their information could have been stored within a new collection that referenced the user's collection, however, this would add unnecessary complexity to the solution. Another approach was to use a sub collection and store all the friend's data inside the friend array. This would have worked but again would increase complexity unnecessarily. Just from these two alternatives, it is clear that the option I had selected makes the most sense logically and also reduces the need for further collections.

Chat

The all chats page, and selected chat page are one of the more complex features within the application. Starting with the all chats page. We need users to be able to see their current chats and let them have the option of starting a new chat with their friends. As this application includes social features such as friends it is important that we ensure the privacy of users. For this reason, users will only be able to send messages to their friends. This helps with the all chats page, as we need to look for the user's friends. `AllChatsPage` class has a key method in order to find the chats the user has with their friends, that method is called `findFriendsData()` and it queries the database for the current user's data. Once we have queried the current user's data, we need to find out who the current user's friends are and query their data. To conduct the query efficiently we use the code below in figure 28.

```

97 //Checks if the user has friends, by seeing if the friends field is not empty.
98 if (value.docs[0]["friends"].toString() != '[]') {
99     //If the user does have friends we need to collect their data.
100     for (var x in value.docs[0]["friends"]) {
101         //For each of the ids inside the friends field we need to run another firebase query.
102         //We are now collecting the friends data.
103         friendData = await FirebaseFirestore.instance
104             .collection('users')
105             .where(FieldPath.documentId,
106                 isEqualTo:
107                     x) // x matches to the correct id inside the friends array from current user.
108             .get()
109             .then(
110                 (value) //Once this new query has run we need to execute more code.
111                 async {

```

Figure 29. Code used to query valid friends efficiently

This code is already conducted within a query, the variable `value` is the datatype `QuerySnapshot<Map<String, dynamic>>` which acts like a dictionary that stores the data from Firebase. We then need to access this data so by using `value.docs[0]["friends"]` we can retrieve the array from firebase which holds all the user's friends. Once we have their friends we need to query each of the friends, and once we have the data from the query we need to execute more code. Following on from this block of code, we need to find whether the user has a chat with the friend. This is done by checking whether there is a chat id with either the user's name or the friend's name at the start of it. Once we know there is an existing chat we are able to separate out the users that have chats and those who do not. We store that into a list and from there we are able to display the active chats the user has and also the users who do not have a chat with the user. Now we give the user the option of starting a chat with those they do not have a chat with.

We need to check for existing chats so that we keep the efficiency of the code. It is also necessary for the feature to work as the user needs to be able to see an overview of their chats. This was inspired by commonly used chat applications that allow the user to create a chat and view their past chats. Where this feature lacks is in locating new chats, this is to do with the ids that are used with each chat. I do not believe having the two users' ids combined as the chat document id is the best solution however it was one of the only ones I could think of. Originally the chats id contained each user's username, this provided a problem when the ability to change a username was added. Whenever a user would change their username the id of the chat would not change. To avoid creating a method to update the usernames, I shifted the chat documents id to be dependent on the user's id which will never change. Avoiding the creation of an update method helps to keep some efficiency of the code. It is also good coding practice as the unique id for a document of any kind should not be updated, they should remain the same.

A chat document contains a subcollection titled 'messages' that stores the messages that the users send. Having this sub collection does mean that we are able to sort the messages into time order and display them back to the user. The field of `time_sent` stores the time that the messages are sent; however, we use the method of `millisecondsSinceEpoch` to store the date-time into firebase. As this allows the messages to be sorted in time order regardless of any time zones. This is important as users should see the time order in which messages are sent and that should be immune to whether the one user is in a different time zone to the other.

Ways to improve this feature would be to add real-time notifications into the application. Having notifications while a user is active will make the application more practical. A further improvement to this feature could be the addition of read recipients. Many mainstream chat applications such as WhatsApp include a way of indicating to the user that their message has been read [28]. Having this added into the application would also allow us to highlight new unread messages to the user. This would make the application feel more interactive.

Breathing Exercise Screen

In order for the user to get the maximum out of using the device, the exercise screens would be crucial. There were two exercises that we chose to implement, breathing and a calm walk. These two exercises were imperative in allowing the users to become more aware of their own mental wellbeing. These exercises have been well documented for assisting those who may be struggling emotionally [24]. As this was one of the key components of the application and it was clear that the screens to conduct these exercises needed to be interactive.

For implementing the breathing, I knew from the beginning that I wanted an interactive exercise that could walk the user through the breathing clearly and easily. In using the haptic vibrations of the device we were able to have the device vibrate based on the users following the exercise. For breathing, we are using the 4-7-8 breathing method that was discussed earlier. We also need to show the users some sort of count up and count down for them to follow, along. By creating a count up method we were able to use a large count overlaid on a breathing animation to help bring the exercise to life.

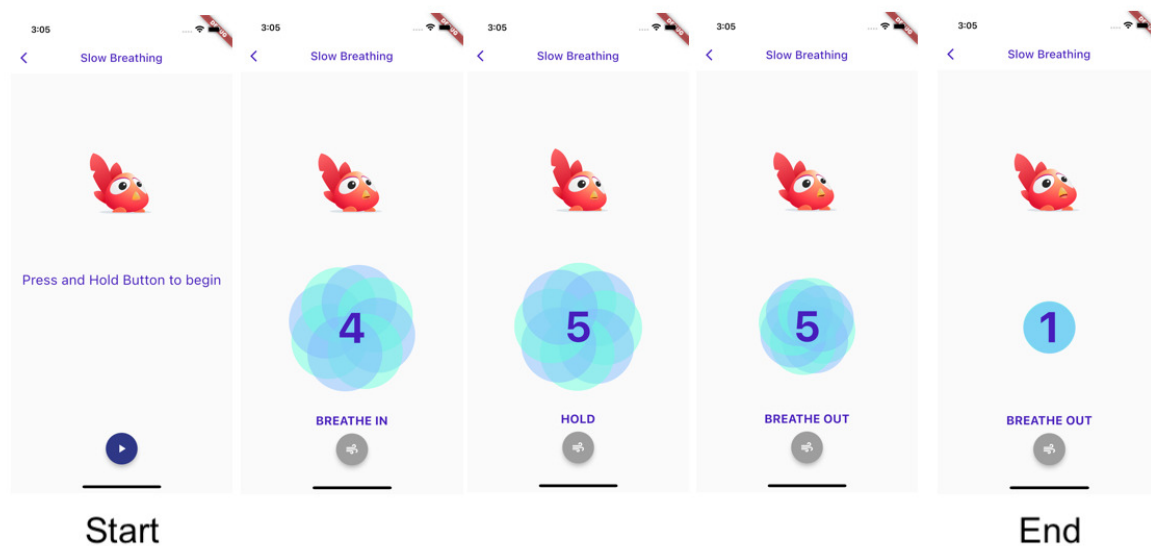


Figure 30. Breathing Exercise Screen

The above figure 30 shows the screens and how they progress during the breathing exercise, the screen is animated so the circle will increase in size and decrease on the exhale. The character is also seen breathing

The count was increased by each second and this was using a timer that actively changed as the user started the breathing. To start the exercise the users need to select the play button and hold the button as the count increases. The idea is to have the user press and hold the button for as long as they want, the

count should walk them through how long they need to breathe in, hold and breathe out. Implementing this was quite tricky. Firstly the long press on the button was achieved by using a `GestureDetector` which is a built-in class that allows us to pick up any taps on the screen. In this case, we wanted to know how long the user was pressing the screen.

Once the button was being long pressed we were able to start the count up and the timer. The count-up timer increased until it reached the number 4 while having the prompt breathe in underneath to encourage the user to follow along. Then it would reset when the user was required to hold, again the prompt under the count would be changed to hold, once that count reached 7 the prompt under would be shifted to breathe out and the countdown would be increased to 8, then it would begin the countdown to zero. This shows how I followed the 4-7-8 breathing technique.

```
//Widget to show the user the breathing graphics.
//Takes the parameter of timeCounter which shows the count up or down and indicator
//Indicator is to show the part of the exercise the user is doing, e.g holding, exhaling or inhaling.
Widget buildBreathingGraphics(
  {required String timeCounter, required String indicator}) {
  return Column(
    mainAxisAlignment: MainAxisAlignment.center,
    children: [
      //Stack allows the time and the lottie animation to overlap one another.
      Stack(
        alignment: Alignment.center,
        children: <Widget>[
          SizedBox(
            height: 300,
            child: Lottie.asset(
              'assets/breathing-flower.json',
              controller:
                controller, //Sets the controller to the one initialised earlier.
              onLoadComplete:
                (composition) //When the animation is loaded have the controller start.
                {
                  controller.forward();
                },
            ), // SizedBox
          //Have the time text overlap over the lottie animation.
          Text(
            timeCounter,
            style: TextStyle(
              fontWeight: FontWeight
```

Figure 31. Breathing Exercise Code

In order to have the counting graphics we used a method that returns a widget, this method is called `buildBreathingGraphics`, this takes the parameter `timeCounter` and `indicator`. With the first parameter we are able to show the number that we need, and the second parameter, is the text indicator to the user for what phase of the breathing they are in. For this method to work we need to have the `timeCounter`, this is obtained by using another method called `showCounting`, in this method we take the attribute of the class titled `duration` and set the attribute as the `timeCounter` along with the required boolean statements for the indicator.

This implementation is a great example of the ability to constantly reconstruct a screen in flutter. The dynamic number changes of the count is only possible as the method is constantly called when used in the scaffold of the page. Allowing the user to follow the breathing exercise. In order to add more interactivity

with this exercise, we call the haptic feedback for each count up, and for each count down. However to differentiate between the breathing in and breathing out we changed the intensity of the vibrations. Meaning that when the user is exhaling the vibrations are more intense. This was done by calling the `heavyImpact()` method instead of just the `vibrate` method. Changes in vibration help to signify to the user that they are in a different phase of the exercise.

Another way of increasing interactivity with the screen and the exercise is to add the companion, and have the companion in a breathing state to signal to the user that they are with them. In this implementation initially I had planned for the companion to follow the user as they would breathe in and out. This proved to be far more challenging than what I initially planned. Due to the animation controllers for the Rive package not allowing you to change the speed of the animation. This would have been ideal as it would have allowed the companion to breathe in, hold and exhale in the same duration as the user. Instead we had to settle for the character doing their own breathing animation and just resetting the character when the user would stop pressing the button.

Use Of In-Built Device Sensors

In order to increase complexity and interactivity of the application we need to be collecting data from the device's sensors. Using the device's sensors should allow us to create a more immersive experience for the user. When deciding on how to implement the collection of the sensor data, one thought was to have the character be responsive to the movements of the device. This would mean that the companion would enter a walking state when the device was moving substantially. Having a walking state and using it outside of the calm walk exercise screen increases the interactivity of the application.

The implementation of this new feature needed to fit into the code that was already present. In order to ensure a seamless addition to the code, I added another attribute into the `calculateState()` method. This was a boolean value called `isWalking`. This bool value would be set to false at the start of the application and would later be changed if the device was found to be moving. With using `sensors_plus` as the package that allows us to have access to the sensor data within the phone we can pick up movement. We can identify the movement of the device by using the `listen` method.

```
//We want to check the sensors without including gravity.
userAccelerometerEvents.listen((UserAccelerometerEvent event) {
  //These are the velocity in directions for the device.
  var x = event.x; //Velocity in x
  var y = event.y; //Velocity in y. Without gravity this is.
  var z = event.z; //Velocity in z.
  //Taken from CalmWalkDisplay() class.
  //Need to make sense of the magnitude of the movement.
  double movement = sqrt(x * x + y * y + z * z);
  //If the movement has shown a large change then the user is moving.
  if (movement > 6) {
    isMoving = true;
  }
});
```

Figure 32. Code to check device movement

By using `accelerometerEvents.listen` we can detect any changes in the devices coordinates, and therefore whether or not the device is moving. However, there is a problem that is encountered when using the method `accelerometerEvents.listen`, that is that the device will always be registered as moving in the y axis due to gravity. Luckily to avoid having to create a workaround in code we can use another method from `sensors_plus` called `userAccelerometerEvents.listen` this method will give us the device movement excluding gravity. Now that we have the information from the device that excludes gravity we can check for movement. However, just like the problem when querying the database there is a problem for us when we attempt to retrieve sensor data which is the delay. In order to avoid this delay, `sensors_plus` has made the method `.listen` a `StreamSubscription` which allows us to have code executed once the device has retrieved the data we are interested in. This also allows us to read the data that is returned from the sensors in a singular function. We can identify events with the accelerometer in the x, y and z axis. So what we need to do is save the events, which are the velocity changes in those axis. Once we have saved the events we can check if the values are particularly high and from there we can change the `isWalking` value.

After this method has been completed it is important to check that the user's device is walking before checking any other data within the `calculateState` method. This is because if the user is walking and moving fast we want the walking state to be the prominent state before any others. The second exercise screen and one that utilises more of the sensors of the device is the calm walk;

Calm Walk Exercises Screen

For this exercise we needed to access the sensors inside the device to allow us to track the following; duration, calories, distance and steps. These are measurements that are simple yet ideal for displaying a walk exercise. This data was also not too complex to retrieve from the device, however we did require a package in order to retrieve the data from the sensors. The package used is `sensors_plus` this lets us tap into the gyroscope and the accelerometer of the device. From that we are able to deduce whether or not the device is moving, from that we can gather other impactful measurements. Once we had the measurements from listening to the device we needed to run methods to make sense of the measurements. Using the methods we are able to find the movement value travelled, this is done by squaring the values of x, y, z and adding the values together. From that we can figure out that the device has moved, but we need to know by how much since the previous movement.

This can be done by subtracting the new movement value by the old value which is stored using the package `package of SharedPreferences`. We then add the new values and set it to the previous value for the next time the device moves. However, once the new movement value has surpassed a set value, which was set to 6, we add a step. This then calculates the total steps that the user has travelled.

