

Mindfulness-Based Stress Reduction Virtual Program

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ii. Abstract

This paper presents the software development of a Mindfulness-Based Stress Reduction (MBSR) virtual program with a virtual coach. The core parts of the in person MBSR program are transferred into the software system. Improvements that could only be achieved through a software system include constant monitoring, constant feedback, and the ability to change techniques more quickly. The system has potential to be used for a variety of different purposes, including a companion to in person MBSR, a standalone MBSR course, or to manage a non MBSR meditation practice.

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iv. Introduction

Shortcomings of the mindfulness-based stress reduction (MBSR) program are meeting only once a week, having to rely on their own motivation to perform the techniques, and less monitoring from their coach. These problems adhere well to a digital solution. Existing virtual coach and meditation technologies are discussed. The methodologies and technologies for creating the software are described. The MBSR coach can be transferred into a virtual coach and carry out a virtual program. The various ways to turn MBSR into a digital solution are discussed in detail. The full set of requirements are outlined for the system in the use case diagram, use case descriptions and their attributes. The design of the system is presented, including parts of the graphical user interface (GUI). The PHP pages are set out in a class diagram with accompanying notation. The function of the main classes is described, including their interaction with other pages. The database schema is presented with description of its design and the justification of normalisation decisions. The finite state dialogue diagrams depict the flow of dialogue with the virtual meditation coach. Key sections of the virtual coach dialogue algorithm are described and demonstrated in PHP, MySQL, JavaScript, CSS and HTML. The testing strategy is discussed, and testing plan presented. A group of respondents took part in a survey to evaluate the requirements of the system. The responses are very positive and reflect the strengths of the project. One of the most promising directions for the system could be to create a companion web app for the in person MBSR course.

1. Problem Specification

1.1 Mindfulness-Based Stress Reduction

1.1.1 The Program

The eight-week Mindfulness-Based Stress Reduction (MBSR) program started at the University of Massachusetts Medical Centre by Dr. Jon Kabat-Zinn, over 40 years ago. Kabat-Zinn brought Buddhist meditation to the West, in the form of mindfulness meditation. There are several variants of the program including mindfulness-based cognitive therapy and Acceptance and commitment therapy. The MBSR program spread throughout the world with good success. The program was designed to treat people with stress related illnesses and give them a program to take home. The program has one different class each week and a full day retreat. Most of the practise is done at home and requires discipline. After completing an MBSR program, clients must continually practice what they learnt to keep the benefits. The program is intensive and requires a commitment both in time and effort. Online MBSR courses have a similar structure with classes conducted using video conferencing technology. A typical class is led by one or more qualified mindfulness teachers. They lead clients through the eight-week program, enabling them to develop their own meditation practice to incorporate into their daily lives.

1.1.2 Typical Week in the Eight Week MBSR Program

Time commitment	<ol style="list-style-type: none"> 1. One class between 2.5-3.5 hours. 2. 45-60 mins home practice a day.
Formal practice	<ul style="list-style-type: none"> • Sitting meditation • Moving meditation • Body scan meditation • Awareness of breath • Walking meditation • Mountain or lake meditation • Guided meditation
Informal practice	<ul style="list-style-type: none"> • Mindfulness of routine activities • Mindful listening and speaking
Typical class	Do a selection of formal practices, group discussion, discussion of progress since last week and home practice discussion.
Home practice	Perform formal and informal practice learnt in class. Clients are given guided meditation CD or Mp3s.

1.1.3 Mindfulness Formal Practice

An in person MBSR formal practice session typically consists of a qualified mindfulness practitioner guiding clients through one or two mindfulness meditation techniques. If it is a body scan, the client follows along to the practitioner's voice performing the techniques. The practitioner encourages clients not to conform doggedly to their voice or instruction, but to pay attention to their own internal

experience, moment by moment. The techniques themselves are just a guide to bring a client more closely into the present moment. Learning the techniques is not the goal. The goal is to find their own experience of the present moment.

To cultivate a regular practice of mindfulness takes effort and commitment. The mind often wants to go anywhere but the present moment and a certain amount of effort is required to ingrain it into daily living. Most of the MBSR course is home practice. The core technique of the program is the awareness of breath. It is much less a technique, but more pure meditation. The awareness of breath meditation is the closest to the ancient origin of mindfulness in Buddhist meditation. The awareness of breath is the true form of meditation that requires no technique, although using a technique is good for developing a regular practice.

1.2 Parts of MBSR Amenable to a Software System

- A meditation coach that can monitor a client and give feedback
- A client to coach dialogue system
- 8 weeks in length with dynamic change of techniques
- Connecting with a community
- Making a commitment to practice and seeing progress
- A client can monitor their own home practice
- Mindfulness meditation formal and informal practices

1.3 Shortcomings of in Person MBSR

There is only one in person class a week. For the rest of the week clients must rely on their own motivation to perform the home practice. The only guidance a client has is to follow the guided meditation CD, or Mp3s, throughout the week. The client may be sticking doggedly to a technique that is not working well for them without a chance to get feedback. Each week's home practice only has one set of techniques to perform. Clients cannot see each other's progress until they meet in class each week.

1.4 Target audience

The original goal of the MBSR program was to reduce stress in clients that might have a serious stress related illness, or mild stress. That is the primary audience, but anyone can attend an MBSR program. They might not be stressed but interested in improving wellbeing and health. Therefor the secondary target audience is anyone in the general population interested in mindfulness meditation. The third target audience is members of religious organisations where meditation is emphasised. Many religions have rituals that involve quiet time in a meditative state that is either called meditation directly or includes aspects of it. There is a large interest in meditation from religious traditions. Mindfulness meditation is strongly associated with new age spirituality, which is the fourth target audience. If the system had an overtly new age spiritual style it might put off a portion of more

traditional religious groups and vis versa. The primary audience is those with stress related illness and the range of other groups with interest in meditation is diverse, therefore the design of the software should be appealing to all groups mentioned and not exclude any.

1.5 Related Technologies

A relational agent is a screen based, virtual entity that communicates through facial expressions, gestures, text and synthetic speech. They are programmed with an expertise that is transferred to the client. When a client starts a dialogue, they are presented with a question and answers to choose from. The way they answer dictates the unfolding of the dialogue. Long term client data is stored and analysed to create a custom experience. At Northeastern University they created a meditation relational agent connected to a respiratory sensor to record client breathing data and tailor the experience based on breathing patterns (Shamekhi and Bickmore 2018). Breathing is an integral part of meditation and recording its rhythm is one way to digitally monitor a meditation experience. Another study produced a natural dialogue relational agent to coach a client through the process of mindfulness meditation. It included what mindfulness meditation involves and how to establish regular participation. The study found that clients had increased meditation engagement with a relational agent, as appose to self-directing a meditation program (Hudlicka, 2013).

Calm has over 1.25 million consumer ratings on Android and Apple with an average score of 4.6/5. It has a dialogue system at the start to assess why the client wants to meditate. A client can choose reduce anxiety, better sleep, reduce stress, increase happiness and more. If they choose reduce stress, the app is customised for reducing stress. There is a daily mood check in with ability to view mood check in history. There are guided meditations by expert practitioners.

Insight timer has over three hundred thousand ratings on Android and Apple with an average score of 4.9/5. Free client features include a countdown timer, guided meditations, progress history and community features. Paid membership includes courses that focus on improving sleep, stress, relationships, or anxiety. Courses are guided by a an expert and last between 7-40 days.

Smiling mind has over three thousand ratings with an average score of 4.1/5. The application includes programs for sleep, stress, attention, wellbeing, relationships and sports. There is meditation tracking stats and a way to track wellbeing by giving a rating on a scale. Questions focus on relationships, sleep, awareness, focus, responding and stress. A client can view their historic wellbeing and meditation performance.

2. Proposed Solution and Justification of the Development Model

2.1 Methodologies

Software development was iterative and incremental. There was regular supervisor meetings every two weeks, like a SCRUM methodology. Each two weeks was like a sprint and then a meeting to critically examine the progress and direction. During meetings new ideas were formulated and some

ideas were dropped due to being unfeasible or out of scope. When one component was built, or changed, other connected components were tested to make sure they behaved the same way. If new additions to the software negatively affected existing features a new solution was found to integrate all components. The system was continuously tested from a client and human coach perspective, with long running test accounts.

Queen's University Belfast (QUB) has wellbeing services that provide literature on meditation exercises and ongoing mindfulness meditation classes from a qualified teacher. The expertise of such a teacher can be transferred into a virtual coach. The virtual coach can be created with or without a variety of features: avatar, text to speech, text-based only or speech recognition. Adding an avatar personifies the coach and enables communication through facial expressions. Text to speech brings the avatars voice to life with audio. The chosen virtual coach has a 2D avatar that changes facial expression on each new question.

The virtual coach could be the primary hub of the web app, with all functions contained within the dialogue system. If the web app was only a dialogue system, it would be difficult to view features such as Google charts that take up the full screen. A full screen chart does not leave space for a virtual coach. The other choice is to have the virtual coach dialogue system to appear at key points during a client's interaction. When important decisions are made on the web app, like creating a wellbeing program, the dialogue interface is presented. Part of the web app has a recurring dialogue system that is always available. This is the central dialogue system hub, like a dialogue only system.

2.2 Technologies

The software could be an application created with Java or Python and installed onto a PC or embedded into a web page. It could have been created with a JavaScript framework such as Angular or Vue, which has faster module loading times. The virtual coach image, question and answers could be fast loading modules. The chosen development strategy is to use mostly PHP, MySQL, CSS, HTML and JavaScript. This technology is more traditional and well-established.

The web app must have a good-looking graphical user interface (GUI), a database to store information and a server-side scripting language to perform tasks between the front end and server. The technology stack is well established for many years with comprehensive documentation and large online resource for working through bugs and technical challenges.

There are several JavaScript libraries in the project, such as the countdown timer. Some JavaScript libraries have less ability for scripting and have not been tested for every possible real-world application. For example, the countdown timer needed to take a custom range of seconds, minutes and hours from a HTML input form and convert that to start a countdown. The simple.timer.js library was not well optimised for this purpose. The problem with libraries is they are designed for a specific purpose, but often the developer has not accounted for the multitude of operations an end user needs. The advantage of building everything from the ground up is more freedom, although at the

cost of time. Using a JavaScript library saves time, but in a continually developing project the library might not keep up with the functionality required.

Bootstrap is an effective CSS and JavaScript library to speed up front-end web app development with inbuilt responsivity. It looks good and integrates well with other technologies. There are paid for web app templates. Having a market version increases the motivation for developers to create a better functioning product, although Bootstrap has its limitations. Bootstrap classes are a quick way to implement styling, although they do not offer the same freedom if the CSS code is created manually. The project includes a mixture of Bootstrap classes and CSS created manually.

2.3 Similar Solutions

2.3.1 Virtual Coach

When creating a virtual coach they can communicate with synthetic speech, text only or both. Text only is good for people that like reading as opposed to listening. Often people read quicker than the output of speech. The relational agent communicates with facial expressions in Figure 2.1. Facial expressions add another level of communication, dependant on how the conversation unfolds. On each additional question the face changes to communicate the virtual coach's emotion.

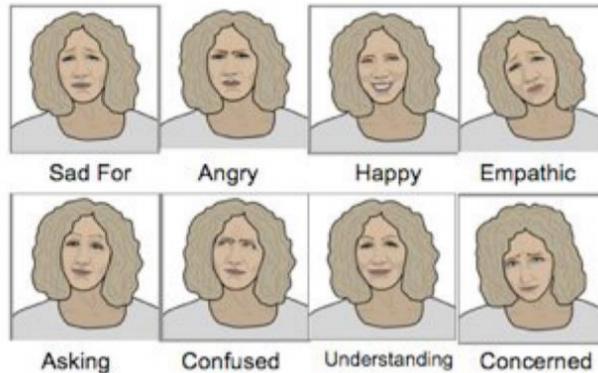


Figure 2.1: Virtual meditation coach expressions (adapted from Hudlicka, 2013).



Figure 2.2: Relational agent dialogue system (Bickmore et al. 2016).

In the Bickmore et al, 2016 study, the conversational agent displays some key information to the client. The agent has several animations to aid communication that include facial expressions and gestures. They have a synthetic voice. There is a finite number of multiple-choice answers to choose. Displaying key information is one way to transfer expertise from the agent to client, see Figure 2.2.

Content	Approval	Encouragement	Satisfaction	Centred	Happy
Thinking	Unamused	Questioning	Concerned	Awe	Shocked

The emoji is well recognised and able to communicate human emotion with different facial expressions and adds an element of fun, see Figure 2.3.

Figure 2.3: Emoji expressions (adapted from Openemoji.org, 2020).

The chosen solution has a virtual meditation coach with an emoji face that changes dynamically. The emoji represents the virtual coach's current emotions. They ask questions that are displayed to screen and converted to synthetic speech. The virtual coach can store long term information of how the client answers to configure the program and tailor the experience.

2.4 Meditation Software System

The software system could be a good way to organise daily home practice as part of an MBSR program or used as a stand-alone program. At the beginning, the client goes through a dialogue system with the virtual coach to commit to the eight-week program and set a meditation time target for each day. Once the program is started the client can monitor their progress for the program duration. They can see if they reached their daily target. Viewing progress is like progress feedback on an MBSR course. They receive experience points for completing a meditation. The important decisions of the program are made in a dialogue system with the virtual coach. The client is taken through a series of questions, with answers to choose from to carry out tasks such as: creating the meditation program, creating wellbeing programs, receiving advice, requesting help and receiving interventions from the human coach. The virtual coach dialogue is like the interaction between client and a real-life coach.

2.5 Wellbeing Questions

One way to measure a client's progress is to ask them wellbeing questions and measure their response on a scale. The Mood Ring app achieved this using a series of emojis to choose from, see Figure 2.4. All responses are stored to monitor the history and measure progress. After practicing meditation, a client can see if it had an effect on their wellbeing ratings.

How are you feeling?



Figure 2.4: Emoji wellbeing rating on Mood Ring app (Appgrooves.com, 2020).

2.5.1 Wellbeing Question Types

1. Social connectedness is a measure of how close a client is to other people. Most of the successful meditation apps out there have programs for improving relationships and social connectedness.
2. Sleep quality is how comfortable a client is about their sleep patterns. Several studies found a positive correlation between practicing mindfulness and sleep quality (Winbush, Gross and Kreitzer, 2007; Kim, Park and Seo, 2016).
3. Contentment is a state of happiness and satisfaction. Many of the existing meditation apps use scales of happiness to monitor progress and have custom programs and guided meditations to focus on cultivating happiness and satisfaction.
4. Resilience is how well a client deals with pain and suffering. The MBSR curriculum claims a client will have 'New ways to cope more effectively with your own condition, difficulty, pain or suffering' (Santorelli et al., 2020).
5. Self-care is how well a client performs actions that lead to personal growth and improvement. One of the claimed benefits of the MBSR program is 'Learning to take better care of oneself' (Santorelli et al., 2020).
6. Non reactivity is the quality of having the inner peace to not impulsively react but respond appropriately. A quote from the benefits of MBSR says 'Some people report a quieter mind, a sense of balance and enhanced wellbeing' (Santorelli et al., 2020).

When a client practices mindfulness meditation it is expected the wellbeing ratings will improve. The virtual coach can see if they improve and recommend a wellbeing program to improve the weakest area.

2.6 Wellbeing Programs

For each wellbeing question there is a corresponding wellbeing program. If a client scores low on one wellbeing rating, for example social connectedness, the virtual coach will recommend the social connectedness program. The standard length of a program is one week. The length can be changed. A client does not have to do the recommended program, they can choose a different one. This gives the client more freedom to explore different practices and see what works. Once the program is started more expert advice will be given. Each day, they can fill out a tick box to show it is done. This enables daily client monitoring to see their engagement level. The human coach can monitor all performance and intervene if it is consistently negative. The client can view their wellbeing program performance and see if it affected their wellbeing ratings.

2.6.1 Wellbeing Program Types

1. The social connectedness program is to engage in active listening and speaking. In week one of the MBSR program the client is introduced to mindful listening and speaking and throughout the course this is the informal practice. Listening attentively to a speaker can

improve the social connection. Being mindful when speaking creates space for precise communication.

2. The sleep quality program is to engage in a moving meditation, or yoga, each evening. Jon Kabat Zinn notes in his first book 'If you can't let go, you can't go to sleep' (Kabat-Zinn, 1990, p. 40). Moving meditation each evening gives the mind a chance to slow down in preparation to let go. Doing the program at the same time each evening helps develop discipline and structure.
3. The contentment program is to engage in mindfulness of routine activities throughout the day. When doing repetitive tasks such as washing the dishes there is a tendency to do them unconsciously. A state of present moment awareness and breathing can turn a daily chore into a new experience.
4. The resilience program is to do a walking meditation. The walking meditation can help to deal with difficulty and suffering because it integrates mindfulness meditation into everyday activities 'The challenge is to make calmness, inner balance, and clear seeing a part of everyday life.' (Kabat-Zinn, 1990, p. 134).
5. The self-care program is to do one mountain meditation a day. Clients visualise themselves as the mountain: dignified, strong and unshakable. The client is unchanged by the elements and fast pace life around them. They embody the dignified posture, peace and tranquillity of the mountain.
6. The non-reactivity program is to complete a body scan meditation. There are consequences to not living in the present moment 'A lifetime of unconscious reactivity is likely to increase our risk of eventual breakdown and illness significantly.' (Kabat-Zinn, 1990, p. 248).

2.7 Progress Monitoring

Clients can view meditation and wellbeing progress in Google charts throughout the eight-week program. There are 3 experience points awarded for every minute meditating. Each day a wellbeing program is complete they receive 15 experience points. They can view their current experience point total, their level and how much experience they need to reach the next level. When a client is meditating their public location, time meditating, and level are published in the community. Showing experience level to others in the community creates a joint experience.

2.8 Community

Features include a world map library with geolocation for live meditations. The library uses the public IP address to store geolocation coordinates and display the meditators location on the world map. The total number of clients enrolled in the program is shown and the number of live meditators. When a client is meditating, other clients can see their world map location, city, country, meditation length, profile picture and experience level. As soon as the meditation is finished, it is removed from the page. The geolocation map is a successful way to connect clients together and view each other's progress.

2.9 Human Coach Monitoring

The human coach can log into the admin section, register clients, monitor their meditation and wellbeing performance, enable interventions and chat to clients. They are like the head MBSR practitioner that oversees the program. They can monitor daily time target engagement, wellbeing program engagement, all time wellbeing ratings, wellbeing ratings and meditation time in Google charts. They can review progress and if necessary, recommend the client starts one of the following three interventions:

1. Change the length of wellbeing programs
2. Changing the daily meditation time target
3. Restart the entire program

3. Requirements Analysis and Specification

3.1 Use Case Diagram



3.2 Use Case Descriptions

Use Case	<i>Create Meditation Program</i>
Actors	Initiated by client
Flow of Events	<ol style="list-style-type: none"> 1. Client selects meditate tab on the navbar for the first time. 2. Dialogue with virtual coach starts. 3. Client is asked if they want to start a meditation program. 4. Client chooses a daily meditation time target. 5. Client chooses to begin.
Alternative Flow	<ol style="list-style-type: none"> 3a. Client ends dialogue. 5a. Client can go back, review meditation target and change it.
Pre-condition	Client must be registered and logged in.
Post-condition	<ol style="list-style-type: none"> 1. Client has an eight-week meditation program. 2. Client can meditate with timer.

Meditation Program Attributes	
Start date	Date format
End date	Date format
Program duration	Numeric
Daily time target	Numeric
Date	Date format
Week	Numeric
Day	Numeric
Daily sessions	Numeric
Daily minutes	Numeric
Target completed	Yes or no
Meditation experience points	Numeric

Use Case	<i>Meditation</i>
Actors	Initiated by client
Flow of Events	<ol style="list-style-type: none"> 1. Client selects the meditate tab. 2. Client selects a time to countdown from, in hours, minutes and seconds. 3. Client rates wellbeing before starting the meditation. Wellbeing rating is available once a day. 4. Countdown timer starts. 5. Extension point: <i>View Live Meditations</i>. 6. The client meditates until the countdown timer reaches 0. 7. Save meditation session.

Alternative Flow	1a. Client chooses a guided meditation with set countdown limit. 7a. Do not save meditation.
Pre-condition	Client is logged in and the <i>Create Meditation Program</i> use case was completed at any time in the past.
Post-condition	1. Client can view eight-week program. 2. Client can view wellbeing and meditation time charts. 3. Client can start a wellbeing program. 4. Client gains experience points for the meditation, three per minute.

Meditation Attributes	
Meditation duration (hours, minutes, seconds)	Numeric
Meditation length	Numeric
Save/do not save	Yes or no
Meditation type	Alphabetic
Rating question	Alphabetic
Rating score	Numeric

Use Case	<i>View Live Meditations</i>
Actors	Initiated by client, visible to other clients
Flow of Events	1. A client activates the <i>Meditation</i> use case. 2. While the meditation is live, the details are published on the community tab for other clients to see: client name, meditation length, city, country, experience level and location on the world map.
Alternative Flow	2a. No client goes to the community tab to view the meditation.
Pre-condition	Both clients are logged in and have meditation programs.
Post-condition	Clients are aware of other client's progress.