Once we have the steps we can find out how many miles the user has done, this is done by using the average step length and multiplying it by how many steps are in a mile. With the steps we are also able to find out how many calories the user has burnt doing so, this is done using the average calories burnt per step. During this we also start a timer to count the duration of the walk. These methods for the CalmWalkDisplay class that conduct the calculates the calories and miles can be seen in figure 33.

```
//Below methods are adapted from: https://www.youtube.com/watch?v=IDTGdc3ScPY&t=1448s
//Method to calculate the miles that have been done.
int calculateMiles(int steps) {
    //Refrence for step length: https://chparks.com/411/How-To-Measure-Steps#:~:text=An%20average%20person%20has%20a,steps%20has%20many%20health%20ben
    //Average length of a stride is 2.2 feet, so we multiply that by the number of steps taken.
    //5280 foot in a mile. So we divide 2.2 by 5280.
    double miles = (2.2 * steps) / 5280;
    return miles.round();
}

//Method to calculate the calories that have been done.
int calculateCalories(int steps) {
    //Refrence for average claories burnt per step: https://calculator.academy/steps-to-calories-calculator/#:~:text=In%20general%2C%20most%20people%2
    //The number of calories burnt per step is .04 as a result we multiply the number of steps taken by the calories per step to get total calories.
    double calories = (steps * 0.04);
    return calories.round();
}
```

Figure 33. Code to calculate calories and calories

In Implementing this feature we encountered a problem when the data would constantly update, even if the user had not started the walk. In order to fix this we added a check before we used the setState() method to dynamically change measurements being displayed. Adding this check meant that the measurements were only updated upon a button press. These measurements would also be paused when the button was pressed again. The calculateSteps method is responsible for updating the measurements shown to the user. The method can be seen below in figure 34 .

```

calculateSteps() {
  //Need to start the timer as while as recording measurements.
  if (isPressed == true) {
    //We start the timer on the button click.
    startTimer();
  } else {
    //We cancel the timer on button click. But we do not reset timer, as the user is only pausing.
    timer?.cancel();
  }
  return userAccelerometerEvents.listen((UserAccelerometerEvent event) {
    //These are the velocity in directions for the device.
    var x = event.x; //Velocity in x
    var y = event.y; //Velocity in y. Without gravity this is.
    var z = event.z; //Velocity in z.
    if (isPressed == true) {
      //We need to figure out how far the device has moved.
      movement = valueMoved(x, y, z);
      //If the movement has been large we need to count the steps.
      if (movement > 6) {
        steps++; //Increase the steps.
      }
      //Dynamically change the data shown to the user.
      setState(() {
        //Calculate the calories
        calories = calculateCalories(steps);
        //Calculate the miles.
        miles = calculateMiles(steps);
      });
    } else {
      //We do not do anything in this else
    }
  });
}
}

```

Figure 34. Calculate Measurements Calm Walk Code

Audio Entries

Another feature of the application that utilises the device capabilities is the audio entry. This was a late addition to the application and was a result of the design feedback sessions. In order to access the microphone we needed to change the permission for both IOS and Android. To record the audio I used the package `flutter_audio_recorder2`. This particular package uses a deprecated version of the Android embedding, this was not ideal however it was working for the android emulator that I used, and furthermore I did not encounter any problem when I used the IOS simulator and due to this I felt that using this package would not be a problem. The next package was `audioplayers` this allowed us to playback the recording of the audio.

How this feature worked was firstly by checking if the user has given their permission to use the microphone, if they have not the audio recording will not work, but the users are informed through a popup dialog. Once we have checked permissions we are able to start recording. When recording we save the audio to a local file, this file is overwritten each recording, so in order to ensure that the users can play their past audio entries we need to save the audio to the storage of Firebase. Once the audio file is saved in firebase storage we need to reference the file from the entries collection inside the Firebase database, this is done by retrieving a download URL, this URL is then added into a document in the Firebase database so that users are able to later listen to their audio recordings. The download URL is the same approach that was used

for the image entries. Firebase Storage allows us to store the larger files that cannot be stored in the collections, so referring back to files in the storage is an effective way of retrieving the data needed.

The implementation of the audio player and audio recording in isolation were not complex, however when adding the file into the Firebase storage and calling that file back for playback was more complex. For audio playback we use the `audioplayers` package that allows us to start an audio file, so when we are on a past audio entry we can play the file from the URL that we retrieve from Firebase. We need to set the `isLocal` bool parameter to false when we use the `.play` method of the `audioPlayer`. This is clearly seen below in figure 35.

```
//Need to play the audio, we use the given audioUrl parameter to do so.
audioPlayer.play(audioUrl, isLocal: false);
//When the audio has finished we need to change the button back.
audioPlayer.onPlayerCompletion.listen((duration) {
  //Changes the state of the button back,
  //--so users can replay the audio.
  setState(() {
    isPressed = false;
  });
});
```

Figure 35. Playback audio from firebase code

Testing and Evaluation

For this application there were no specific testing systems or procedures that were put into place, as I felt the best way to test the application would be the useability from the users perspective. The application had features that were expected to be run correctly, and avoiding creating test cases does mean that these features are not rigorously tested, however I believe that the application benefits more from having the users determine whether or not the system is working as expected. Due to this we had a final evaluation session where the users would be asked to use the application and complete a system usability scale, which is the best tool for the perceived useability of a system [2].

After conducting the final evaluation session we are able to draw conclusions on the usability of the applicant. In order to exactly know if the application is considered usable from the participants an average SUS score of over 68 will be required. Over 68 will imply that the application is above average, the feedback of the users gathered in this final evaluation session will also be telling as to whether or not the application has met the desired outcome.

For the final evaluation session we had 10 participants that walked through the application for themselves. They then answered the system usability scale which can be seen in Appendix 1, under the section user research protocol. When conducting the final evaluation session we received feedback as the users walked through the application for themselves. In order to walk through the application the users followed an outline of tasks that was designed to see whether the user was capable of using the application and its key features without any assistance, this guide can also be found in Appendix 1, in the under user research protocol. Participants also provided feedback during their application walkthrough. Collecting both system usability

scale scores and feedback from the participants meant that we were collecting both quantitative and qualitative data for the evaluation on application.

All the feedback was very positive, one participant saying “Application is really easy to use. Really straightforward and interactive.”. We were able to calculate the System usability score based on the participants answers, the system scored an average of 95.5. The results and calculations can be found in Appendix 9, under SUS results from final evaluation session section. Scoring this high means that the application is extremely usable and that and considering this result we can say that from usability perspectives the application has met its aim. Question one of the system usability scale was “I think that I would like to use this application frequently” this score averaged a response of 4.8 which is ideal for the project aims. For the application to support and enhance users mental wellbeing, users would need to actively want to use the application, therefore scoring an average of 4.8 on question one is a sign that users would want to use this application, in turn increasing the chances of the application supporting and enhancing users mental wellbeing. Question three of the scale “I thought this application was easy to use” scored a perfect average of 5. Meaning that all participants found the application easy to use.

The system useability score that we have received is enough evidence for the application to be user friendly, however, we can use the users feedback as a measure of knowing whether or not the application overall meets the aims, and objectives that we outlined earlier in the report. In order to find out what the feedback from the participants means we can do a thematic analysis on the feedback.

The thematic analysis process, involving the creation of codes and sub themes for the final evaluation session, can be found in Appendix 10 under the section thematic analysis final evaluation session. We make reference to the sub-themes generated from the codes in figure 35 below.

Relationship Between Main Theme and Sub-themes

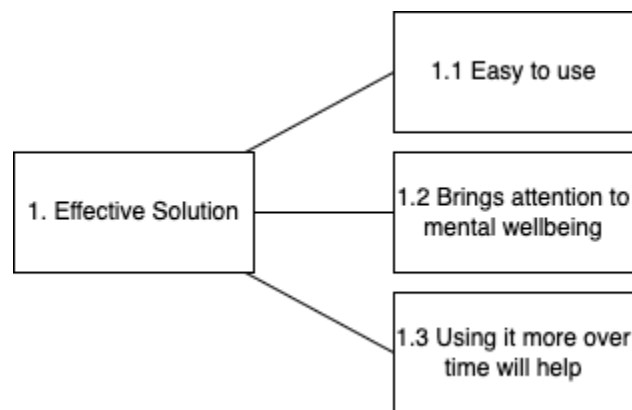


Figure 36. Relationship between the sub themes and main themes

Effective Solution

This theme is the most accurate after analysing the feedback that was received from the participants. As shown in the transcripts the participants all felt that the application was a useful tool, and found that the application could help them become more aware of their mental wellbeing through more use. I feel that this theme is also a fair representation, considering the iterations that have been informed from the feedback of the participants. These results are in part due to the fact that we worked with participants on creating a solution that would be best suited for them. Considering the aim of the project this was very important, from our initial research to this evaluation we have been guided by participants and their views and opinions on mental wellbeing, to receive this feedback and system usability scores from the participants is a result of constant iteration of a solution that should be best suited for helping individuals mental wellbeing. For this reason I believe that the theme of effective solution is not only appropriate from the analysis of these results but was also expected considering the input, and according alterations that had to be made to the application up to this point.

When analysing the feedback we can see that the participants feel the application will help their mental wellbeing over time, this is crucial as we will be unable to make a fair statement on if the application can help enhance mental wellbeing as we would need to conduct research over time, comparing their mental wellbeing before and after. Ideally this research would have been conducted however time constraints limited the overall research that could be conducted, due to this I felt that prioritising the development and feedback of the initial application to be imperative. Participants also believe that the application will be a tool that can help benefit their mental wellbeing. Participants put this down to the fact that the application's features have a reflective nature, and by using the features users will be forced to become more aware, as participant 2 said *"So, these features will force people to become more aware."*. This is encouraging for the project as the aim is to make users more aware of their mental wellbeing.

Discussion

Now that we have collected our findings we can analyse the effectiveness of the application in relation to the existing solutions and the problem that we provided background on. This solution differs from existing applications for mental wellbeing as it adds features and capabilities that those existing applications do not have. Firstly the existing solutions that I provided information on do not have any social features. Those applications are purely for a singular user experience, there can be benefits to this as it allows the user to feel that they are working on themselves without the added pressure of their friends or social standings.

Although in contrast to that, the users can feel lonely with those applications. I felt that adding these social features would make the user feel a part of a community that wants to improve, not only is this beneficial as social groups have been proven to help with mental wellbeing [29] it was also commented on by a participant in our final evaluation session who said “It felt friendly and like a community. I think I could build quite a supportive community with the app, but it was nice and easy to use and would help you with understanding yourself more.”. Another feature where this application will differ is with the interactive virtual companion, this feature is the main focus of the application, and from my research no other application currently has this feature within their application. The companion was the highlight of the application from the participants, they often commented that the character was their favourite feature, one participant when asked what feature stood out the most to them said “*The character, but also the journal.*”.

From the findings that I have collected I feel that I have learned that many people would want an application that could help them with their mental wellbeing. Not only from the final evaluation session but from each section that participants gave their feedback on, people seem willing to become aware of their mental wellbeing, and ways that they can improve it. I feel from my findings I am able to identify that there is a problem that can be addressed using a solution such as this one. The hope is that with an application such as this one, we can have many more solutions developed with the focus of bringing awareness to mental wellbeing. These solutions should do some in their own unique ways. One of the biggest findings from the initial research is how individual the experience of mental wellbeing is, so it is key to have an abundance of solutions as it will increase the likelihood that a solution benefits an individual. I feel that using technology is a good way to address this issue, and from the findings it is clear that there is a user base that will want to use systems around this topic area.

Future Work

Any future improvements and features that could be added to the application, come from a combination of ideas that I had when creating the application and the feedback from the participants. For all the feedback that was received throughout the project participants had good ideas of what could be improved, due to time constraints and other reasons these ideas did not make the final iteration of the application. However, they would improve the user experience for any future version.

Smart Watch

Having a smart watch app that partners with the current application would be a great way of increasing user engagement with the application, this would be able to help reach the aim of the application. It was initially in my plan to create a smart watch application however, there were various issues that I encountered in doing so. The first issue was the time constraints for the project, as I wanted to ensure that the main application was completed to the best standard possible. Another issue that was encountered was that flutter does not allow users to build an apple watch app, but rather create one natively and add it as an

extension. Considering this and my lack of experience with building smart watch applications I decided against doing so.

Location tagging posts

An idea that was suggested from a participant was to allow posts to have a location field, whereby you can tag a post that you make with a specific location. This is definitely something that needs to be considered for a future feature, it will allow the user to engage more with the application. It will also add more of a community element to the application which is something that was mentioned by a participant during the iterative design when they said *“maybe adding locations to photos”*. This feature was not implemented due to time constraints and its complex nature, I felt that the application needed to have crucial features to help improve individuals mental wellbeing, and although this feature would be an interesting addition I do not see how it would help to support or enhance the mental wellbeing of the users.

Add Friends from nearby

Another feature that could be added is to add friends based on their location. A similar idea was suggested by a participant during one of the design feedback sessions where they said; *“maybe there could be an explore page and maybe people can reach out to these people on the explore page.”* Adapting this idea could see an explore page where users are able to see posts from users nearby to their location, they in turn could add these friends from this page. This would be another complex feature for the application and could be an interesting inclusion in a future iteration of the application. However, this feature was not added to this iteration as it does not fit well with the current features of the application. Currently you are not able to see any users details as they are all set to private, for this feature to work we would need to change this so users can make their profiles public, that way it would make sense to add users based on if they are nearby.

Limiting database calls

Currently the data is constantly loaded from the database whenever a new page is visited, this can be a problem if the application is used by many users. Constantly reloading the page as we wait for the data from the database is not efficient as there may not be any changes that have been made. We can fix this problem by adding a check and refresh system, we can give each class a bool parameter to check if we need to recall the information from the database. We would need to call the information from the database upon first loading, but we could limit the calls after that point. This could be controlled by the user, whereby whenever they refresh a page we will recall the information from the database in turn updating any necessary information. This would make the code more efficient as the call to the database would only be made when they are requested. Currently this is not a huge problem and therefore we have not implemented this feature, however, with any new iteration this feature would be imperative. I believe that this feature could improve the overall user experience of the application, as each page would load quickly instead of a delay before the page is shown.

Conclusion

From the findings that we have collected we are able to make a conclusion based on if the project has met its aims that were set out at the start of this project. To draw an accurate conclusion we can look at the objectives to see if they have been met, we will use the feedback and evidence collected from the participants as a means of judging whether or not the objectives were achieved.

The first objective was, creating a way to help users become mindful. Based on the feedback from the participants we can say that this objective was achieved, evidence of this can be found when participant 3 said *“Just to get your thoughts onto a page, and I mean you can compare how you're feeling throughout the week to other weeks and see like if you're making progress or maybe just had a bad week.”* during the final evaluation session. We can deduce that from this users would need to be mindful, in order to record their feelings.

For the second objective, make users more aware of their own mental wellbeing and how to improve it. Looking at the results from the participants we can again say that this objective was completed, as participant 2 said *“I think it will make people more aware. I think the features that are being used are in their nature reflective.”* during the final evaluation session.

Our third objective that we set was, having users interact with friends who can be supportive of their mental wellbeing. This objective was achieved too, participant 7 said *“I think I could build quite a supportive community with the app”* in the final evaluation session.

The fourth objective was, providing exercises for users to complete that helps them manage their mental wellbeing. This objective is very similar to the fifth objective, which was; supplying techniques and tools to users who might be feeling stressed in a simple and easy to understand way. I would say that both of these objectives have been achieved as participant 1 during the final evaluation session said *“I think some of the standout features of the application are being able to journal and being able to show what your current state, through how you feel and the fact that you can do audio notes as well.”* participant 1 then went on to say *“I think it's all good and all of that focuses and brings your attention to your own mental well being.”*. We can say the features participant 1 mentioned acts as tools and techniques for the users, as for the exercises they do help as participant 8 in the final evaluation said this about the application *“In general it makes you reflect and that can help you with understanding your feelings more, like with the entries and the exercises. The whole thing helps, I think.”*

The final objective was, educate users on the importance of mental wellbeing and how it can be affected. This objective has not necessarily been achieved, however from the evidence gained in the initial research it is fair to say that people are already educated in the importance of mental wellbeing, and from an individual perspective are able to understand what affects it for them. This is evident with participant 13 who said *“Yeah, for sure. I think it's definitely becoming a relevant topic in news and popular media and culture in the content that we consume.”* and with what participant 9 had to say *“I think for myself, exercise is a key element to having a healthy life or a healthy Mental well being.”*. This can help to highlight the fact that the participants are aware that having a healthy life and healthy mental wellbeing are as important as one another. Also from what participant 13 said we can see that there has been more of a societal change around mental wellbeing.

As all of the objectives have been met in some form, we can say that the overall aim of the project has also been met, with a large number of participants stating that they feel the application would make users more aware of their mental wellbeing. In order to accurately know how exactly the application makes users more

aware we would need further studies. It would be interesting to conduct research on if the application can support and enhance users mental wellbeing too, this research would require a longer period of time and more detailed examinations on how exactly mental wellbeing can be affected.