Live Meditation Attributes	
Meditators name	Alphabetic
City	Alphabetic
Country	Alphabetic
Meditation length	Numeric
Experience level	Numeric
Longitude	Numeric
Latitude	Numeric

Use Case	<i>Create Wellbeing Program</i>
Actors	Initiated by client
Flow of Events	<ol style="list-style-type: none"> 1. Client selects coach tab in the navbar for the first time. 2. Dialogue with virtual coach starts. The client is asked to make a commitment to a wellbeing program. 3. Client is shown all time wellbeing rating averages by the virtual coach. 4. Virtual coach recommends starting the wellbeing program associated with their lowest average score. 5. Client chooses the recommended program. 6. Client starts the program.
Alternative Flow	<ol style="list-style-type: none"> 2a. Client decides to end the dialogue. 5a. Client chooses a different wellbeing program.
Pre-condition	Client is logged in, has a meditation program and completed at least one meditation.
Post-condition	<ol style="list-style-type: none"> 1. Client can view their wellbeing program. 2. Client can complete the wellbeing program. 3. Client can engage in a recurring dialogue with the virtual coach on the coach tab.

Wellbeing Program Attributes	
Start date	Date format
End date	Date format
Program duration	Numeric
Program name	Alphabetic
Program image	Image
Program description	Alphabetic
Date	Date format
Day	Numeric
Program completed	Yes or no
Program experience	Numeric

Use Case	<i>Complete Wellbeing Program</i>
Actors	Initiated by client
Flow of Events	<ol style="list-style-type: none"> 1. Client can fill out they have completed the wellbeing program. It is only available to fill out on the current date.
Alternative Flow	<ol style="list-style-type: none"> 1a. Client misses a day and does not fill it out.
Pre-condition	Client must have activated the <i>Create Wellbeing Program</i> use case at some point in the past.
Post-condition	1. Client receives experience points for wellbeing program completion.

	2. Client can view their wellbeing program alongside their wellbeing ratings to see if the wellbeing program had an effect.
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Use Case	<i>View Messages</i>
Actors	Initiated by client, message sent to human coach
Flow of Events	<ol style="list-style-type: none"> 1. Client starts dialogue with virtual coach on coach page. 2. Virtual coach asks client if they want extra support. 3. Client chooses the option for extra support. 4. Client can choose from the topics: change wellbeing program length, change meditation target length, restart course, or write a custom message. 5. Client sends the message. 6. Human coach gets a new message notification on the admin choose client page. 7. Both actors can continue the conversation.
Alternative Flow	4a. Client chooses not to send message and goes back to previous page.
Pre-condition	Client is logged in, with a meditation program and wellbeing program.
Post-condition	The human coach can use a help request to enable the <i>Start Intervention</i> use case.

Message Attributes	
Message content	Alphanumeric
Author	Alphabetic
Date	Date format
Time	Time format

Use Case	<i>Register Client</i>
Actors	Human Coach initiated, creates client account
Flow of Events	<ol style="list-style-type: none"> 1. Human coach enters client details on registration page. 2. Human coach submits details.
Pre-condition	Human coach has the client's details.
Post-condition	<ol style="list-style-type: none"> 1. Client is registered in the system and able to begin the course. 2. Human coach can view client's account and progress.

Client Attributes	
Email	Alphanumeric
Password	Alphanumeric
Username	Alphanumeric
First name	Alphabetic

Second name	Alphabetic
Phone number	Alphanumeric
Address	Alphanumeric

Use Case	<i>Start Intervention</i>
Actors	Client initiated
Flow of Events	<ol style="list-style-type: none"> 1. Client starts dialogue with virtual coach on the coach tab. 2. Client sees only the interventions enabled by the human coach. 3. Client starts the intervention.
Alternative Flow	3a. Client decides not to start the intervention.
Pre-condition	The human coach has enabled one of the following interventions: change wellbeing program length, change daily mediation time target or restart program.
Post-condition	<ol style="list-style-type: none"> 1. Intervention has modified the client's program. 2. Human coach is notified when the client starts the intervention.

Intervention Attributes	
Intervention type	Alphabetic
Intervention enabled	Yes or no
Date intervention started	Date format

Use Case	<i>View Progress</i>
Actors	Initiated by client
Flow of Events	<ol style="list-style-type: none"> 1. Client can view wellbeing rating charts, meditation time charts, experience points and level.
Pre-condition	Client is logged in, has a meditation program and wellbeing program.
Post-condition	<ol style="list-style-type: none"> 1. Client can see if their wellbeing program engagement influenced their wellbeing ratings. 2. Client can see if the change target time intervention influenced their meditation time quantity. 3. Client can see if the change wellbeing program length intervention influenced their wellbeing ratings.

Progress Attributes	
Wellbeing program completion	Yes or no
Wellbeing questions	Alphabetic
Wellbeing rating	Numeric
Daily meditation time	Numeric

Meditation target	Numeric
Meditation target reached	Yes or No
Experience level	Numeric
Experience points	Numeric

Use Case	<i>View Client Progress</i>
Actors	Initiated by human coach
Flow of Events	1. Human coach can view wellbeing rating charts, meditation time charts, wellbeing program engagement, meditation target engagement, experience points and level.
Pre-condition	The human coach is logged in as an admin, the client has an active meditation and wellbeing program.
Post-condition	1. Human coach can use the progress information to decide if the client needs an intervention. 2. Human coach can see what effect the wellbeing programs and interventions had.

4. Design

4.1 Graphical User Interface

4.1.1 Index.php

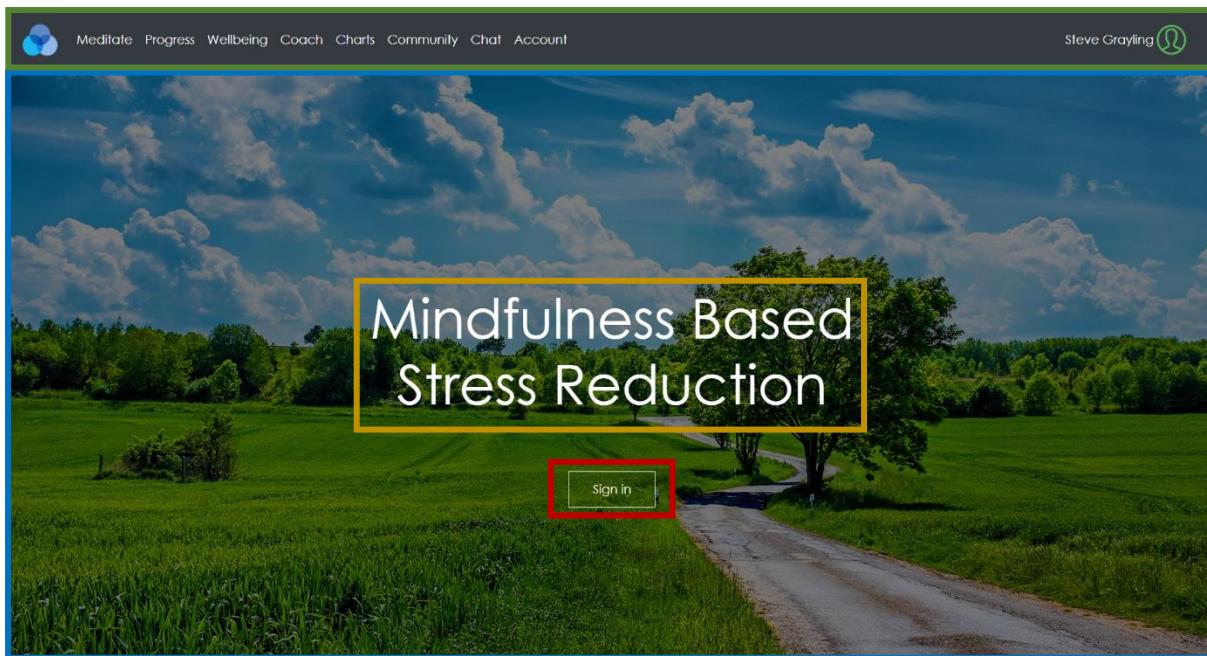


Figure 4.1: Index.php desktop GUI design (image by author).



The navbar logo has three overlapping circles that represent the different dimensions of life that come together and create balance, see Figure 4.1. The central point is meditation that acts like an anchor to keep them all together. Although these themes are not explicitly detailed in the logo, the motivation is to create the image in the client's mind. The focal point of the index page is the title in the centre. It describes the theme of the web app.

The main colours of every page are taken from the background image, see Figure 4.1. They are blues, greens, white and grey. The colours are neutral, balanced and calming, in line with the meditation theme. The background image is relaxing. The road represents the journey the client is on. When the screen goes below 770 pixels a smaller background image is loaded to increase load time on mobile.

Figure 4.2: Index.php mobile GUI design (image by author).

4.1.2 Dialoguemeditation.php

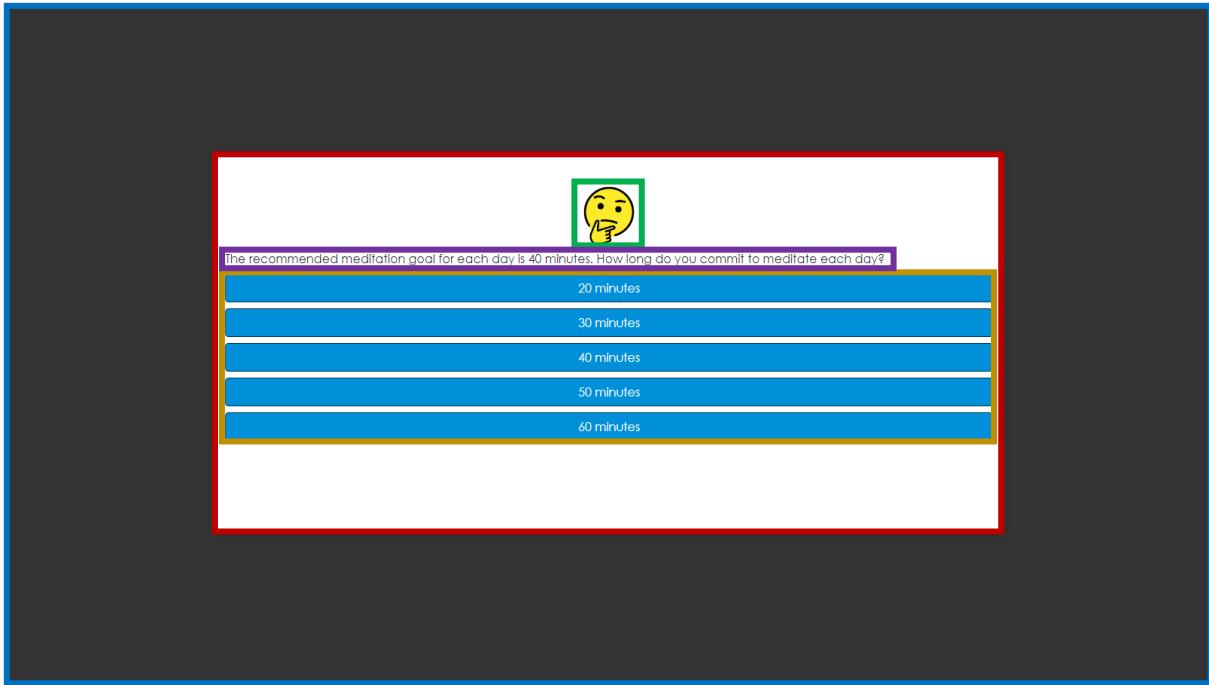
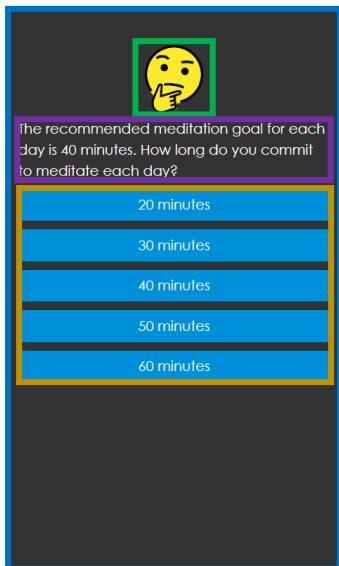


Figure 4.3: Dialoguemeditation.php desktop GUI design (image by author).