In conclusion the solution that has been developed meets all the objectives and in turn, the overall aim of the project. This can be attributed to the user centred design approach that was used when developing this application. Participant involvement is another large reason for the success of the application, as without the participants feedback a sufficient solution would not have been developed. From this we can say that the application is successful as it meets its aim.

Reflection On Learning

Upon reflection on this project I am able to say that I have learned a lot of skills and lessons. This was my first individual application that I developed from start to finish. I feel that as a result of this there were a few mistakes that I made initially. The first mistake was focusing too much on the design of the navigation bar, I found myself spending too long on the creation of the navigation bar. I wanted to create a floating navigation bar using the tools that flutter provides, only to find out that there were external packages that handle the creation of the navigation bar. Being the first application that I had individually developed I was able to improve my programming skills and habits, while also improving my project management skills.

Although I had coded part of an application using flutter and dart, I was not familiar with all the aspects of it, and through research I was able to learn more about the language. Comparing my abilities now with when I started on the project there is a clear gap that has been a result of the knowledge that I have picked up working on flutter. At the start of the project I found it very difficult to know what approach would be the most ideal for a given feature, and as a result of this a lot of the code was refactored and improved when I was more confident with flutter. I believe that this taught me the value of just starting. Many people might struggle to start on a project of this size due to its daunting nature, however by just starting on one feature I was able to learn valuable lessons in programming. Another mistake that I made was not commenting on the code as I worked on it, I did a large amount of the project before considering explaining what piece of code was doing what. This then meant I had to go through most of the project commenting on how the code works, this is extremely difficult if there has been a gap between when you coded and comment. However, this did further improve my understanding of the programming language dart, as a result when I added the audio feature it took a considerably shorter amount of time than any other feature.

This project was also my first time reading academic journals and reports when conducting research, this is extremely valuable. I now understand how to interpret academic findings, and how to use these findings to support a statement. This skill gives me a better appreciation for the time and effort that goes into conducting these research studies, in an era with increasing misinformation, I believe that this skill will serve me well for other aspects of my life.

Finally I believe that not only do I feel I have furthered my understanding of another programming language but I have a better overall understanding about developing an application. Time management was imperative to the project's success. I mostly followed the timeline that I had outlined in the initial plan, however, I had to be adaptable when I encountered problems that took far longer than initially planned, such as the companions' state changes. I feel that in this project I was also able to enhance my skills when it came to interviewing participants. I interviewed roughly fifteen different participants for the whole project, this came with its own challenges such as organising the interview time slots.

Overall I feel that completing this project to the level that I did has given me a better understanding of app development as a whole and all the components involved. I also complete this project with a better knowledge of how individuals view their own mental wellbeing, giving me a newfound respect for those around me and appreciation for how everyone is unique in their own ways.

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Appendices

Appendix 1.

User Research Protocol

Initial Interview

For the first interview, I will be gathering more information on participants' perceptions and opinions towards mental health and wellbeing, to get insights into how potential users may already be aware of their mental wellbeing, and to inform the design of a virtual companion to support mental wellbeing. This interview will take roughly 10-15 minutes. The questions asked in the interview will be separated into 2 sections. First, your personal views of mental wellbeing, the importance of mental health and wellbeing in society.

Questions before the start of the interview:

1. Before starting the interview may I ask your age?
2. And your gender?

A personal view of Mental Wellbeing:

1. How would you describe mental wellbeing?
2. What actions or activities would you consider having a positive impact on your mental wellbeing?
3. What actions or activities would you consider having a negative impact on your mental wellbeing?
4. Describe what environments you think would be beneficial for your mental wellbeing?
5. In what ways is mental wellbeing important to you?
6. In what ways would you say, you are aware of your own mental wellbeing and how things can affect it?
7. Describe in what ways your daily routines influences your mental wellbeing?
8. Would you say that your friends and family talk about their own feelings often?
9. What are the challenges you face/experience that make it difficult to become more aware of your mental wellbeing?
10. Have you used or are you aware of any tools and activities that can boost your mental wellbeing if you are having a difficult day?

Society Questions

11. What are your thoughts on society becoming more accepting of individuals' mental wellbeing?
12. How do you think as a society we are becoming understanding of what can influence the way we feel?
13. What are your views on mental wellbeing becoming more commonly spoken about compared to the past?
14. How do you think technology has played a role in an individual's perspective of their mental wellbeing?
15. Describe how you think technology can negatively or positively influence the mental wellbeing of others?
16. Do you have any other comments or suggestions?

Iterative Feedback Sessions

This will be the iterative feedback part of my information gathering, these sessions will be done with the same participants from the initial interview, there will be several design iterations of the application and as a result, these feedback sessions will be used to gather user opinion on each iteration. The hope from the feedback is to gather information on any potential issues or design flaws with each iteration of the application.

Participants will be given a brief explanation of what the application is. These feedback sessions will focus on gathering the participants' thoughts on the design, they will be shown a demonstration of the application and its key features. After the users have seen the application they will be asked questions on the design and their thoughts on the application.

This process should take no longer than 20 minutes.

Design Questions:

1. What do you think about the design of the application?
2. How could the design of the application be improved?
3. Was there anything that would be difficult for the user to understand?
4. Was the text easy to read?
5. What part of the design did you like the most?
6. What part of the design did you like the least, or would find the least useful?
7. Is there any feature of the application that stood out to you? If yes, why?
8. What features could be added to improve the user experience?
9. Are there any features that you feel should not be in the application?
10. Would you have any concerns about how easy the application is or should be for the user?

Personal Thoughts:

11. Could you see yourself personally using this application?
 1. Please elaborate on your answer, how could you see yourself using the application, and why?
12. Do you think that the application could make you more aware of your own mental wellbeing?
 1. Please elaborate your answer, do you think any feature in particular?
13. What was your favourite part of the application?
14. What could be done to improve the application as a whole?
15. Would you recommend the application to any friends or family?
16. Any additional comments or suggestions?

Final Iteration Evaluation

This is the final part of the information gathering process. After the participants have contributed to each iteration of the application they will be asked to use the final iteration of the application. They will follow a set of outlined tasks and use Think Aloud techniques to note down their thoughts on the design and thoughts of the application. Overall usability of the app will be measured using the system usability scale after. Once the system usability scale is completed the session will conclude. The results from this final evaluation should provide an insight into whether the final iteration is usable.

This process should take no longer than 30 minutes.

Tasks to be completed:

(Tasks may be added with iterations of application)

1. Log in
2. Post a journal entry
3. Post a mood entry
4. Post an image entry
5. Post an audio entry
6. View past entries
7. Add a friend
8. View a user's profile
9. Send a chat to a user
10. Complete breathing exercise
11. Navigate to companion
12. Interact with companion using interaction options
13. Log out
14. Create a new account
15. Log in
16. Log out
17. Other.

Adapted System Usability Scale:

Participant ID: _____

Date: ____/____/____

System Usability Scale

Instructions: For each of the following statements, mark one box that best describes your reactions to the application.

	Strongly Disagree				Strongly Agree
1. I think that I would like to use this application frequently.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found this application unnecessarily complex.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I thought this application was easy to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I think that I would need assistance to be able to use this application.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I found the various functions in this application were well integrated.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I thought there was too much inconsistency in this application.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I would imagine that most people would learn to use this application very quickly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I found this application very cumbersome/awkward to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I felt very confident using this application.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I needed to learn a lot of things before I could get going with this application.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please provide any comments about this application:

Appendix 2.

Participant Information Sheet



PARTICIPANT INFORMATION SHEET

Creating an Interactive Virtual Companion to Enhance Mental Wellbeing

You are being invited to take part in a research project. Before you decide whether or not to take part, it is important for you to understand why the research is being undertaken and what it will involve. Please take time to read the following information carefully and discuss it with others, if you wish.

Thank you for reading this.

1. What is the purpose of this research project?

The aim of this project is to create an application that will enhance users' awareness of their mental wellbeing through gamifying the mindfulness activities with an interactive virtual companion.

2. Why have I been invited to take part?

You have been invited because you displayed interest through one of the social media broadcasts, and you are a healthy adult and do not suffer from any severe medically diagnosed health issues.

3. Do I have to take part?

No, your participation in this research project is entirely voluntary and it is up to you to decide whether or not to take part. If you decide to take part, we will discuss the research project with you and should you want to proceed you will be given a consent form, which you will have two days to sign. If you decide not to take part, you do not have to explain your reasons and it will not affect your legal rights. If you are a student at Cardiff University participation in this research project will have no effect on your education or progression through a degree course. You are free to withdraw your consent to participate in the research project at any time, without giving a reason, even after signing the consent form.

4. What will taking part involve?

You will be asked to join a zoom call to conduct the initial interview. This interview will aim to get your opinions on mental wellbeing from your own individual perspective and including positive and negative experiences, and its importance in society. This should take no longer than 10-15 minutes. You are free to withdraw at any time if you feel uncomfortable with any of the questions. Once the interview is concluded and if you agreed to continue participating, the iterative feedback sessions will be the next focus. The iterative feedback sessions will be conducted separately at an arranged time. We will conduct feedback sessions on the design of the application, the design will change with each session. Currently we will be aiming for three feedback sessions the initial session will take no longer than 20 minutes as you will be briefed on the application and shown a demonstration of its key features. Following sessions will be quicker and should take roughly 10-15 minutes. The last session will be the final evaluation where you will be given a set of tasks to conduct and give feedback while conducting the tasks. This session will take no longer than 30 mins. All sessions will be conducted via Zoom and will be recorded in order to support the data analysis of the session.

5. Will I be paid for taking part?

No. You should understand that any data you give will be as a gift and you will not benefit financially in the future should this research project lead to the development of a new treatment/method/test/assessment.

6. What are the possible benefits of taking part?

There will be no direct advantages or benefits to you from taking part, but your contribution will help us understand whether the application created will have the potential to enhance users' mental wellbeing effectively.

7. What are the possible risks of taking part?

Questions asked in the initial interview will be based around your opinion of mental wellbeing and your relationship with your own mental wellbeing. Should you not feel comfortable answering these types of questions you are able to withdraw from the research process at any time. Should you not want to answer any specific question for whatever reason, let the interviewer know, and the question will be skipped. If at any point during the interview, you are uncomfortable you inform the interviewer, and the interview will be ended.

8. Will my taking part in this research project be kept confidential?

All information collected from (or about) you during the research project will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation. Please see 'What will happen to my Personal Data?' (below) for further information.

All information obtained during the process will be kept confidential. There are exceptional cases where the information will not be kept as confidential, for example should research team have reason to believe that there is a risk to your safety or the safety of others. In this case, the research team will notify of the need to break confidentiality (this may not be appropriate in all cases). The research team may be legally and or professionally responsible to over-ride the confidentiality of data in these cases.

9. What will happen to my Personal Data?

Cardiff University is the Data Controller and is committed to respecting and protecting your personal data in accordance with your expectations and Data Protection legislation. Further information about Data Protection, including:

- your rights
- the legal basis under which Cardiff University processes your personal data for research
- Cardiff University's Data Protection Policy
- how to contact the Cardiff University Data Protection Officer
- how to contact the Information Commissioner's Office

may be found at <https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection>

Request to the student researcher if a printed copy of the above-mentioned document is needed.

After a week since the interview, the research team will anonymise all the personal data it has collected from, or about, you in connection with this research project, with the exception of your consent form your gender and age will be used. Your consent form which will include personal data in the form of your name will be retained for the duration of the information gathering process (one month) and may be accessed by members of the research team and, where necessary, by members of the University's governance and audit teams or by regulatory authorities. Anonymised information will be kept for a minimum of 1 year but may be published in support of the research project and/or retained indefinitely, where it is likely to have continuing value for research purposes.

All data will be anonymised, no personal identifiable information will be recorded during this process. The retention of data any personal data is in accordance with the university's research records retention schedule. Please note that it is not possible to withdraw any anonymised data should you decided you withdraw the process after information has already been anonymised. Recording of Zoom sessions will be used in order to support the data analysis of the session so that

notes can be compared and enhanced. The recordings will be deleted after finishing the thesis project.

10. What happens to the data at the end of the research project?

Data collected from the initial interview will act as a basis for whether the application produced is needed to help to aid with the awareness of mental wellbeing of its users.

Any feedback gathered from the iterative feedback sessions will assist in the outcome of the application itself. Ensuring that the design of the application is built around the ease of use for the user. Data gathered from the final iteration evaluation will help measure the usability of the application through SUS (System Usability Scale) scoring. The data gathered will also inform any future development of the application. There will not be any future research using the collected data and neither will it be openly available to any other persons. The collected data will be anonymised and securely stored following the completion of the project for 1 year following the University's Research Records Retention Schedule.

11. What will happen to the results of the research project?

It is our intention to publish the results of this research project in academic journals and present findings at conferences. Participants will not be identified in any report, publication or presentation. Participants will not be able to obtain a copy of the results themselves but will be able to find the academic journals. Results will also be used in a report that will be conducted at the end of the project.

12. What if there is a problem?

If you wish to complain, or have grounds for concerns about any aspect of the manner in which you have been approached or treated during the course of this research, please contact Ethan Caldeira via caldeirae@cardiff.ac.uk or Nervo Verdezoto Dias via verdezotodiasn@cardiff.ac.uk. If your complaint is not managed to your satisfaction, please contact comsc-ethics@cardiff.ac.uk. If you are harmed by taking part in this research project, there are no special compensation arrangements. If you are harmed due to someone's negligence, you may have grounds for legal action, but you may have to pay for it.

13. Who is organising and funding this research project?

The research is organised by Ethan Caldeira School of Computer Science in Cardiff University.

Student Researcher: Ethan Caldeira

Supervisor: Nervo Verdezoto Dias

14. Who has reviewed this research project?

This research project has been reviewed and given a favourable opinion by the School of Computer Science Ethics Committee.

15. Further information and contact details

Should you have any questions relating to this research project, you may contact us during normal working hours:

Contact details for lead student researcher:

Name: Ethan Caldeira

Email: caldeirae@cardiff.ac.uk

Personal Phone number may be given upon request.

Thank you for considering to take part in this research project. If you decide to participate, you will be given a copy of the Participant Information Sheet and a signed consent form to keep for your records.

Appendix 3.

Consent Form Template



CONSENT FORM

Title of research project: Creating an Interactive Virtual Companion to Enhance Mental Wellbeing

SREC reference and committee: School Of Computer Science Ethics Committee

Name of Chief/Principal Investigator: Ethan Caldeira

**Please
initial box**

I confirm that I have read the information sheet dated 01/03/22 version 1 for the above research project.	
I confirm that I have understood the information sheet dated 01/03/22 version 1 for the above research project and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
I understand that my participation is voluntary and I am free to withdraw at any time without giving a reason and without any adverse consequences (e.g. to medical care or legal rights, if relevant). I understand that if I withdraw, information about me that has already been obtained may be kept by Cardiff University.	
I understand that data collected during the research project may be looked at by individuals from Cardiff University or from regulatory authorities, where it is relevant to my taking part in the research project. I give permission for these individuals to have access to my data.	

I consent to the processing of my personal information age and gender for the purposes explained to me. I understand that such information will be held in accordance with all applicable data protection legislation and in strict confidence, unless disclosure is required by law or professional obligation.	
I understand who will have access to my personal information provided, how the data will be stored and what will happen to the data at the end of the research project.	
I understand that after the research project, anonymised data may be used for purposes of analysis [EC1] [ND2] and made publicly available via a data repository and may be used for purposes not related to this research project. I understand that it will not be possible to identify me from this data that is seen and used by other researchers, for ethically approved research projects, on the understanding that confidentiality will be maintained.	
I consent to being audio recorded/ screen video[ND3] recorded for the purposes of the research project and I understand how it will be used in the research.[EC4] [ND5]	
I understand that anonymised excerpts and/or verbatim quotes from my interview and feedback sessions may be used as part of the research publication and a part of the project report.[ND6]	
I understand how the findings and results of the research project will be written up and published.	
I agree to take part in this research project.	

Name of participant (print)

Date

Signature

Name of person taking consent
(print)

Date

Signature

**Role of person taking consent
(print)**

THANK YOU FOR PARTICIPATING IN OUR RESEARCH

YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP

Appendix 4.

Thematic Analysis on Initial Research Session

Creating Initial Codes from Initial Research Feedback

Transcript	Codes
<p>00:00:38 InterviewerYes, for you, how would you describe your well being?</p> <p>00:00:46 Participant 2 It's a combination of, how you feel physically and I guess that is emotionally too. Also, like how it affects how you act. I guess if you're feeling a certain way mentally and you need to be going somewhere you're not going to want to, maybe go outside or do some kind of physical activity as well, or you know you can't concentrate on work.</p> <p>00:01:07 Participant 2 Well it also goes the other way if your mental well being is good. Like you're happy, you're happy doing whatever it is that you're doing, whether that is socialising more sport or just nothing. Even just like chilling out, yeah.</p>	<p>Emotional Wellbeing that directly correlates to physical wellbeing.</p> <p>Impacting daily activities. Through emotions.</p> <p>Less likely to do things if you do not feel that way.</p> <p>Could affect individuals' desire to change their feelings.</p> <p>Easy to give into the negative feelings.</p> <p>Goes both ways, if you are feeling well you are more likely to do things.</p>
<p>00:00:41 Interviewer</p>	<p>Mental wellbeing is a broad term.</p>

<p>... Don't have to do so.</p> <p>00:00:42 Participant 8 Cool, I'd say mental well being quite a broad term itself. In that it covers everything. Yeah, everything. I heard a fact though that you make about something like 30,000 decisions a day.</p> <p>00:00:58 Participant 8 And some of those decisions that you make throughout your day, and if not a life can be pretty hard work and tiring, and I think it's different for everyone in that they have their own perception like what should be the right thing to do?</p> <p>00:01:14 Participant 8 Uhm, so the first thing I would say is probably it is very unique and different to everyone but mental well being to me is how I feel about it. What I'm doing in my day to day and every decision I make.</p>	<p>Mental wellbeing is impacting the decisions that are made on a daily basis.</p> <p>Some decisions can be though, this could impact mental wellbeing.</p> <p>Unique to everyone.</p> <p>Mental Wellbeing is down to the way we feel.</p> <p>No right or wrong approach to wellbeing.</p> <p>Different impacts on everyone.</p> <p>Mental wellbeing is what you are doing in your day and the decisions you make.</p>
<p>00:00:29 Interviewer So for the first question, how would you describe mental well being?</p> <p>00:00:34 Participant 9 I think mental well being is having a healthy, emotional, psychological and social state.</p>	<p>Mental wellbeing is having a healthy emotional, psychological, and social state.</p> <p>Emotions and mental well being are connected.</p>
<p>00:00:45 Interviewer So what actions or activities would you consider to have a positive effect on your Mental well being?</p> <p>00:00:55 Participant 9 I think for myself, exercise is a key element to having a healthy life or a healthy Mental well being.</p> <p>00:01:06 Participant 9 I think about the foods that you eat and what you put in your body and also the amount of sleep you get. I think those are three big factors that affect your mental well being.</p>	<p>Eating healthy foods and having a good sleep schedule can impact your mental wellbeing.</p> <p>Three different contributing factors to mental wellbeing improving.</p> <p>External factors contribute to emotions.</p> <p>Need to be reflective on what can be contributing to your feelings.</p>
<p>00:01:29 Interviewer Well speaking on decisions, what actions or activities would you consider to have a positive impact on your mental well being?</p> <p>00:01:44 Participant 8 Cool, so since a kid I've always just loved being outside.</p>	<p>Being in nature can help mental wellbeing.</p>

<p>So fresh air and getting out of the house is a massive thing that really benefits my mental well being.</p> <p>00:01:57 Participant 8 I say that's the first one, the second one is hobbies and like, I love my flying and that's what I want to do for the rest of my life. So things that make me feel happy.</p> <p>00:02:13 Participant 8 Well being, uh my say the last one probably would be.</p> <p>00:02:19 Participant 8 Friends and family. I love laughing. Making people laugh. It's just, it's nice to be around the people that you feel comfortable and happy with.</p>	<p>Fresh air, and being outside.</p> <p>Benefits mental well being when you are doing what you love.</p> <p>Finding hobbies can impact your outlook.</p> <p>Socialising with people you want to be around.</p> <p>People you feel comfortable with.</p>
<p>00:01:53 Interviewer Say for example, you start the day and you're in a bad mood or something happens and it puts you in a bad mood. Is it quite difficult to shake out of that? Does that trickle down to your performance in, say, work or the rest of your day?</p> <p>00:02:08 Participant 13 Mental well being is something that you can acknowledge and review from a different viewpoint from sort of different perspective and then realise, right? If I'm not feeling so good, here's what I need to do to change that and then you can proactively change your state of mind.</p> <p>00:02:21 Participant 13 Acknowledging you need to be slightly introspective. Think about what you're feeling, know what works for you, and then sort of adapt accordingly.</p> <p>00:02:27 Participant 13 Also, if you have a bad day, but for me I just get out be more active and helpful to me.</p>	<p>Requires the need to view yourself in a different perspective.</p> <p>Introspection leads to acknowledgement of feelings, and you can change from there.</p> <p>Need to proactively be looking at ways of changing your state of mind.</p> <p>Wellbeing is linked to your state of mind.</p> <p>Adaptation is needed to change your feelings.</p> <p>Being more active can help your mental wellbeing.</p>
<p>00:07:02 Interviewer ... screen time being quite a negative factor and having an impact on our feelings. Is that something that you think as a society we're becoming more conscious of?</p> <p>00:07:14 Participant 13</p>	<p>Content we consume is now more focused on being conscious of what can affect your feelings.</p>

<p>Yeah, for sure. I think it's definitely becoming a topic and a relevant topic in news and popular media and culture in the content that we consume.</p> <p>00:07:23 Participant 13 Mental wellbeing that is. It's been going this way for the last sort of 10-15 years, but definitely more so, especially with social media and our generation, self care and all that is a big trend right now.</p>	<p>More spoken about, more relevant.</p> <p>Becoming more conscious of how things can impact us.</p> <p>Online connection leading to more conscious conversations.</p> <p>Social media is creating more conversation around self care.</p> <p>Been changing for the last few years.</p> <p>More aware than we were before.</p>
<p>00:00:41 Interviewer So for the first question, how would you describe mental well being?</p> <p>00:00:46 Participant 4 I would describe mental well being. As for me personally, yeah, being aware of your thoughts and your language. How you think.</p> <p>00:01:10 Participant 4 I think it's about how you think positively, sounds a bit cheesy, but it's how you think in a way that is the best in any situation. And that's how I sort of think of it. Is looking at it in a positive or negative way?</p>	<p>The way you use language.</p> <p>Self dialogue, to regular dialog.</p> <p>Reflecting on the way you are thinking.</p> <p>Being aware of your thoughts.</p> <p>Being positive over being negative.</p> <p>Adapting to each situation.</p> <p>Making the best of a situation.</p>
<p>00:01:31 Interviewer ...So what for you is your positive thing?</p> <p>00:01:36 Participant 1 Definitely sports.</p> <p>00:01:40 Participant 1 Rowing and doing things I enjoy. Ah, socialising with people. For me, being able to connect with people certainly. It brings you back into reality.</p> <p>00:01:54 Participant 1 Kind of thing. Gets you out of your own head and also just going outside and being part of the environment too.</p>	<p>Sports and Exercising can help.</p> <p>Socialising with new people.</p> <p>Connecting with people.</p> <p>Mental wellbeing is internal.</p> <p>Being in an outside environment.</p>

Generating sub-themes from the codes

Sub-themes	Codes Belonging to the sub-theme
<p>"I would say is probably it is very unique and different to everyone "</p> <p>- Participant 8</p> <p>Unique experience.</p>	<p>Emotional Wellbeing that directly correlates to physical wellbeing.</p> <p>Could affect different individuals' desire to change their feelings.</p> <p>Easy to give into the negative feelings.</p> <p>Goes both ways, if you are feeling well you are more likely to do things.</p> <p>Mental wellbeing is a broad term.</p> <p>Mental wellbeing is impacting the decisions that are made on a daily basis.</p> <p>Some decisions can be though, this could impact mental wellbeing.</p> <p>Unique to everyone.</p> <p>No right or wrong approach to wellbeing.</p> <p>Different impacts on everyone.</p> <p>Being more active can help your mental wellbeing.</p> <p>Adapting to each situation.</p> <p>Making the best of a situation.</p> <p>Sports and Exercising can help.</p>
<p>"Being aware of your thoughts and your language"</p> <p>- Participant 4</p> <p>Requires Reflection.</p>	<p>Mental wellbeing is having a healthy emotional, psychological, and social state.</p> <p>Becoming more conscious of how things can impact us.</p> <p>Need to be reflective on what can be contributing to your feelings.</p> <p>Requires the need to view yourself in a different perspective.</p> <p>Introspection leads to acknowledgement of feelings, and you can change from there.</p>

	<p>Need to proactively be looking at ways of changing your state of mind.</p> <p>Reflecting on the way you are thinking.</p> <p>Mental wellbeing is internal.</p> <p>Wellbeing is linked to your state of mind.</p> <p>Being positive over being negative.</p>
<p>"I think for myself, exercise is a key element to having a healthy life or a healthy Mental well being."</p> <p>- Participant 9</p> <p>Is affected by the external.</p>	<p>Eating healthy foods and having a good sleep schedule can impact your mental wellbeing.</p> <p>Three different contributing factors to mental wellbeing improving.</p> <p>External factors contribute to emotions.</p> <p>Adaptation is needed to change your feelings.</p> <p>Being in nature can help mental wellbeing.</p> <p>Fresh Air, and being outside.</p> <p>Emotions and mental well being are connected.</p> <p>Mental Wellbeing is down to the way we feel.</p> <p>Content we consume is now more focused on being conscious of what can affect your feelings.</p> <p>The way you use language.</p> <p>Self dialogue, to regular dialog.</p> <p>Being aware of your thoughts.</p> <p>Being in an outside environment.</p>
<p>"For me, being able to connect with people certainly. It brings you back into reality."</p> <p>- Participant 1</p> <p>Who you are with.</p>	<p>Socialising with new people.</p> <p>Connecting with people.</p> <p>Socialising with people you want to be around.</p> <p>People you feel comfortable with.</p>
<p>"Also, like how it affects how you act. "</p> <p>- Participant 2</p>	<p>Mental wellbeing is what you are doing in your day and the decisions you make.</p> <p>Benefits mental well being when you are doing</p>

<p>What you do each day.</p>	<p>what you love.</p> <p>Finding hobbies can impact your outlook.</p> <p>Impacting daily activities. Through emotions.</p> <p>Less likely to do things if you do not feel that way.</p>
<p>"It's been going this way for the last sort of 10-15 years"</p> <p>- Participant 13</p> <p>Times are changing</p>	<p>More spoken about, more relevant.</p> <p>Online connection leading to more conscious conversations.</p> <p>Social media is creating more conversation around self care.</p> <p>Been changing for the last few years.</p> <p>More aware than we were before.</p>

Appendix 5.

Use Cases

Use Case No. 2	Use Case Name: Log In	Rating: Must have
Purpose: Users must be able to log in to their account.		
Main actor: Current user		Secondary Actor: N/A
Pre- conditions: <ul style="list-style-type: none">• Users must be on the login screen.• Users must already have an account to log in to.		
Trigger: When the user presses the login button on the login page.		
Description: The User must: <ol style="list-style-type: none">1. Enter their accounts email address. Needs to match the email that was used to create the account.2. Enter their password for the account: Must be the correct password assigned to the account.		
Extension: Users can log in using Google, Facebook or Apple accounts		
Alternative Flow: N/A		
Related Use Cases: Use Case 1 – Sign Up		
Post-Conditions: <ol style="list-style-type: none">1. Once a user has logged in they will be sent to the homepage.		

Use Case No. 3	Use Case Name: Update Account information	Rating: Must have
Purpose: Users must be able to update their account information.		
Main actor: Current user		Secondary Actor: N/A

Pre- conditions: <ul style="list-style-type: none"> • Users already have an account. • Users must already be logged on.
Trigger: When the selects the settings option in the navigation drawer on profile page.
Description: The User must: <ol style="list-style-type: none"> 1. Be able to update their username for the new account. No spaces in the username and it must not be taken. 2. Be able to update their name for the new account: No limit for the name of the user. 3. Be able to update their email for the new account Must be a valid email with the correct format style, and already used by another account. 4. Be able to update their password for the new account. Must be greater than 6 characters. Must Enter password twice before it will be updated.
Extension: Users can log in using Google, Facebook or Apple accounts.
Alternative Flow: N/A
Related Use Cases: Use Case 2 – Log In
Post-Conditions: <ol style="list-style-type: none"> 1. Once a user updates their information they must be able to log in with the new details. 2. All database related entities with the user's details will be updated.

Use Case No. 4	Use Case Name: Add an Entry	Rating: Must have
Purpose: Users must be able to post an entry of types; Journal, Image or Mood check in.		
Main actor: Current user		Secondary Actor: N/A
Pre- conditions: <ul style="list-style-type: none"> • User is already logged into their account. • User must be on the homepage. 		
Trigger: When the selects the add button on the homepage.		

Description: The User must: <ol style="list-style-type: none"> 1. Select either an image, journal or mood check-in entry. User is taken to an add entry page that corresponds to the selected entry. 2. Enter the details of the entry. Specific to the selected entry, from example the entry title. 3. Save their entry to view later. Details of the entry are saved to the database.
Extension: Users can share a video entry.
Alternative Flow: N/A
Related Use Cases: Use Case 5 – View Entry.
Post-Conditions: <ol style="list-style-type: none"> 1. Once the entry is posted the user must be able to see it on their homepage. 2. Users must be able to view the entry in more detail. 3. Entries must be visible in the past entries section on users profiles. 4. Entries must be visible in the past entries page.

Use Case No. 5	Use Case Name: View and Edit Entry Posts	Rating: Must have
Purpose: Users must view their posts and edit their posts.		
Main actor: Current user		Secondary Actor: N/A
Pre- conditions: <ul style="list-style-type: none"> • User is already logged into their account. • User must have posted an entry. 		
Trigger: When the user selects an entry from the entry previews.		
Description: The User must: <ol style="list-style-type: none"> 1. Be able to see the post details. User is taken to a view entry page that corresponds to the selected entry. 2. Edit the post details. Specific to the selected entry, from example the entry title, or mood. 3. Save the new post details to view later. Updated Details of the entry are saved to the database. 4. Be given the option to delete the entry. If the entry is deleted the details should be removed from the database. 		
Extension: Users can comment on their friends' posts.		