*Figure 4.4:
Dialoguemeditation.php mobile
GUI design (image by author).*

The dark grey background makes the virtual coach dialogue the focal point, see Figure 4.3. The central box contains all the virtual coach parts. On a large desktop screen attention is bought to the central white box. In the mobile version the virtual dialogue is big enough to take up all the screen, see Figure 4.4.

On each question the emoji changes to communicate different emotions. The emoji has humanoid features, but the animated style is light-hearted. A less serious design is good for those suffering from stress related illnesses. The client should not take themselves too seriously when meditating.

The question the virtual coach asks is presented in the purple box, see Figure 4.3. In this area the virtual coach presents their mindfulness expertise. All answers have the same button style with white writing that is in keeping with the overall web app design.

See Appendix B for dialogue desktop and mobile GUI design variations.

4.1.3 Rating.php

Wellbeing Rating

1. I have been feeling close to other people

2. I've been satisfied by my sleep

3. I am at peace with myself

4. I cope well with difficulties, pain or suffering

5. I take good care of myself

6. I have noticed my reactions without having to react to them

Continue

Figure 4.5: Rating.php desktop GUI design (image by author).

Wellbeing Rating

1. I have been feeling close to other people

2. I've been satisfied by my sleep

3. I am at peace with myself

4. I cope well with difficulties, pain or suffering

5. I take good care of myself

6. I have noticed my reactions without having to react to them

Continue

The wellbeing rating scale to choose from ranges from angry to beaming with joy, with 7 graduations in between. 5 is exactly in the middle and neutral, see Figure 4.5. The emojis used are the same as the virtual coach. They were reduced in size, changed colours and added a scale. Using 9 different emojis gives the client a wide range of emotions to choose from. Using the same emojis as the virtual coach creates consistency in design and adds to the relational agent experience.

The wellbeing questions all have the same format and rating scale to choose from. The questions are designed to be thought provoking with some depth and meaning. The design is minimal and requires little effort to answer and is only done once a day. On subsequent meditations on the same day the rating page will be skipped.

Figure 4.6: Rating.php mobile GUI design (image by author).

4.1.4 Timechart.php

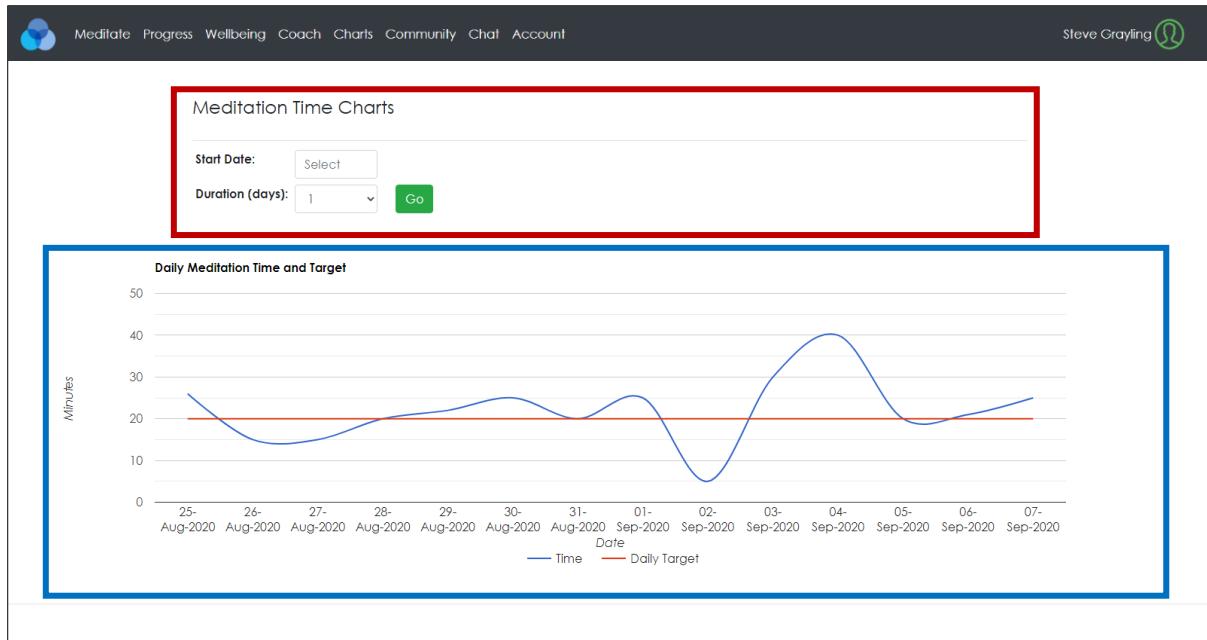


Figure 4.7: Timechart.php desktop GUI design (image by author).

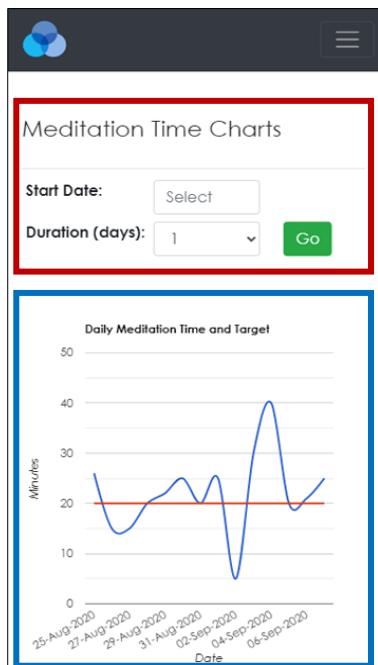


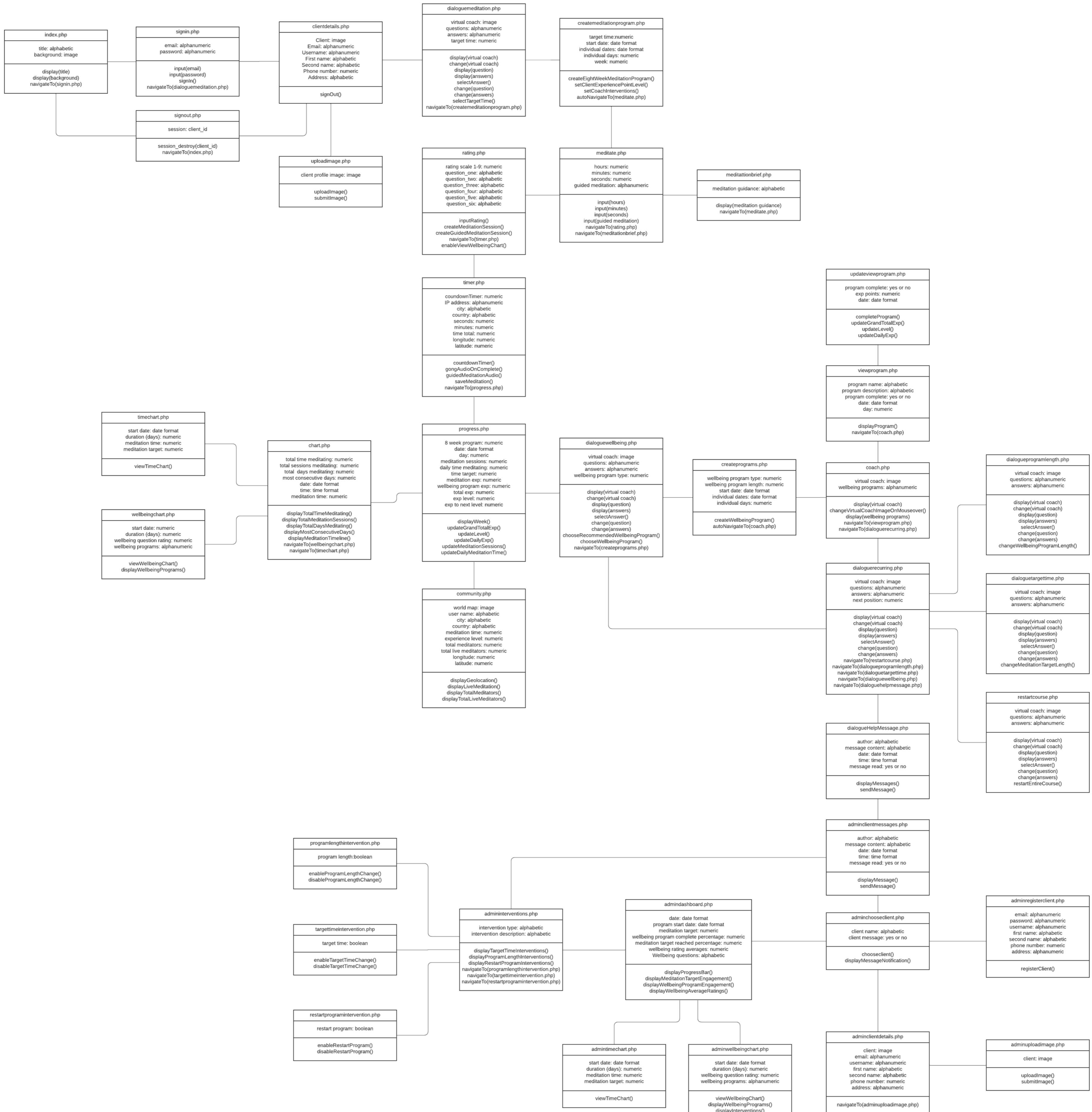
Figure 4.8: Timechart.php mobile GUI design (image by author).