<p>Alternative Flow: Viewing a Friends post</p> <p>Pre- conditions:</p> <ul style="list-style-type: none"> • Users must be friends to view each other's posts. • The friend users must have a post to view. <p>Description: The User must:</p> <ol style="list-style-type: none"> 1. Be able to see the friends post details. User is taken to a view entry page that corresponds to the selected entry. 2. Must not be able to edit the post details. The post belongs to the user's friend so should not be able to edit the post details.
<p>Related Use Cases: Use Case 4 – Add an Entry. Use Case 6 - View a Friends Entry Posts</p>
<p>Post-Conditions:</p> <ol style="list-style-type: none"> 1. Once the entry is posted the user must be able to see it on their homepage. 2. Users must be able to view the entry in more detail. 3. Entries must be visible in the past entries section on users profiles. 4. Entries must be visible in the past entries page.

Use Case No. 6	Use Case Name: View a Friends Entry Posts	Rating: Must have
Purpose: Users must view their friends' posts.		
Main actor: Current user		Secondary Actor: Friend Users
<p>Pre- conditions:</p> <ul style="list-style-type: none"> • User is already logged into their account. • Users must be friends to view each other's posts. • The friend users must have a post to view. 		
Trigger: When the user selects a friend entry from the entry previews.		
<p>Description: The User must:</p> <ol style="list-style-type: none"> 1. Be able to see the friends post details. User is taken to a view entry page that corresponds to the selected entry. 2. Must not be able to edit the post details. The post belongs to the user's friend so should not be able to edit the post details. 		
Extension: Users can comment on their friends' posts.		

Alternative Flow: N/A
Related Use Cases: Use Case 5 – View and Edit Entry Posts
Post-Conditions: N/A

Use Case No. 7	Use Case Name: Add Friends	Rating: Must have
Purpose: Users must be able to add friends.		
Main actor: Current user		Secondary Actor: Potential Friend User
Pre- conditions: <ul style="list-style-type: none"> • Both users need to have accounts. • User is already logged into their account. 		
Trigger: When the current user searches another user's username		
Description: The User must: <ol style="list-style-type: none"> 1. Search for other users. Users must be able to search for other users and visit their page when tapping on their profile. 2. Be able to send friend requests from the search page. Users must be able to add a friend from the search page. Users should be able to see if they have sent or received a request from the searched user. 		
Extension: Add friends based on nearby locations.		
Alternative Flow: Add a friend from the other users page. Description: The User must: <ol style="list-style-type: none"> 1. Be able to send friend requests from the other users page. Users must be able to add a friend from the other users page. Users should be able to see if they have sent or received a request from the other user. 2. Must not be able to see the other users post. If the users are not friends the other users posts should not be visible. 		
Related Use Cases: Use Case 6 - View a Friends Entry Posts		

Post-Conditions:

1. Once a request is sent it should be added to the sent request list of the current user.
2. Once a request is received it should be added to the friend requests list of the current user.
3. When a request is accepted the users must become friends.
4. If a request is denied it should disappear from the friend requests list.

Use Case No. 8	Use Case Name: Chat with Friends	Rating: Must have
Purpose: Users must be able to chat with friends.		
Main actor: Current user		Secondary Actor: Friend User
Pre- conditions: <ul style="list-style-type: none"> • Both users need to have accounts. • User is already logged into their account. • Users must be friends to chat. 		
Trigger: When the current user starts a chat with their friend		
Description: The User must: <ol style="list-style-type: none"> 1. Start a chat with their friend. Users must be able to create a new chat with a friend of theirs. 1a. View existing chat with their friend. Users must be able to view existing chats with friends. 2. Send Messages to their friends. Users must send text messages to friends. 3. View Messages from their friend. Users must be able to view text messages from friends in their chat page. 		
Extension: Send images as chat messages.		
Alternative Flow: N/A		
Related Use Cases: Use Case 7 - Add Friends		
Post-Conditions: <ol style="list-style-type: none"> 1. Once a text message is sent it should be visible from the friend user. 		

Use Case No. 9	Use Case Name: Adjust Time limit	Rating: Must have
Purpose: Users must be able to change the default time limit of the application.		
Main actor: Current user	Secondary Actor: N/A	
Pre- conditions: <ul style="list-style-type: none">• User is already logged into their account.		
Trigger: When the presses on the time limit option on the navigation drawer on the profile page.		
<p>Description: The User must:</p> <p>1.Select a valid time limit. Users must select a valid time limit between 12 hours and 10 minutes.</p> <p>2. Save the new time limit settings. The new selected limit should be saved to the database. The time limit should be applied after it is saved.</p>		
Extension: Notify users when they are approaching the time limit		
Alternative Flow: N/A		
Related Use Cases: Use Case 3 - Update Account information		
Post-Conditions: <ul style="list-style-type: none">1. The time limit lock page should appear if the user surpasses their new selected time limit.		

Use Case No. 10	Use Case Name: Follow Exercises	Rating: Must have
Purpose: Users must be able to follow the exercises of the application.		
Main actor: Current user	Secondary Actor: N/A	
Pre- conditions: <ul style="list-style-type: none">• User is already logged into their account.• User is on the tool page.		
Trigger: When the selects an exercise from the tools page.		

<p>Description:</p> <p>The User must:</p> <p>Breathing Exercise</p> <p>1.Start the exercise.</p> <p>Users must start the exercise in order to follow it.</p> <p>2. Be guided through the breathing exercise.</p> <p>Users should be guided through the breathing while holding the breath button, they should experience haptic feedback and the count should be shown.</p> <p>3. View the companion partaking in exercise.</p> <p>The companion should be visible following the user through the exercise.</p> <p>Calm Walk Exercise</p> <p>1.Start the exercise.</p> <p>Users must start the exercise in order to follow it.</p> <p>2. Shown their steps and other measurements .</p> <p>Users must be able to see their steps, calories, distance and duration after they have started the walk.</p> <p>3. Be able to save their walk .</p> <p>Users must be able to save their walk information. Must be saved to the database to view again later.</p> <p>4. View the companion partaking in exercise.</p> <p>The companion should be visible following the user through the exercise.</p>
<p>Extension: Adding a meditation exercise</p>
<p>Alternative Flow: N/A</p>
<p>Related Use Cases: Use Case 2 - Log in</p>
<p>Post-Conditions:</p> <ol style="list-style-type: none"> 1. Once the user has saved the calm walk they should be able to view it in past walks, on the calm walk page.

Appendix 6.

Thematic Analysis For Iterative Design Feedback

Thematic Analysis Round 1 Design Feedback

Creating codes from feedback round 1

Transcript	Codes
<p>00:05:49 Interviewer So do you think that's something that should be changed? That you can't view other profiles?</p> <p>00:05:52 Participant 1 Make them private, yeah, I think you should be friends in order to view.</p> <p>00:05:58 Participant 1 Just to maintain that level of trust so that you know that people who can view your things and reach out to you or people that you really care about or.</p>	<p>Keeping trust.</p> <p>Smooth flow of the app.</p>
<p>00:18:21 Interviewer ... email, I guess that's the main thing.</p> <p>00:18:24 Participant 2 Little bugs and stuff, but if you can fix the bugs then I think that will improve it the most, maybe another entry type too?</p>	<p>Fix the bugs.</p> <p>Extra entries.</p> <p>Smooth flow of the app.</p>
<p>00:17:10 Interviewer ...How things affect it?</p> <p>00:17:12 Participant 2 100%, especially the questioning in the mood checking thing. I think that's really like just again, it's just so smart to be like. How are you feeling? Why do you think this is and what does? That makes you feel you know, like, Bang Bang bang, it's just it's. It's very quick check in.</p>	<p>Smooth flow of the app.</p> <p>Speed of features.</p> <p>Speed of features.</p>
<p>00:01:55 Interviewer Is there any feature of this application that stood out to you?</p> <p>00:02:01 Participant 1 The character, but also the journal.</p> <p>00:02:03 Interviewer OK.</p> <p>00:02:04 Participant 1 I like the questions in the journal. They're short and easy to follow, but also there it's it's.</p>	<p>Speed of features.</p> <p>Smooth flow of the app.</p> <p>Habit generating.</p> <p>Easy for the user to understand.</p>

<p>It's easy enough to be able to create a habit for you.</p> <p>00:02:19 Participant 1</p> <p>So if you woke up every day and you were answering those questions, I think it would have a positive impact on your mindset.</p>	<p>Keeping consistent features.</p>
<p>00:01:20 Interviewer</p> <p>What features could be added to improve the user experience?</p> <p>00:01:26 Participant 3</p> <p>There were a few errors and bugs when you were just walking through the app, so just making sure those are all clear.</p> <p>00:01:31 Participant 3</p> <p>I saw a couple of the loading screens. They had a different colour, so maybe just make all the loading screens the.</p> <p>00:01:39 Participant 3</p> <p>I mean the colour for those little loading circles.</p> <p>00:01:49 Participant 3</p> <p>Also I noticed some of the text on the chat. It it shows the username first.</p> <p>00:01:52 Participant 3</p> <p>I really feel like it should show the name first.</p>	<p>Smooth flow of the app.</p> <p>Improve experience.</p> <p>Fix the bugs.</p> <p>Loading circle update.</p> <p>Keeping consistent features.</p> <p>Easy for the user to understand.</p>

Generating sub-themes from the codes

Sub-themes	Codes Belonging to the sub-theme
<p>"And no, I think overall the application is really easy to use"</p> <p>- Participant 3</p> <p>Ease of use</p>	<p>Smooth flow of the app.</p> <p>Easy for the user to understand.</p>
<p>" It's easy enough to be able to create a habit for you"</p> <p>- Participant 1</p> <p>Effortless user experience</p>	<p>Keeping trust.</p> <p>Habit generating.</p> <p>Speed of features.</p>
<p>"And I think the the whole communication between the app and the user is really nice like"</p> <p>- Participant 2</p> <p>Continuous design</p>	<p>Improve experience.</p> <p>Fix the bugs.</p> <p>Keeping consistent features.</p> <p>Loading circle update.</p>

Appendix 7.

Thematic Analysis Round 2 Design Feedback

Creating codes from feedback round 2

Transcript	Codes
<p>00:00:25 Interviewer How could the design of the application be improved?</p> <p>00:00:33 Participant 5 I think maybe you could have. Are we talking about design right?</p> <p>00:00:40 Participant 5 Yeah, I do like the design.</p> <p>00:00:42 Participant 5 Maybe you could have different colours for entries or as you navigate through the app maybe different sections could have different colours.</p>	<p>Improve colours.</p> <p>Variety of colours.</p> <p>Smooth design.</p>
<p>00:01:02 Interviewer Was there anything that would be difficult for the user to understand?</p> <p>00:01:07 Participant 5 Uhm, I don't really think so. I thought it was quite seamless.</p>	<p>Easy to use.</p> <p>Smooth design.</p>
<p>00:00:11 Interviewer How could the design be improved?</p> <p>00:00:19 Participant 4 Maybe a few more colours than just the ones you've got at the moment.</p>	<p>Improve colours.</p> <p>Variety of colours.</p>
<p>00:02:01 Participant 4 Maybe having a uh, check notification? Instead of purposely going having to look for the chat?</p> <p>00:02:10 Participant 4 And maybe a character's name.</p> <p>00:02:15 Interviewer Sorry, what was that?</p> <p>00:02:17 Participant 4 So maybe you can name your character.</p>	<p>More interactive.</p> <p>Character interaction.</p> <p>Notifications.</p> <p>More for the user to do.</p> <p>Increases involvement with the app.</p>
<p>00:01:38 Interviewer What features could be added to improve the user experience?</p> <p>00:01:42 Participant 3</p>	<p>Tagging photos.</p> <p>Audio Entry.</p>

<p>Uhm, well I think it depends.</p> <p>00:01:44 Participant 3</p> <p>I think on a basic level, maybe another form of like entry like an audio note could be quite helpful and on a higher level maybe adding friends based on locations or tagging images with locations.</p>	<p>More interactive.</p> <p>Friends by location.</p>
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Generating sub-themes from the codes

Sub-themes	Codes Belonging to the sub-theme
<p>"Maybe you could have different colours for entries"</p> <p>- Participant 5</p> <p>Colour consistency</p>	<p>Improve colours.</p> <p>Variety of colours.</p> <p>Easy to use.</p> <p>Smooth design.</p>
<p>"So maybe you can name your character. "</p> <p>- Participant 4</p> <p>Interactivity of the character</p>	<p>More interactive.</p> <p>Character interaction.</p> <p>Increases involvement with the app.</p>
<p>"I think on a basic level, maybe another form of like entry like an audio note could be quite helpful"</p> <p>- Participant 3</p> <p>Complexity increase</p>	<p>Tagging photos.</p> <p>Audio Entry.</p> <p>Friends by location.</p> <p>More for the user to do.</p> <p>Notifications</p>

Appendix 8.

Thematic Analysis Round 3 Design Feedback

Creating codes from feedback round 3

Transcript	Codes
<p>00:00:01 Interviewer What do you think about the design of the?</p> <p>00:00:03 Participant 3 I think the design as per my last interview is still very good.</p> <p>00:00:08 Participant 3 I think it's consistent, easy to use and I like the changes that have been done.</p> <p>00:00:12 Interviewer How could the design of the application be improved?</p> <p>00:00:15 Participant 3 I noticed a few back buttons that weren't quite consistent with the other button, so maybe just improving that.</p>	<p>Consistent Design.</p> <p>Easy to use.</p> <p>Clear any inconsistencies.</p>
<p>00:00:08 Interviewer How could the design of the application be improved?</p> <p>00:00:12 Participant 2 I don't think there's anything further that needs to be done with it. It looks good and for the most part is very consistent.</p> <p>00:00:16 Interviewer Term, was there anything that could be difficult for the user to understand?</p> <p>00:00:20 Participant 2 No, not any.</p>	<p>Easy to use.</p> <p>Simple to understand.</p> <p>Clear any inconsistencies.</p> <p>Consistent Design.</p>
<p>00:00:26 Interviewer What part of the design did you like the most?</p> <p>00:00:34 Participant 1 I love the overall feature of the entire application.</p> <p>00:00:37 Participant 1 The colours are extremely complementary.</p> <p>00:00:39 Participant 1 I love how you've changed them. They work so well together.</p>	<p>Complementary Colours.</p> <p>Easy to use.</p> <p>Simple to understand.</p>
<p>00:00:40 Interviewer What part of the design did you like the most?</p> <p>00:00:43 Participant 4</p>	<p>Improvements made.</p> <p>Interactivity improved.</p>

<p>Well I like the character and being able to name it now makes it.</p> <p>00:00:46 Participant 4</p> <p>It is a big difference.</p>	
<p>00:00:46 Interviewer</p> <p>Uhm, what features could be added to improve the user experience?</p> <p>00:00:52 Participant 5</p> <p>As I've said I really like it but I think you could add different types of features like maybe adding locations to photos or maybe there could be an explore page and maybe people can reach out to these people on the explore page. In an effort to try and help them out.</p>	<p>More features.</p> <p>Future work.</p>
<p>00:02:07 Interviewer</p> <p>What do you think could be done to improve the application as a whole?</p> <p>00:02:10 Participant 1</p> <p>The only points are, being really picky is to say maybe you could have different colours for the friends posts.</p>	<p>Complementary Colours.</p> <p>Easy to use.</p> <p>Simple to understand.</p> <p>Improve colours.</p>

Generating sub-themes from the codes

Sub-themes	Codes Belonging to the sub-theme
<p>"I noticed a few back buttons that weren't quite consistent with the other button, so maybe just improving that."</p> <p>- Participant 3</p> <p>Consistent Design</p>	<p>More features.</p> <p>Future work.</p> <p>Consistent Design.</p> <p>Easy to use.</p> <p>Clear any inconsistencies</p> <p>Simple to understand.</p>
<p>"The only points are, being really picky is to say maybe you could have different colours for the friends posts."</p> <p>- Participant 1</p> <p>Distinguish user posts</p>	<p>Complementary Colours.</p> <p>Improve colours.</p> <p>Improvements made.</p> <p>Interactivity improved.</p>

Appendix 9.