The control panel sits above the chart and controls the chart output, see Figure 4.7. Only dates in the clients eight-week meditation program are loaded onto the date picker. They must select a start date and a duration of days. In Figure 4.7, the start date is 25th August and the duration 14 days.

The chart works well across most resolutions, except below 350px there is not enough space for all data. The chart can handle up to 30 entries, although some graduations are lost on the x-axis. Code was added to stop the chart instantly reloading every time it is resizing to reduce overall load time. If a client starts a time target intervention the red time bar will go down or up from the date they started the intervention. On wellbeingchart.php the wellbeing programs and interventions are visible to the client.

See Appendix C, D and E for GUI design of meditate.php, timer.php and progress.php.

4.2 Class Diagram



4.3 Class Diagram Notation

4.3.1 Meditation

Class	Dialoguemeditation.php
Function	<p>The client is taken through a dialogue system to create the eight-week meditation program. Each question has a series of answers to choose from. The questions are converted from text to synthetic voice by the virtual coach, using Google speech synthesis API. The virtual coach facial expression changes on each question. The client is asked to commit to a daily meditation time target between 20-60 minutes.</p> <p>If the client chooses 40 mins the value 40 is stored in a session variable. When the dialogue is complete the page navigates to createmeditationprogram.php to create the meditation program with daily time target. They can go back review their target and change it before committing. They can decide not to commit to the meditation program and end the dialogue. If they commit to starting the program, they can progress onto meditate.php and access the rest of the site.</p>

Class	Createmeditationprogram.php
Function	<p>The eight-week meditation program is created with the daily time target created on dialoguemeditation.php. The complete_exp_details and meditation_complete tables are each filled with 56 rows of data for the eight-week program with the following pseudo code:</p> <pre> While(\$day<56){ if(\$day%7 == 0){ \$week++ } \$date == \$todays_date + \$day; Insert row into complete_exp_details with \$date Select \$complete_exp_details_id for newly inserted row Insert row into meditation_complete table with \$complete_exp_details_id, \$target, \$day and \$week \$day++ }</pre>

Class	Meditate.php
Function	The client can navigate to meditationbrief.php to see meditation guidance. They can choose a meditation time length. Seconds, minutes and hours are posted from here to

	rating.php. They can select from a choice of mindfulness guided meditations. If guided meditation is chosen it is posted from here to rating.php.
--	---

Class	Rating.php
Function	<p>The hours and minutes from meditate.php are converted to minutes and stored in a session variable called time. Seconds are stored in a session variable called seconds. The time value is checked to see if it equals zero. If the client has chosen a meditation length of zero, they navigate back to meditate.php.</p> <p>The client does six wellbeing ratings. They must answer each question on a scale from 1-9. The wellbeing ratings are stored for future use and review. When the ratings are complete the results are posted to the same page, inserted into the database and the page navigates to timer.php. The database is checked to see if there is already a wellbeing rating completed for today. If there is, they are directed straight to timer.php. If a guided meditation was selected on meditate.php, its string name is stored in a session variable.</p>

Class	Timer.php
Function	<p>A geolocation API retrieves the longitude, latitude, city and country from the public IP address, and they are stored in the database for live meditation view on community.php.</p> <p>The meditation time and second sessions are converted into a JavaScript variable and input into the simple.timer.js library. If a guided meditation was selected the guided session is used to get the path of the audio file. Pure meditation allows the client to practice a form of meditation of their choosing. When the meditation ends the client has the option to save the meditation or not. If saved the page navigates to progress.php and they see the experience points awarded.</p>

Class	Progress.php
Function	<p>Meditation experience points are awarded here. If the client has reached enough experience to cross into the next experience level, it is updated in the database and displayed to the client. A progress bar for the current level is shown with experience required to reach the next level. All experience points for meditations and wellbeing programs can be viewed over the eight-week program. For each week of the program the date, sessions, time total and time target are shown. The current week of the program will display automatically based on today's date, or they can choose a week to view.</p>

4.3.2 Wellbeing Programs

Class	Dialoguewellbeing.php
Function	<p>The all-time average wellbeing ratings are retrieved from the database and presented to the client with a recommendation to start the wellbeing program linked to their lowest average wellbeing rating. Every time the client does a wellbeing rating the averages will change. If the lowest average rating changes the recommended program changes.</p> <p>If the lowest wellbeing rating average improves and becomes higher than the second lowest rating, the next time the client comes to start a wellbeing program the virtual coach will recommend they start the wellbeing program linked to the new lowest average. Monitoring this process enables the human coach to see if the virtual coach advice is having a positive effect. If the client does not want to start the recommended program, they can choose a program themselves. This gives the client added freedom. Before committing to start the recommended or chosen wellbeing program the client is given a description of what it involves. Once confirmed the page is redirected to createprograms.php to create the program.</p>

Class	Createprograms.php
Function	<p>The wellbeing program is created for the standard length of 7 days, unless changed in an intervention. The details include date, day and all entries set to incomplete. This is the algorithm is pseudo code:</p> <pre>While(\$day < \$program_length){ \$date == \$todays_date + \$day; Get row id from complete_exp_details table that matches \$date. Insert row into program_complete table with \$complete_exp_details_id and \$day. day++; }</pre>

Class	Coach.php
Function	<p>Client can see their wellbeing programs and navigate to viewprogram.php to view them. They can see program image, program name, start date and end date. If end date is less than today, wellbeing program is displayed as complete. If end date is greater than today, wellbeing program is displayed as active. The virtual coach icon is available at the top of the screen to select and navigate to dialoguercurring.php for virtual coach ongoing dialogue.</p>

Class	Viewprogram.php
Function	Client can view wellbeing program description, day, date and if the program is complete. If wellbeing program date is equal to today's date, the client can complete the wellbeing program for today. When the checkbox is checked the updateComplete() function is activated and the page navigates to updateviewprogram.php to complete the program.

Class	Updateviewprogram.php
Function	The database is updated to show wellbeing program is complete for the selected day. 15 experience points are awarded for that day. The experience grand total is updated. It is 100 experience to get to the next level from level's 1 to 99. If grand total is 100 experience points or more than the current level, the client level will be updated.

4.3.3 Interventions

Class	Admininterventions.php
Function	The human coach can enable an intervention for the client. They choose from: change wellbeing program length, change meditation target time and restart program. Interventions the client has started in the past are displayed here, with the date they started. If intervention button is selected, update the database to either a 1 or a 0. A 1 is intervention enabled, a 0 is disabled. After an intervention is enabled it will become available for the client to select on dialoguercurring.php.

Class	Dialoguercurring.php
Function	This dialogue is available on the coach tab on the navbar, or by selecting the coach icon on the coach.php page. From here the client can choose to send a message to the human coach for extra help. If they do, they navigate to dialoguehelpmessage.php to chat with the human coach. If there most recent wellbeing program has an end date less than today's date, they are presented with an option to start a wellbeing program. If they choose to start one, they navigate to dialoguewellbeing.php. If the human coach has enabled an intervention on admininterventions.php the option to start the intervention is presented here.

Class	Dialoguetargettime.php
Function	This class is accessible when the target time intervention was enabled by the virtual coach. The client is taken through a series of questions. At the point of choosing a new target time there is an option box, with 12 different target times. Once chosen and confirmed the target time for the rest of the eight-week program is changed. The new

	target time will appear for tracking on timechart.php and admintimechart.php. The human coach is notified the client started the intervention. The client cannot start the intervention until the human coach enables it again.
--	---

Class	Dialogueprogramlength.php
Function	This class is accessible when the program length intervention was enabled by the virtual coach. They can choose a wellbeing program length between 2 and 7 days. They can go back and review the length before committing. Once confirmed all future wellbeing programs will last the chosen number of days. The effect of changing wellbeing program length can be viewed on wellbeingchart.php and adminwellbeingchart.php.

Class	Dialoguerrestartprogram.php
Function	The human coach sees consistently negative feedback and enables a complete program restart on admininterventions.php. The option to restart becomes available for the client on dialogurerecurring.php. The client is notified by the virtual coach that restarting the program will delete all previous progress. The client must decide if they want to go through with it and make a fresh start. All client data is permanently deleted from the following database tables on confirmation: meditation_complete, meditation_program, program, program_complete, client_level, wellbeing_rating, coordinates, complete_exp_details, coach_intervene, intervention_length and intervention_target.

4.3.4 Client

Class	Adminregisterclient.php
Function	The human coach can register a client into the system with the following details: email, password, username, first name, second name, phone number and address. After registration the client can begin the program and the human coach can view all their progress. The human coach can upload an image for a client on the adminclientdetails.php page.

Class	Clientdetails.php
Function	The following client details are displayed on the page: profile picture, email, username, first name, second name, phone number and address. From this page a profile picture can be uploaded, and the client can sign out.

4.3.5 Client Charts

Class	Chart.php
Function	<p>The head of the page has: total time meditating, total meditation sessions, total days meditating and most consecutive days. Every minute meditating for the eight-week program is added together, converted to hours and minutes, and displayed on screen.</p> <p>All sessions over the eight weeks are added together and displayed. Highest number of consecutive days meditating is displayed. There is a meditation timeline using the JavaScript library timeline.min.js that uses date, time and length to display a timeline of every meditation.</p>

Class	Timechart.php
Function	<p>Clients can view daily meditation data for the eight-week program. They can select a start date and duration in days to view a custom range, anywhere from 1 to 30 days. The meditation target is on the chart so they can track how often they reached it.</p> <p>Meditation target interventions are visible by tracking when the target changed value. If no meditations have ever been completed by the client, Google chart will not display, and a message says 'Client has not completed any meditations'.</p>

Class	Wellbeingchart.php
Function	<p>The wellbeing chart displays a chosen range of wellbeing ratings. Wellbeing programs are visible. Wellbeing program length interventions are visible. Clients can see how wellbeing programs effected their wellbeing ratings. The flatpickr.js library is used for picking dates. All dates are retrieved from the database that have a wellbeing rating, only those dates are loaded onto the date picker for selection.</p>

4.3.6 Community

Class	Community.php
Function	<p>Total clients registered and the portion of those meditating right now is displayed. The longitude and latitude of live meditations taken from timer.php are retrieved and used to display live meditation location on the world map. For each live meditation the client's profile photo, username, city, country, meditation length and experience level are displayed. When the meditation is complete the details are removed.</p>

4.3.7 Human Coach Monitoring

Class	Adminchooseclient.php
Function	The human coach can choose from the full list of clients to view. There are unread message notifications next to each client to alert the human coach. All pages except registerclient.php are inaccessible until the human coach has chosen a client. Once chosen, a session with the client id is created to allow entry into the other admin sections.

Class	Admindashboard.php
Function	This page is the central hub for monitoring overall client progress. Meditation target complete total is divided by the total number of days since the program started. The percentage is displayed in a progress bar. The percentage is used to give the progress bar a colour. Less than or equal to 24 the progress bar is red, 25-49 is orange, 50-74 is blue, and 75-100 is green. The same algorithm is used for wellbeing program days complete divided by total number of days since the program started. The all-time wellbeing rating averages are displayed using the same type of progress bar. If the human coach notices any of the progress bars are in the red, they can enable an intervention on the admininterventions.php page to try and help the client. They can view meditation time and wellbeing progress in more detail on admintimechart.php and adminwellbeingchart.php.

Class	Admintimechart.php
Function	The human coach can view total time meditating for every day of the eight-week program, for each client. They can see if time targets are reached and if the client started a time target intervention and what effect it had. Reviewing the meditation time stats in more detail can enable the human coach to make an informed decision to enable a meditation time target intervention on the admininterventions.php page.

Class	Adminwellbeingchart.php
Function	The human coach can view all wellbeing ratings on a client's program. They can see the wellbeing programs a client started and number of days complete. Any interventions the client started are displayed and what date it was started.

4.3.8 Messaging

Class	Dialoguehelpmessage.php
Function	A client can send a message to the coach for help. The client writes a message, it is posted to the same page and inserted into the database, along with the current time, date and author. This creates a message notification on adminchooseclient.php next to the current client's name.

Class	Adminclientmessages.php
Function	The human coach receives message notifications on adminchooseclient.php. They can read the request for help and enable an intervention if they choose. When the human coach writes a message and submits, it is posted to this page and inserted into the database with time, date and author for client to see.

4.4 Database

4.4.1 Database Schema

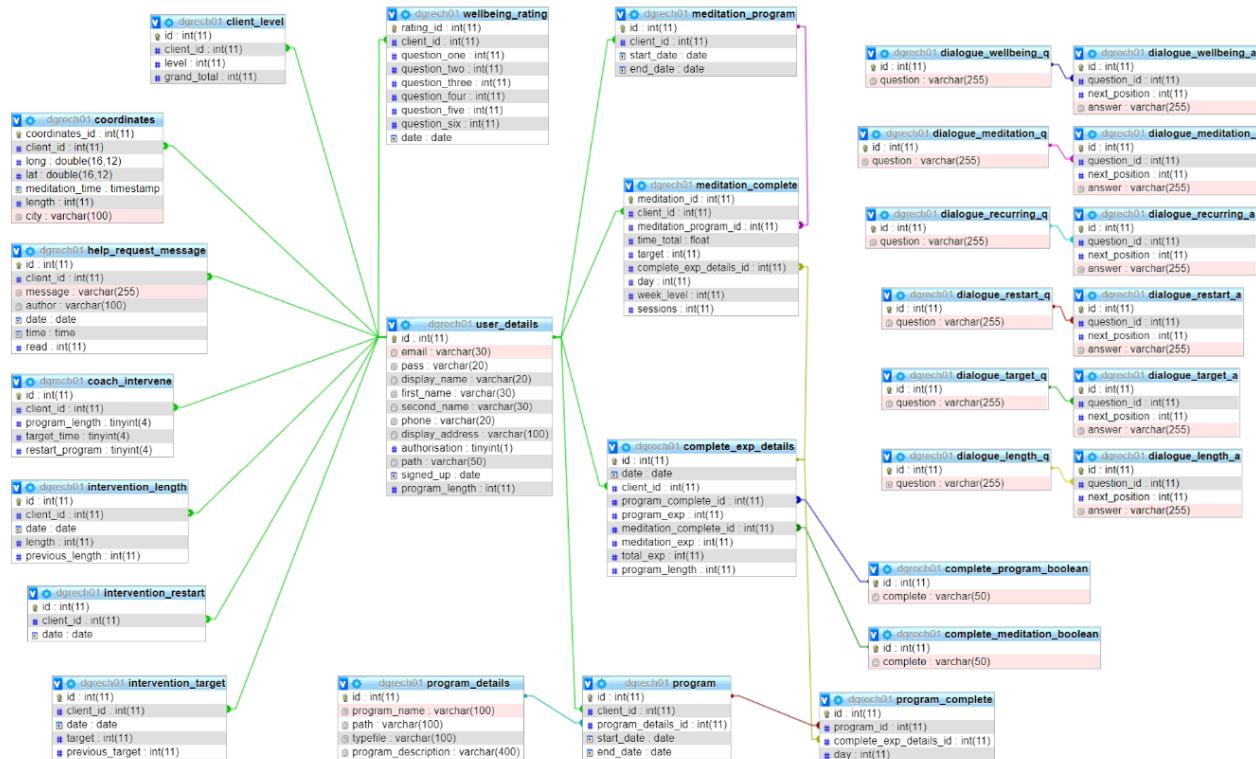


Figure 4.9: Mindfulness Based Stress Reduction Virtual Program database schema (image by author).

4.4.2 Database Design

Each dialogue question table holds a series of questions. Each question has a series of answers in the dialogue answer table. The answers are normalised out into the answer table to avoid repeating data. Each answer has a next_position that is used to go to the next position in the dialogue. For table naming, question and answer are shortened to 'q' and 'a' to make the MySQL code shorter and more efficient.

The meditation_program table holds client start date and end date for the eight-week program. The meditation program details for the 8 weeks/56 days is normalised out into the meditation_complete table. For each client, the meditation_complete table holds 56 rows of data that include week, day, sessions, time target, and time total. Time target completion is normalised out into the complete_exp_details table. The 56 rows in the complete_exp_details table are linked directly to the 56 rows in the meditation_complete table by the complete_exp_details id. Both tables hold data for each individual date for the 56 days. The complete_exp_details table also holds experience point data.

If a meditation time target was reached on any date the meditation_complete_id is stored as 1. Storing a 2 means it is incomplete. The 1 and 2 are foreign keys of the complete_meditation_boolean table. In the complete_meditation_boolean table row 1 is '' and 2 is ''. The HTML code for 1 prints out a tick to represent completion and the code for 2 prints out a cross. If these tables were not normalised out there would be 56 HTML strings in that column for each client. After normalisation there is either a 1 or a 2 for 56 rows. This is much better because if the HTML code requires changing it only needs to be changed once in the complete_meditation_boolean table and all 56 rows for every client are changed instantly. Without normalisation it would require changing it 56 times for each client. Storing a small integer takes up less memory than a string. Another benefit is when manipulating code in PHP it requires checking if the database holds a 1, or 2, instead of a 7-letter string. It is more efficient to perform operations with a small integer, than a string.

The program table is a mirror of the meditation_program table in its function, only it serves the wellbeing programs. The program table holds client start date and end date for each wellbeing program. The details of each individual day are normalised into the program_complete table that is linked to the date in the complete_exp_details table. The complete_exp_details table is the central point that brings the meditation and wellbeing programs together connected to the correct date in the eight-week course. The program_details table is normalised out from the program table. It holds program name, description and image for the 6 different types of wellbeing program.