SUS Results from Final Evaluation Session

SUS Feedback Results										
	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10
Participant 1	5	1	5	1	4	1	5	1	4	2
Participant 2	4	1	5	1	4	2	4	2	5	2
Participant 3	5	2	5	2	5	1	5	1	5	3
Participant 4	5	1	5	1	5	1	5	1	5	1
Participant 5	5	1	5	1	5	1	5	1	5	1
Participant 6	5	1	5	1	5	1	5	1	4	1
Participant 7	4	1	5	2	4	1	5	1	5	1
Participant 8	5	1	5	1	5	1	5	1	5	1
Participant 9	5	1	5	1	5	1	5	1	5	1
Participant 10	5	1	5	1	4	1	5	1	5	1
Average score	4.8	1.1	5	1.2	4.6	1.1	4.9	1.1	4.8	1.4

SUS Calculations										
X	X Formula	Y	Y Formula	SUS Score	SUS Formula					
18	"=(B3+D3+F3+H3+J3)-5"	19	"=25-(B3+D3+F3+H3+J3)"	92.5	"=2.5*(M3+O3)"					
17	"=(B4+D4+F4+H4+J4)-5"	17	"=25-(B4+D4+F4+H4+J4)"	85	"=2.5*(M4+O4)"					
20	"=(B5+D5+F5+H5+J5)-5"	16	"=25-(B5+D5+F5+H5+J5)"	90	"=2.5*(M5+O5)"					
20	"=(B6+D6+F6+H6+J6)-5"	20	"=25-(B6+D6+F6+H6+J6)"	100	"=2.5*(M6+O6)"					
20	"=(B7+D7+F7+H7+J7)-5"	20	"=25-(B7+D7+F7+H7+J7)"	100	"=2.5*(M7+O7)"					
19	"=(B8+D8+F8+H8+J8)-5"	20	"=25-(B8+D8+F8+H8+J8)"	97.5	"=2.5*(M8+O8)"					
18	"=(B9+D9+F9+H9+J9)-5"	19	"=25-(B9+D9+F9+H9+J9)"	92.5	"=2.5*(M9+O9)"					
20	"=(B10+D10+F10+H10+J10)-5"	20	"=25-(B10+D10+F10+H10+J10)"	100	"=2.5*(M10+O10)"					
20	"=(B11+D11+F11+H11+J11)-5"	20	"=25-(B11+D11+F11+H11+J11)"	100	"=2.5*(M11+O11)"					
19	"=(B12+D12+F12+H12+J12)-5"	20	"=25-(B12+D12+F12+H12+J12)"	97.5	"=2.5*(M12+O12)"					

Appendix 10.

Thematic Analysis Final Evaluation Session

Creating codes from final evaluation session feedback

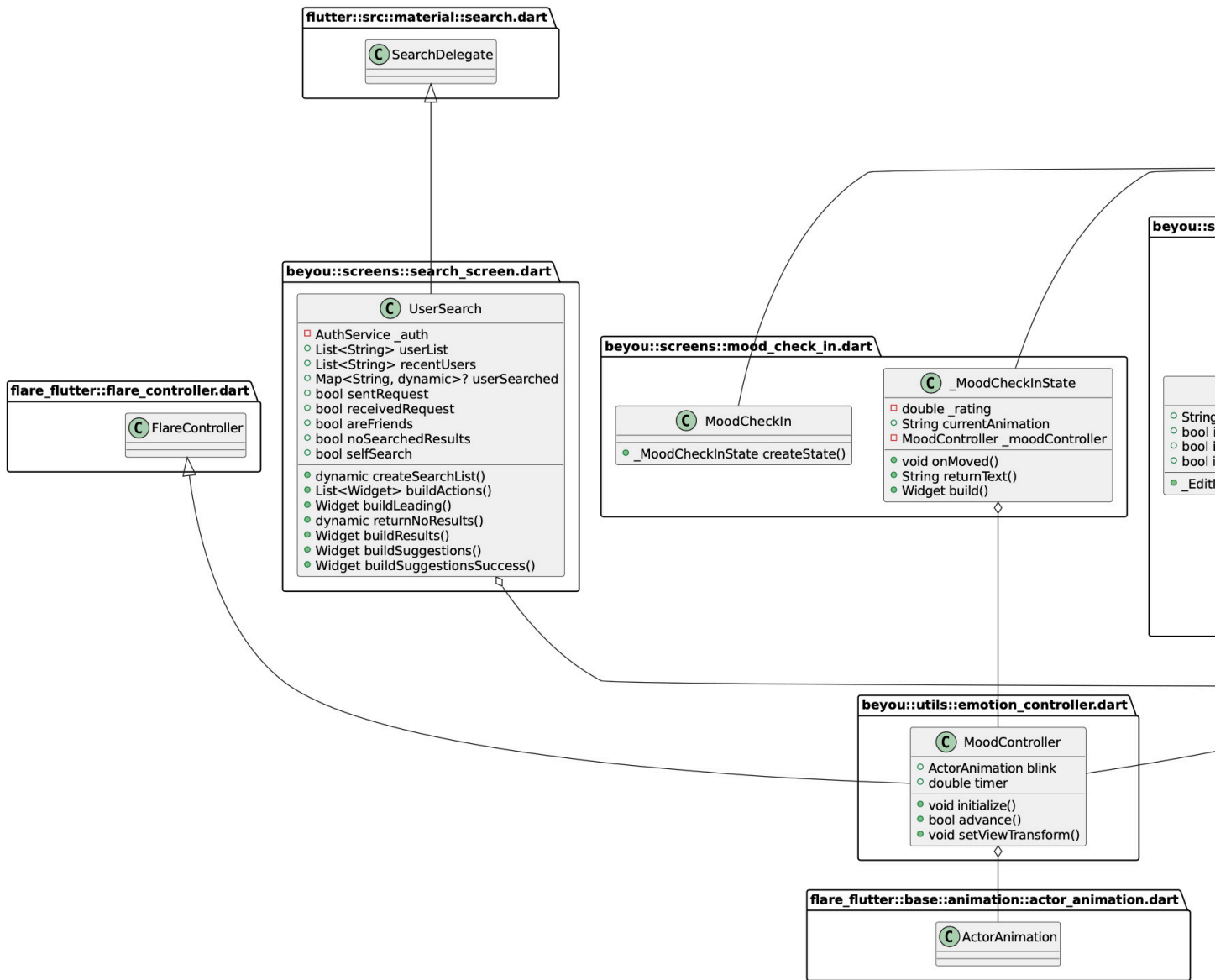
Transcript	Codes
<p>00:00:01 Interviewer How did you find the application overall?</p> <p>00:00:04 Participant 1 I found, overall, very useful, very intuitive.</p> <p>00:00:25 Interviewer Can you actually just say a few of your points on the application?</p> <p>00:00:30 Participant 1 Yes, it will make you more aware of where you are in your mental well being.</p> <p>00:00:37 Participant 1 I think some of the standout features of the application are being able to journal and being able to show what your current state, through how you feel and the fact that you can do audio notes as well.</p> <p>00:00:56 Participant 1 I think it's all good and all of that focuses and brings your attention to your own mental well being.</p>	<p>Very Useful.</p> <p>Very Intuitive.</p> <p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Good features for supporting wellbeing.</p>
<p>00:00:09 Participant 2 I think it will make people more aware. I think the features that are being used are in their nature reflective..</p> <p>00:00:20 Participant 2 So, these features will force people to become more aware.</p> <p>00:00:25 Participant 2 And I think that the character and being able to see that someone is trying to cheer you up or trying to counter your emotion is actually very positive, because I think that can really help to lift people.</p> <p>00:00:38 Participant 2 So overall I think the applications are pretty good.</p>	<p>Very Useful.</p> <p>Very Intuitive.</p> <p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Good features for supporting wellbeing.</p> <p>Forces focus on mental wellbeing</p>

<p>00:00:00 Interviewer Do you think that it's a good application to help with mental well being?</p> <p>00:00:05 Participant 3 Yes, I think it's good.</p> <p>00:00:08 Participant 3 I think it is good application to help people's mental wellbeing. As it will make people more aware the more they use it.</p>	<p>Very Useful.</p> <p>Very Intuitive.</p> <p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Will help overtime.</p>
<p>00:00:12 Participant 4 Oh yeah, I think it definitely will help people enhance their mental health. I think it does that by kind of making you aware of it.</p> <p>00:00:20 Participant 4 How you're feeling on a daily basis instead of kind of going on autopilot.</p> <p>00:00:24 Interviewer Yeah, is there anything in the application that you feel kind of helps the most with that?</p> <p>00:00:33 Participant 4 I'd say maybe the journal for sure.</p> <p>00:00:37 Participant 4 Just to get your thoughts onto a page, and I mean you can compare how you're feeling throughout the week to other weeks and see like if you're making progress or maybe just had a bad week.</p>	<p>Very Useful.</p> <p>Very Intuitive.</p> <p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Good features for supporting wellbeing.</p> <p>Forces focus on mental wellbeing.</p> <p>Will help overtime.</p>
<p>00:00:28 Participant 5 Application is really easy to use. Really straightforward and interactive. I definitely think it can make me more aware of my mental health and well being and therefore enhance it.</p> <p>00:00:32 Participant 5 The longer you use the app, the more it would help, definitely.</p>	<p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Good features for supporting wellbeing.</p> <p>Forces focus on mental wellbeing.</p> <p>Will help overtime.</p> <p>Need to use it to help</p>
<p>00:00:00 Interviewer Were your thoughts on the application?</p> <p>00:00:03 Participant 6 Easy to use, definitely helps.</p> <p>00:00:07 Participant 6 Brings attention to your current state of mind and it helps with overall well being. Over time using it</p>	<p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Good features for supporting wellbeing.</p> <p>Forces focus on mental wellbeing.</p>

as a journal will be a great tool just to be able to reflect.	Will help overtime.
<p>00:00:03 Participant 7 OK, I thought the app was really nice and straightforward to use.</p> <p>00:00:07 Participant 7 It felt friendly and like a community. I think I could build quite a supportive community with the app, but it was nice and easy to use and would help you with understanding yourself more.</p>	<p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Forces focus on mental wellbeing.</p> <p>Community that can be built.</p>
<p>00:00:02 Participant 8 It was easy to use. I think using the application would make you more aware of your mental wellbeing.</p> <p>00:00:10 Interviewer And is that like over time you think or Just in general?</p> <p>00:00:13 Participant 8 In general it makes you reflect and that can help you with understanding your feelings more, like with the entries and the exercises. The whole thing helps I think.</p>	<p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Forces focus on mental wellbeing.</p> <p>Exercises help.</p>

Generating sub-themes from the codes

Sub-themes	Codes Belonging to the sub-theme
<p><i>"It was easy to use."</i> - Participant 8</p> <p>Easy to use</p>	<p>Very Useful.</p> <p>Very Intuitive.</p> <p>Community that can be built.</p>
<p><i>"Brings attention to your current state of mind and it helps with overall well being."</i> - Participant 6</p> <p>Brings Attention to mental wellbeing</p>	<p>Focus on the way you feel.</p> <p>Brings attention to mental wellbeing.</p> <p>Good features for supporting wellbeing.</p> <p>Forces focus on mental wellbeing.</p> <p>Exercises help.</p>
<p><i>"The longer you use the app, the more it would help, definitely."</i> - Participant 5</p> <p>Using it more over time will help</p>	<p>Will help overtime.</p> <p>Need to use it to help</p>



beyou::screens::edit_mood_check_in.dart

C EditMoodCheckIn

- String entryId
- bool isHomepage
- bool isPastJorunal
- bool isProfile

- _EditMoodCheckInState createState()

C _EditMoodCheckInState

- AuthService _auth
- DateTime date
- int moodRating
- String moodFrom
- String moodToday
- bool setAlready
- MoodController _moodController
- double _rating
- String currentAnimation
- int selectedActivityIndex
- int selectedEmotionIndex
- String docId
- String returnTextLowerCase()
- String returnText()
- String returnActivity()
- String returnEmotion()
- int returnActivityIndex()
- int returnEmotionIndex()
- void changeValues()
- void onMoved()
- void deleteEntry()
- Widget build()

beyou::screens::view_any_entry.dart

C ViewAnyEntry

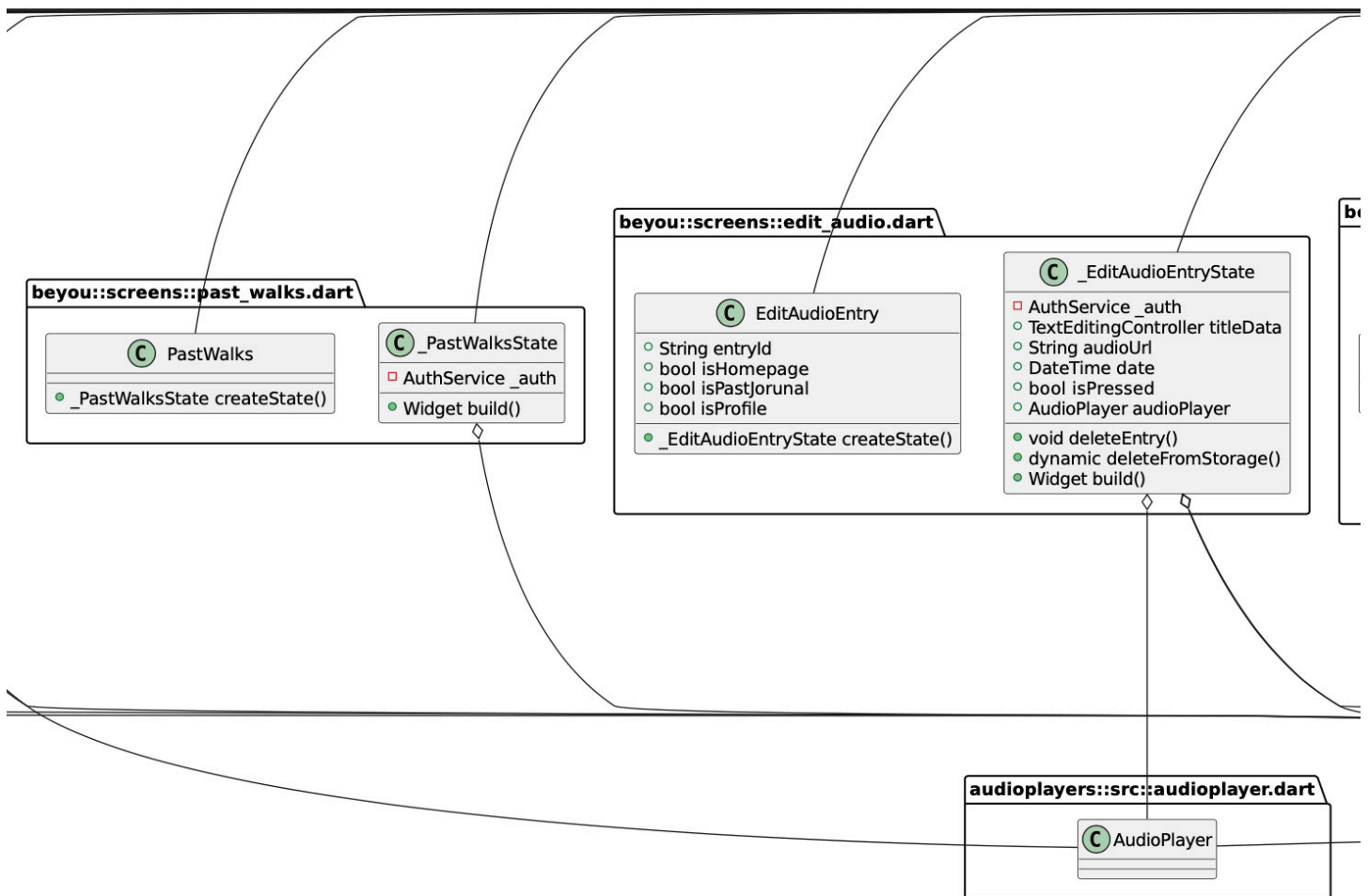
- String entryId
- String userId
- String entryTag
- bool isHomepage
- bool isPastJorunal
- bool isProfile

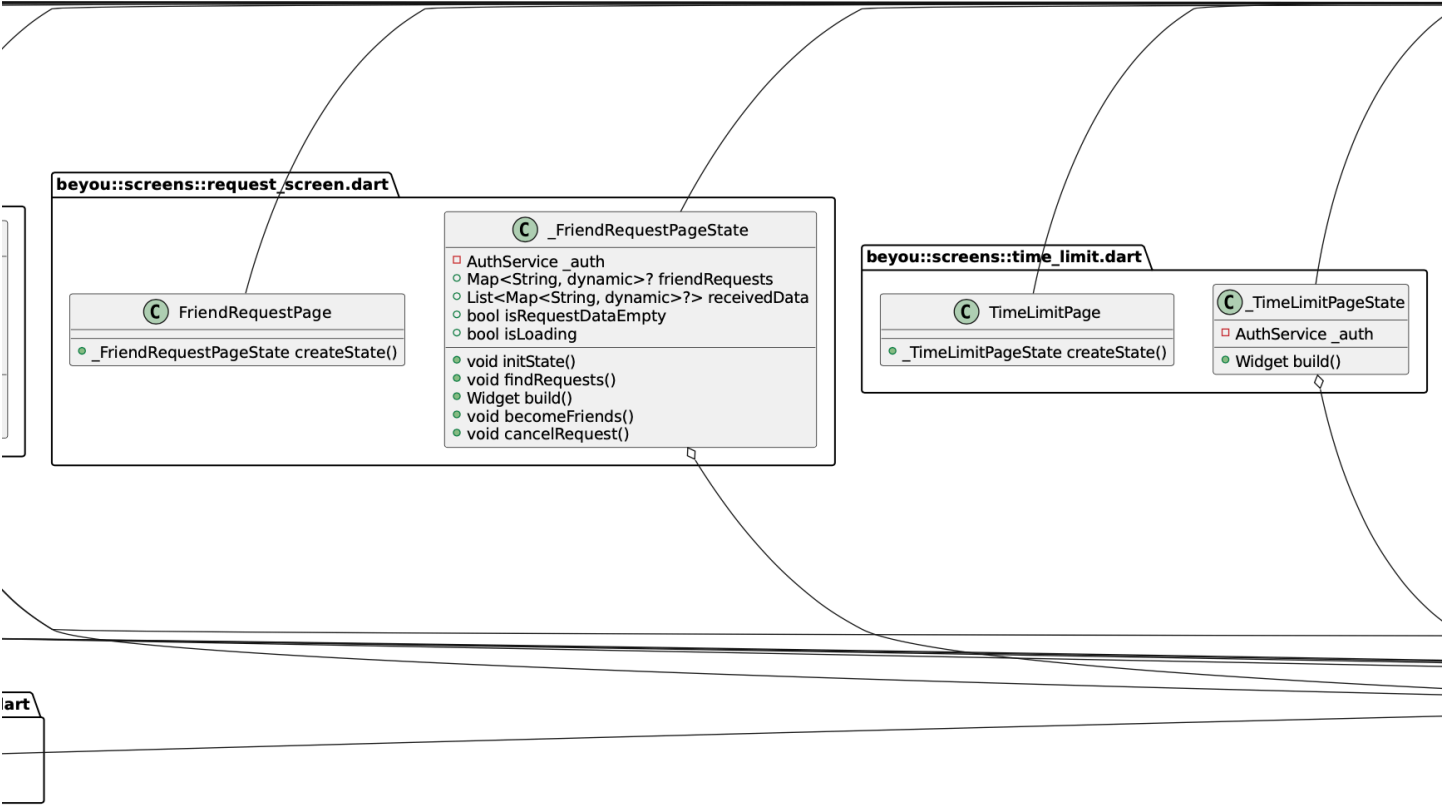
- _ViewAnyEntryState createState()

C _ViewAnyEntryState

- AuthService _auth
- bool isCurrentUser
- AudioPlayer audioPlayer
- void checkCurrentUser()
- void initState()
- Future<void> dispose()
- Widget build()

on.dart





beyou::screens::change_time_limit.dart

ChangeTimeLimitPage

• _ChangeTimeLimitPageState createState()

• _ChangeTimeLimitPageState

AuthService _auth
Duration currentLimit
Duration selectedValue
void initState()
String showDuration()
Duration stringToDuration()
void findCurrentLimit()
Widget build()
void buildTimeLimitPicker()
void navigate()

beyou::screens::all_chats_screen.dart

AllChatsPage

• _ChatsPageState createState()

• _ChatsPageState

AuthService _auth
Map<String, dynamic>? friendData
List<Map<String, dynamic>?> friendChat
List<String> friendChatIds
List<Map<String, dynamic>?> noChat
bool noFriends
bool hasFriendsWithNoChat
bool isChatDataEmpty
bool isLoading
String myId
void initState()
void setMyId()
dynamic createNewChat()
void findFriendsData()
Widget build()

beyou

beyou::screens::friends_screen.dart

C FriendsListPage

• _FriendsListPageState createState()

C _FriendsListPageState

▢ AuthService _auth
• Map<String, dynamic>? friendData
• List<Map<String, dynamic>?> allFriends
• bool noFriends
• bool isLoading
• void initState()
• void findFriends()
• Widget build()
• void removeFriend()

beyou::screens::profile_screen.dart

C _ProfilePageState

▢ AuthService _auth
• GlobalKey<ScaffoldState> mainScaffold
• bool isPastEntries
• bool isExercise
• void initState()
• Widget build()

C ProfilePage

• _ProfilePageState createState()

beyou::screens::sent_requests.dart

C SentRequestPage

• _SentRequestPageState createState()

C _SentRequestPageState

■ AuthService _auth
• Map<String, dynamic>? sentRequest
• List<Map<String, dynamic>?> sentData
• bool isSentDataEmpty
• bool isLoading
• void initState()
• void findSentRequest()
• Widget build()
• void cancelRequest()

beyou::screens::past_entries.dart

C PastEntriesPage

• _PastEntriesPageState createState()

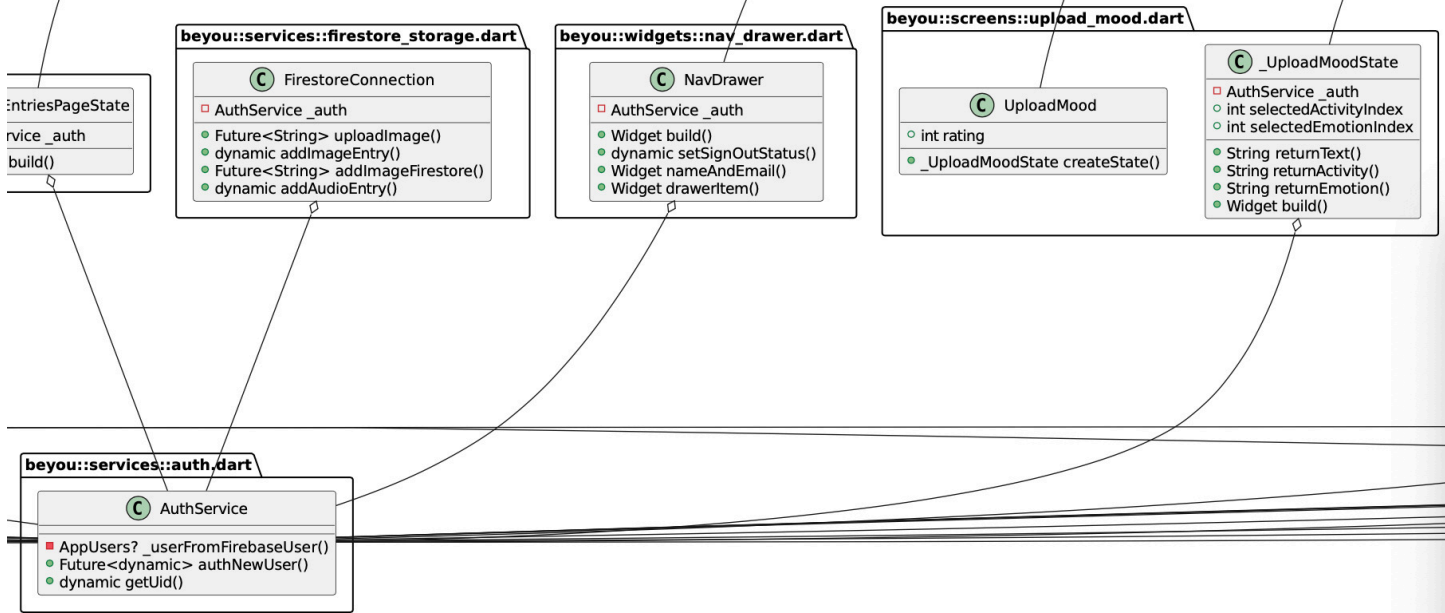
C _PastEntriesPageState

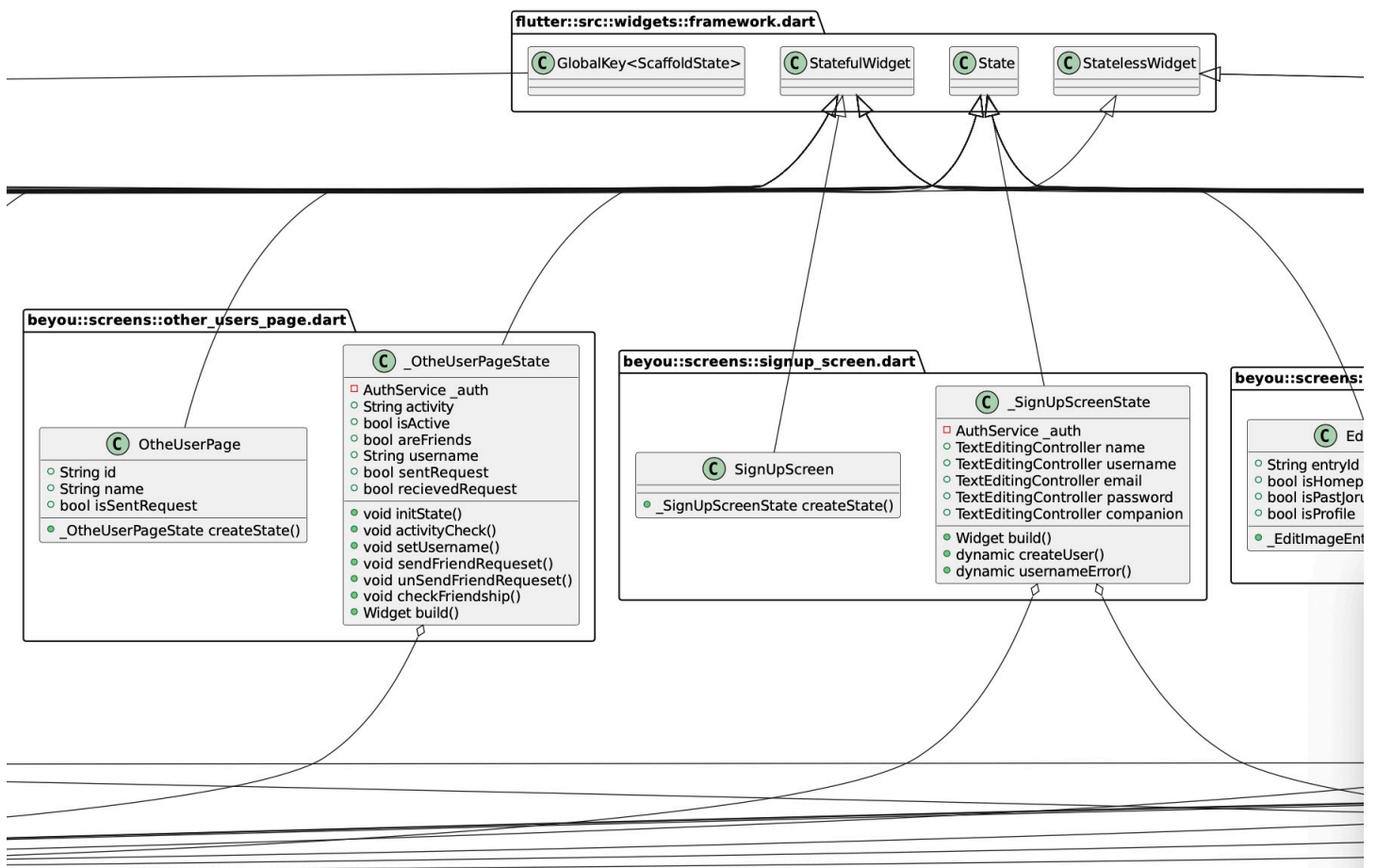
■ AuthService _auth
• Widget build()

beyou::services::