4.5 Finite State Dialogue Diagrams

4.5.1 Dialoguemeditation.php

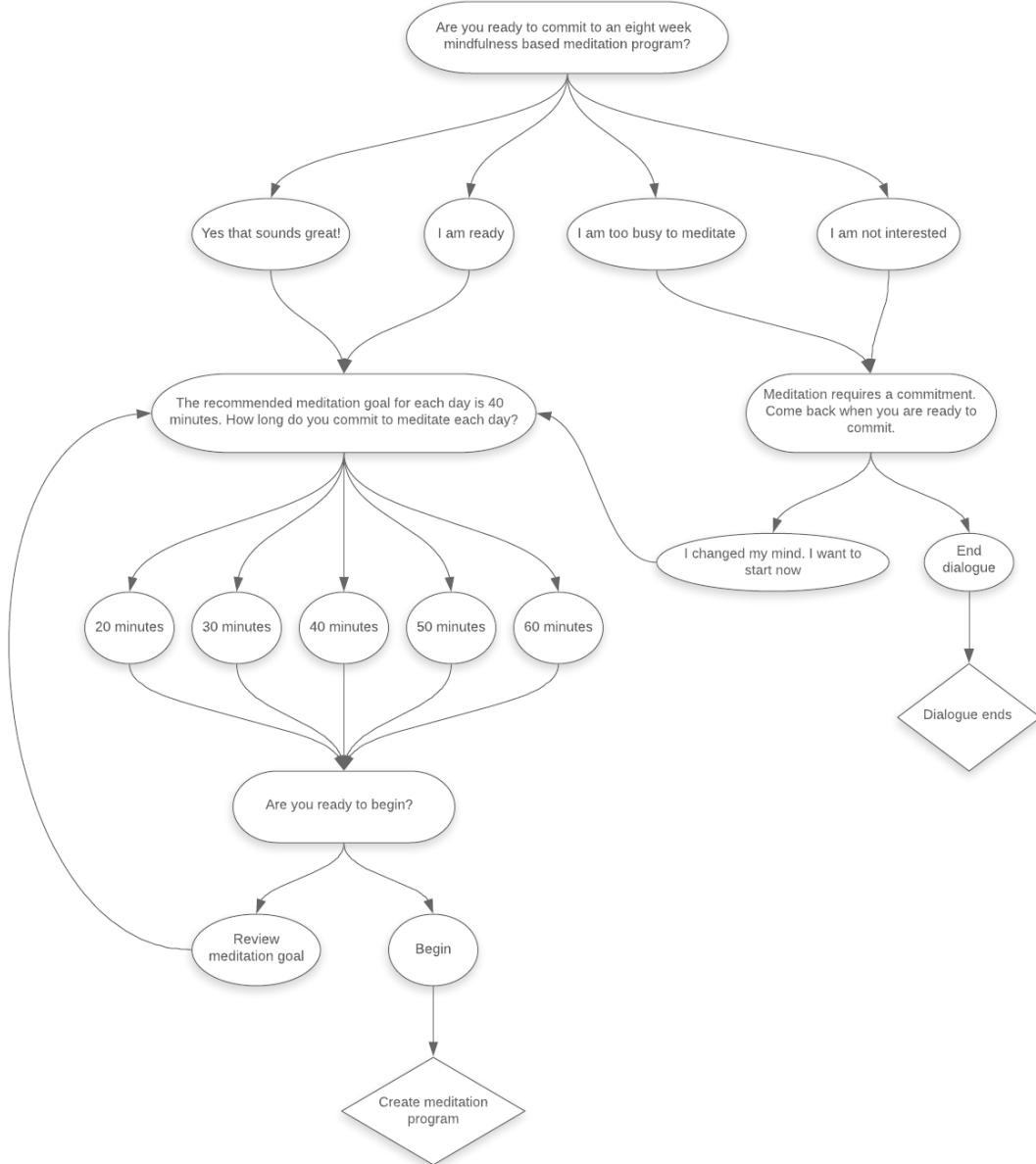
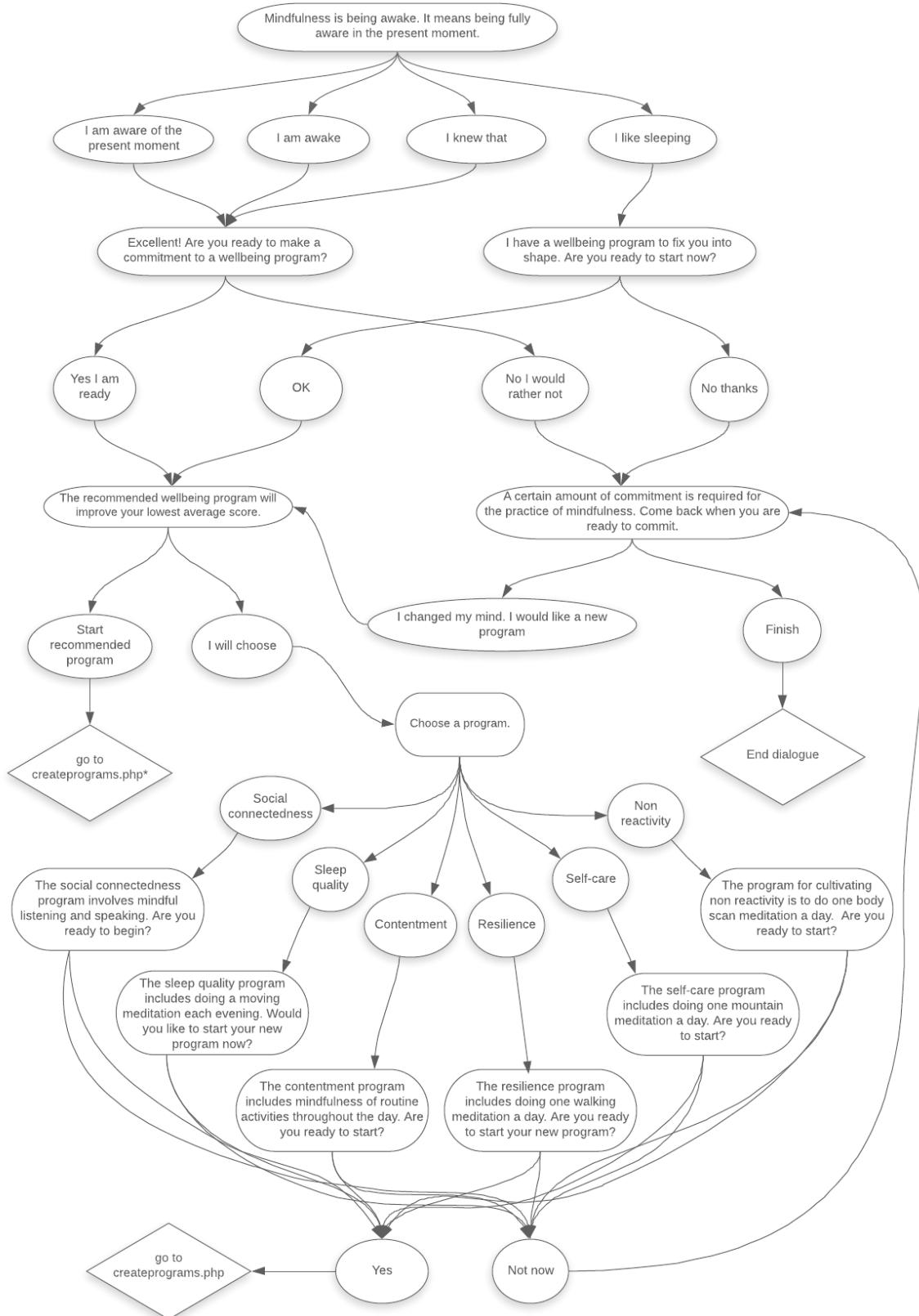


Figure 4.10: Dialoguemeditation.php finite state dialogue diagram (image by author).

4.5.2 Dialoguewellbeing.php



*Figure 4.11: Dialoguewellbeing.php finite state dialogue diagram. *The ‘go to createprograms.php’ diamond after ‘Start recommended program’ will automatically create the wellbeing program with the lowest average score (image by author).*

4.5.3 Dialoguerecurring.php

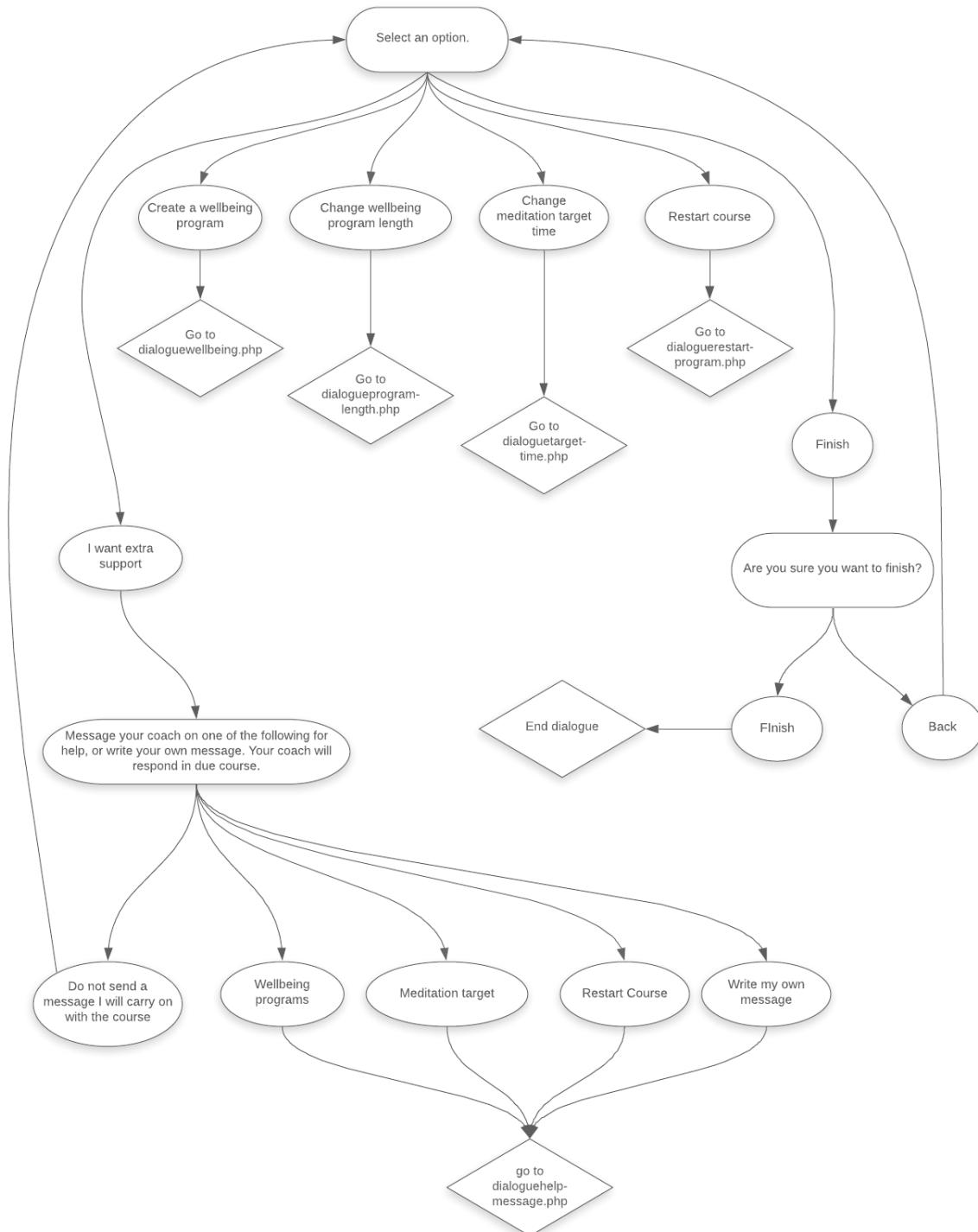


Figure 4.12: `Dialoguerecurring.php` finite state dialogue diagram (image by author).

4.5.4 Dialoguetargettime.php

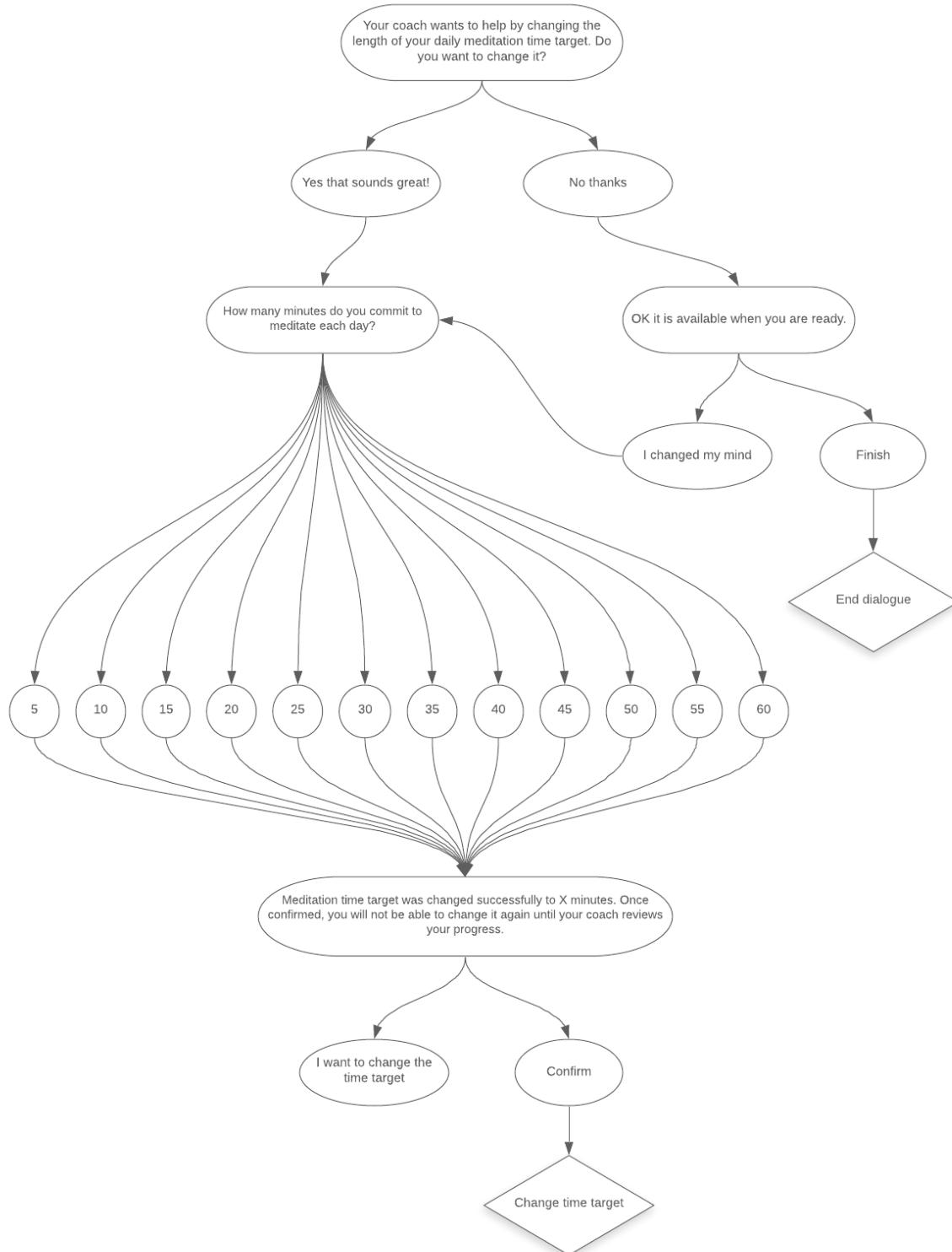


Figure 4.13: Dialoguetargettime.php finite state dialogue diagram (image by author).