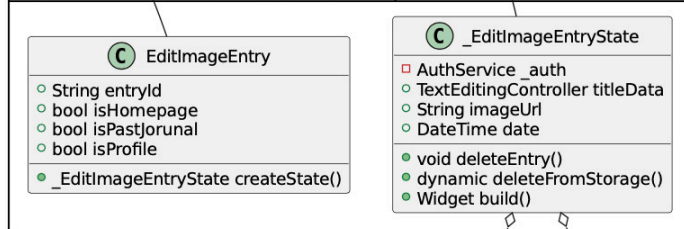
C At

■ AppUsers? _use
• Future<dynam
• dynamic getUId





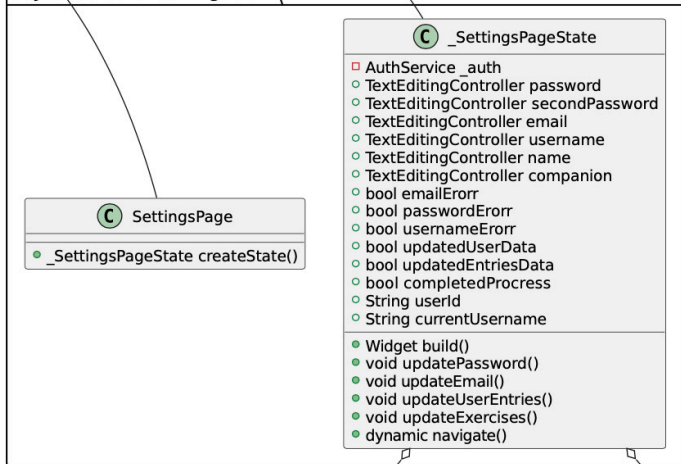
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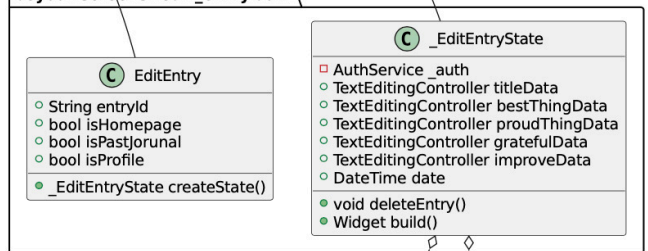
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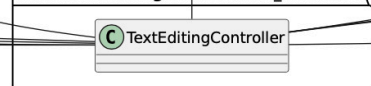
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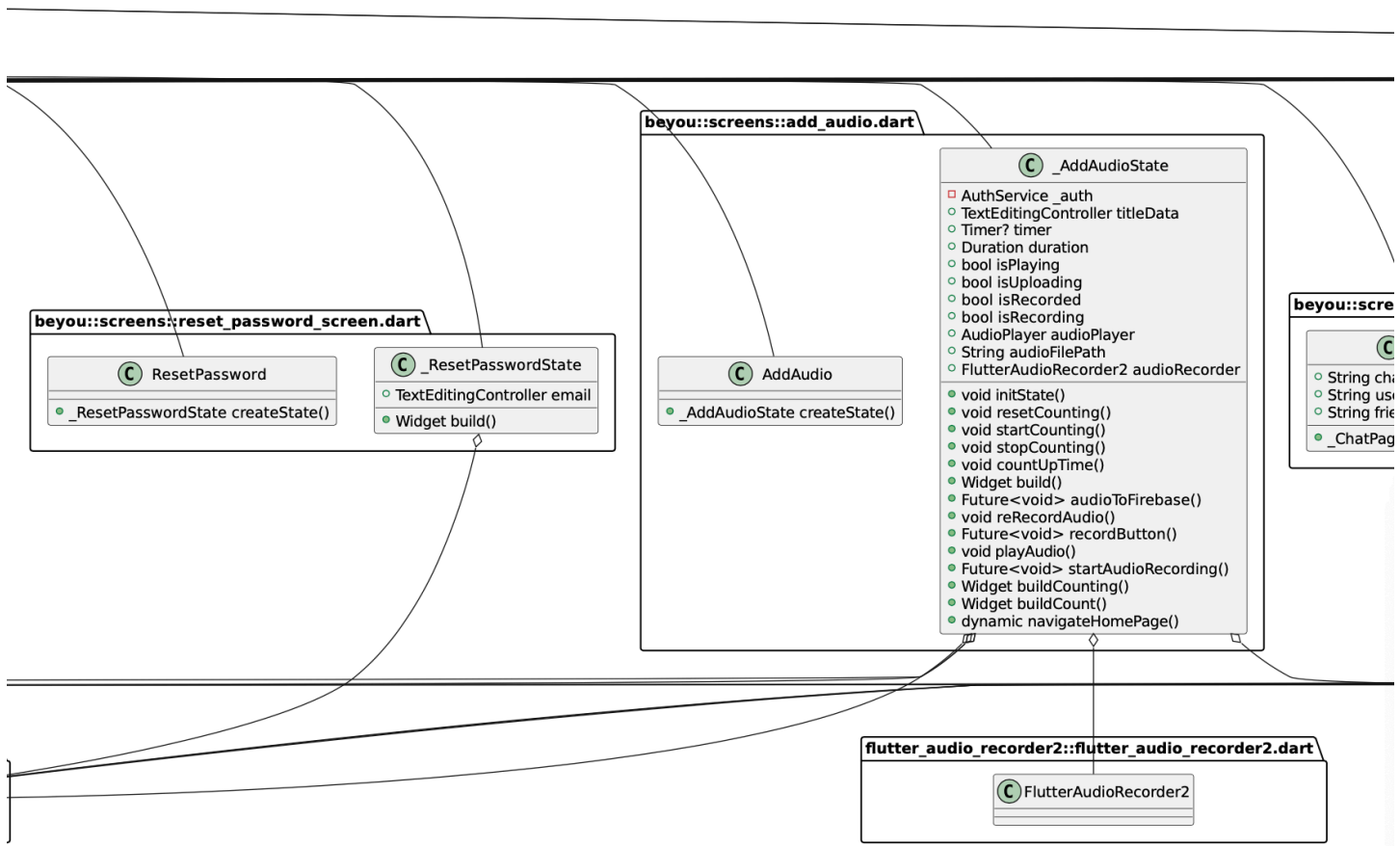


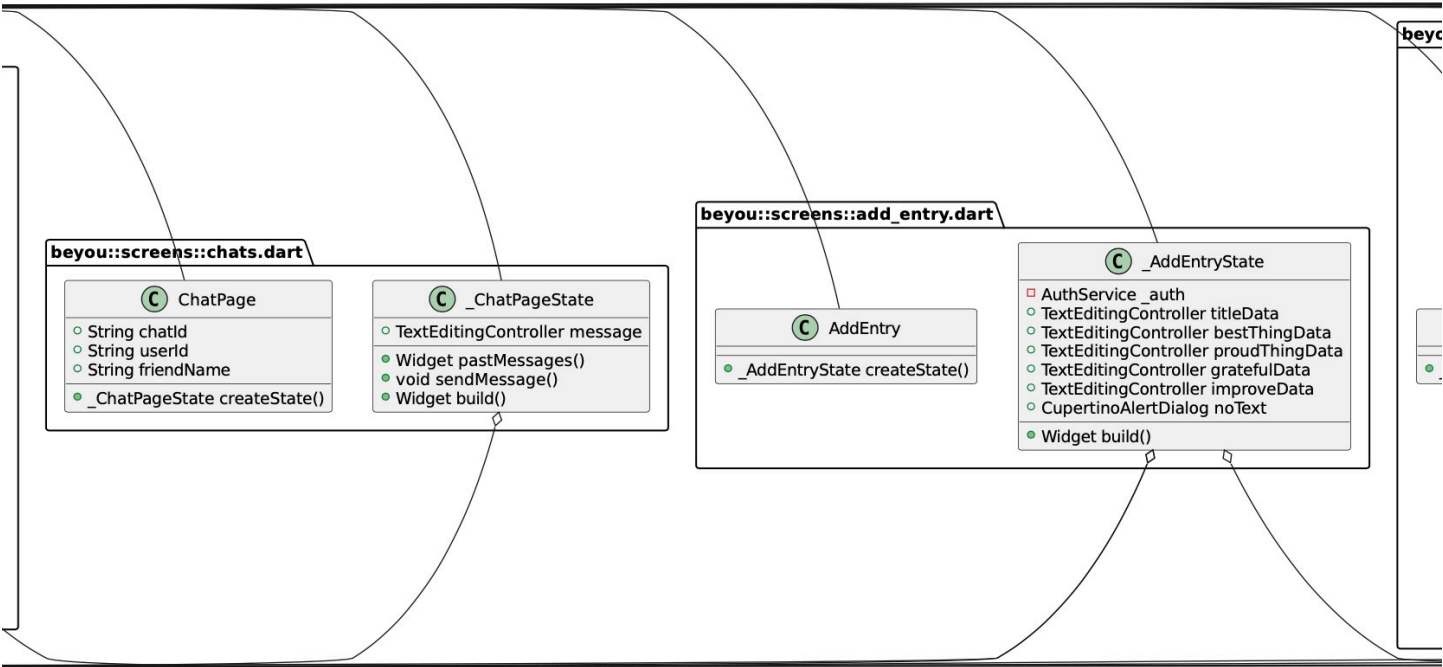
beyou::screens::edit_entry.dart



flutter::src::widgets::editable_text.dart

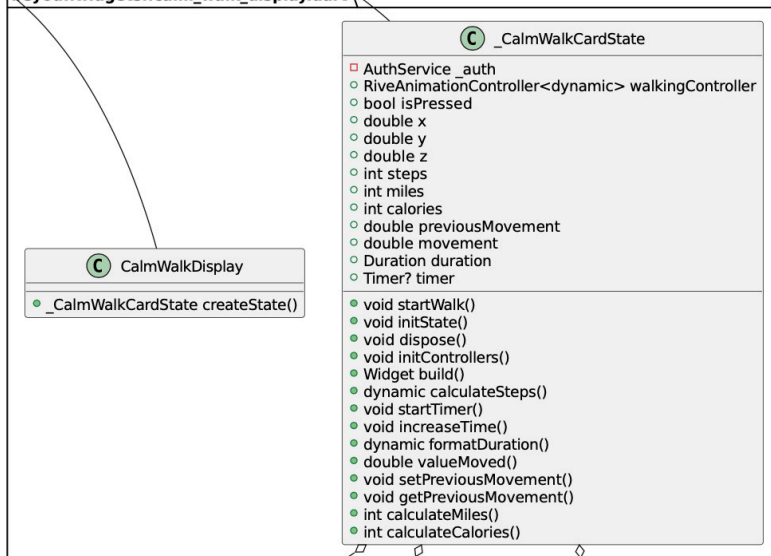




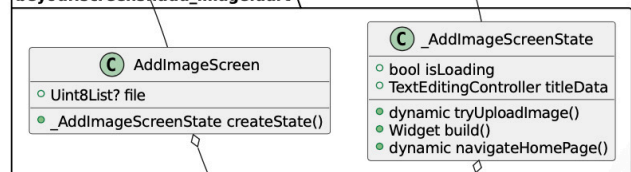


ar2.dart

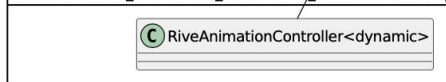
beyou::widgets::calm_walk_display.dart



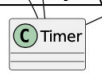
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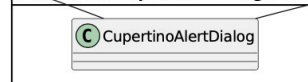
rive::src::rive_core::rive_animation_controller.dart

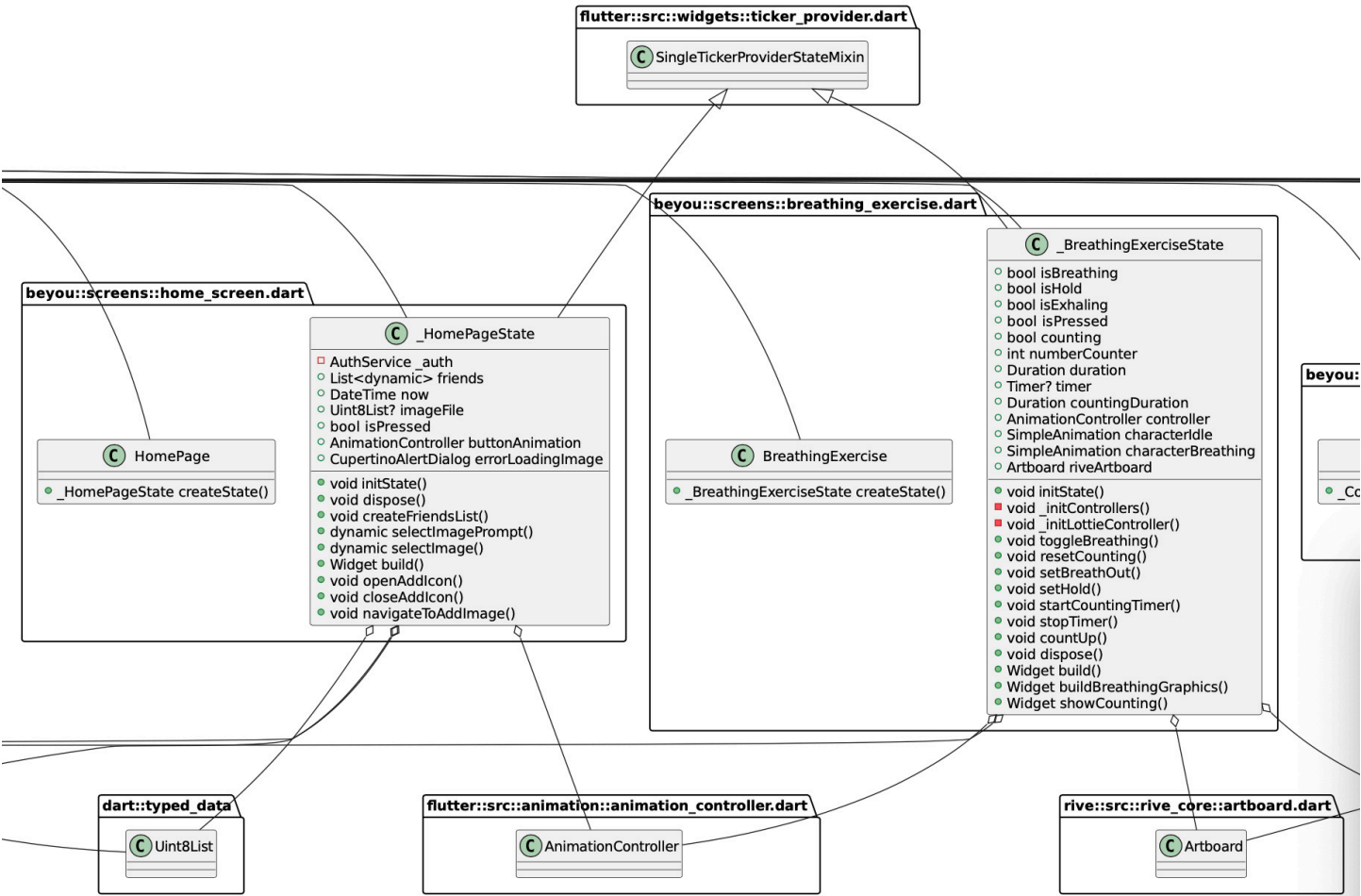


dart::async



flutter::src::cupertino::dialog.dart





beyou::models::AppUsers.dart

AppUsers

- String uid

beyou::screens::tools_page.dart

ToolsPage

_CompanionPageState createState()

_CompanionPageState

- Artboard riveArtboard
- SimpleAnimation jumpController
- bool isJumping

void initControllers()
void initState()
Widget build()

beyou::screens::calm_walk.dart

CalmWalk

_CalmWalkState createState()

_CalmWalkState

Widget build()

beyou::wid

int index

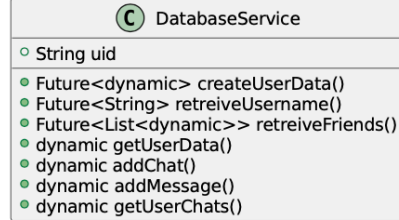
_NavBar

d.dart

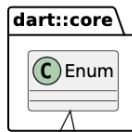
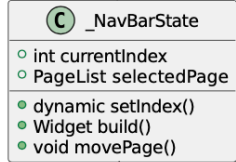
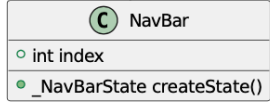
rive::src::controllers::simple_controller.dart

SimpleAnimation

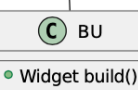
beyou::services::database.dart



beyou::widgets::nav_bar.dart



beyou::main.dart



beyou::widgets::message_bubble.dart