4.5.5 Dialogueprogramlength.php

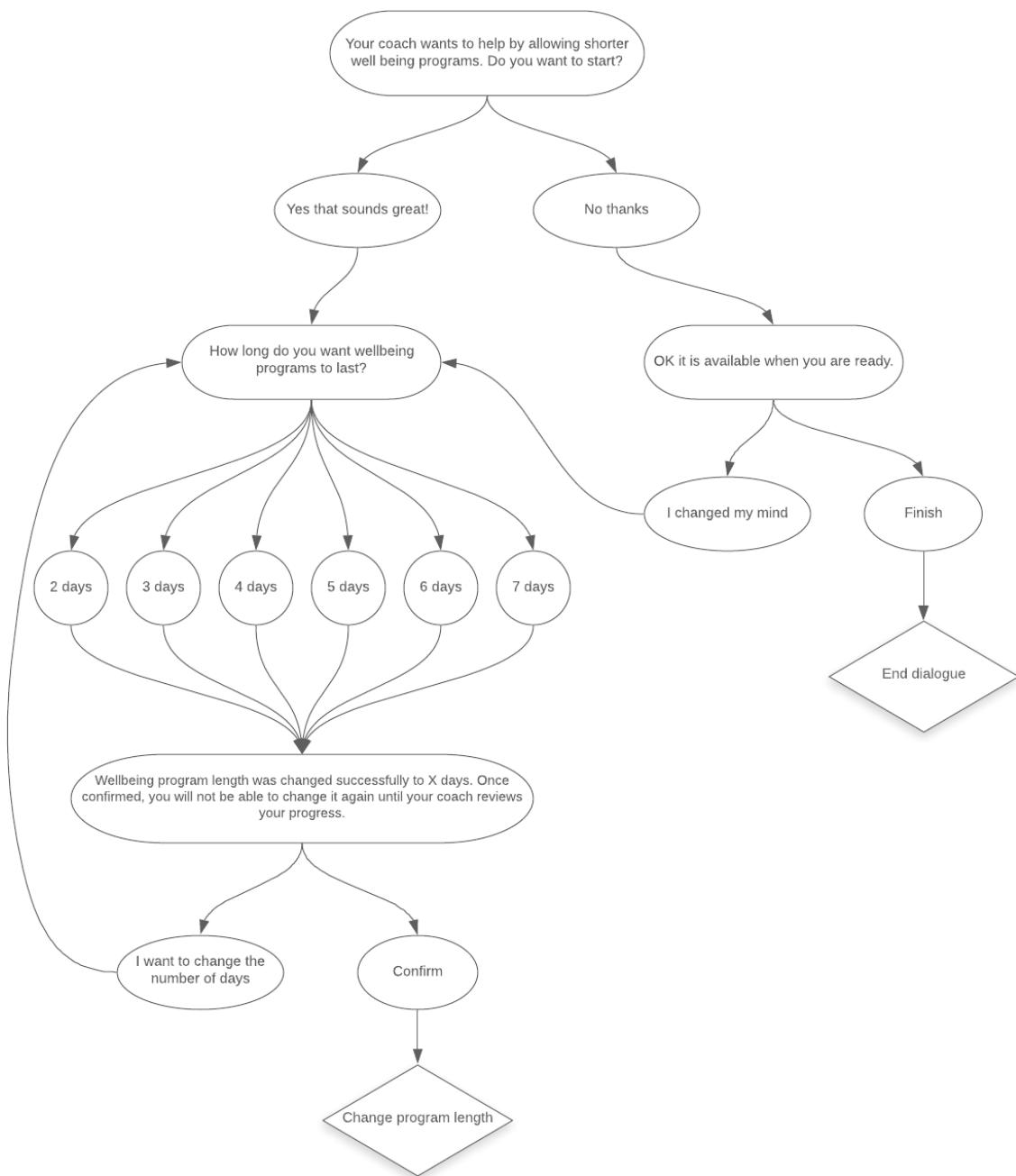


Figure 4.14: Dialogueprogramlength.php finite state dialogue diagram (image by author).

Chapter 5. Implementation

5.1 Virtual Coach Dialogue Algorithm

5.1.1 Dialoguemeditation.php

Each question has multiple answers and each answer has a next_position connected to it. The \$question_id is used to retrieve the question, answers and next positions, see Figure 5.1. If \$question_id is equal to 1, all the details for question one are retrieved.

```
//Get questions and answers for display
$stmt = $conn->prepare("SELECT dialogue_meditation_q.question,
dialogue_meditation_a.next_position, dialogue_meditation_a.answer
FROM dialogue_meditation_a INNER JOIN dialogue_meditation_q
ON dialogue_meditation_a.question_id = dialogue_meditation_q.id
WHERE dialogue_meditation_q.id = ?");
$stmt -> bind_param("i", $question_id);
$stmt -> execute();
$stmt -> store_result();
$stmt -> bind_result($question, $next_position, $answer);
$stmt -> fetch();
```

Figure 5.1: Retrieving dialogue question, answers and next positions from database (image by author).

A while loop fetches every row of data for question one. For each row, a button is displayed with the \$answer and \$next_position hidden, see Figure 5.2. When a client selects an \$answer the \$next_position is posted to the same page. The \$next_position can have any value.

```
//display buttons with answers from the database
while($stmt -> fetch()){
echo"<form method='POST' action='dialoguemeditation.php'>";
echo" <button type='submit' class='btn btn-primary mybtn my-2'>
<input type='hidden' value='$next_position' name='answer'>
$answer";
echo"</button>";
echo"</form>";
}
```

Figure 5.2: Displaying button options with answer and next position (image by author).

When \$next_position is posted to the same page it is converted into the \$question_id, see Figure 5.3. The new \$question_id goes through the database query in Figure 5.1 to receive the next question and set of answers. This algorithm is used to travel to any point in a series of questions, see section 4.5.1 for the finite state dialogue diagram for dialoguemeditation.php. The \$next_position converted to \$question_id is used to set sessions, navigate to other pages and perform database queries.

```
//if condition for when the hidden variable $next_position is posted to this page
if(isset($_POST['answer'])){
    $question_id = $_POST['answer'];
```

Figure 5.3: Converting the next position to question id (image by author).

When \$question_id is equal to 2 the client is given the option to choose a meditation time target, see section 4.1.2 for GUI design. When selecting 20 mins the \$next_position and subsequent \$question_id is 7. A session called ‘target’ is set to 20, see Figure 5.4. The session is used to create the meditation program with the chosen time target. After setting the target session, the \$question_id is set to 3 to bring up question 3. The same process is used for choosing any time target value.

```
//set session dependant on the last answer chosen
if($question_id == 7){
    $_SESSION['target'] = 20;
    $question_id = 3;
}
```

Figure 5.4: Setting target session dependant on question id value (image by author).

When the client selects to start the meditation program the \$question_id is set to 6 and the page is redirected to createmeditationprogram.php, see Figure 5.5. If the client decides to end the dialogue the \$question_id is set to 5 and the page redirects to the index.php.

```
//client has chosen to start the meditation program
if($question_id == 6){ header('location:../program/createmeditationprogram.php');}
//client has chosen to finish dialogue
if($question_id == 5){ header('location:../index.php');}
```

Figure 5.5: Redirecting to another page (image by author).

Each time the page loads the question is transferred into synthetic speech with the Google speech synthesis API, see Figure 5.6. The question was retrieved from the database and stored as a PHP variable. To convert the PHP variable to a JavaScript variable the json_encode(); function is used. The cancel(); function cancels the current speech when a client goes to the next page. The current speech is stopped, and the new speech starts instantly.

```
//end speech from previous question
window.speechSynthesis.cancel();
//Turn question into speech
var speech = <?php echo json_encode($question);?>;
const msg = new SpeechSynthesisUtterance(speech);
msg.volume = 1; // 0 to 1 msg.rate = 1; // 0.1 to 10 msg.pitch = 0; //0 to 2 msg.lang = 'en-US';
window.speechSynthesis.speak(msg);
```

Figure 5.6: Turn question into speech with Google speech API (image by author).

There is a series of emojis stored in the `createmeditationprogram` folder labelled with the same name as the `$question_id`. For example, `1.png` is displayed on question one. When the `$question_id` changes to `2`, the source of the image is changed to `2.png`. The virtual coach image retrieved from the server will be `2.png`. The new path is stored in the JavaScript var `image_position`. The `.getElementById().src` function changes the image source to the new path. The algorithm produces a different image for each question, dependant on the value of the `$question_id`, see Figure 5.7.

```
<?php
echo"
<div class='myemojicontainer mt-3'>
    <img id='imgplace' class='mycoachimage' src='../img/createmeditationprogram/1.png'>
</div>
";
?>
<script>
//set img position
var image_position =<?php echo json_encode
("../img/createmeditationprogram/".$question_id.".png");?>;
//replace image
document.getElementById("imgplace").src = image_position;
</script>
```

Figure 5.7: Change virtual coach image based on question id (image by author).

5.1.2 Dialoguercurring.php

If there is no active wellbeing program an option to create one is presented. If the human coach has enabled an intervention it is available to start. Intervention status is retrieved from the database, see Figure 5.8. If an intervention is enabled it is stored as `1`, disabled stored as `0`.

```
//check if coach has enabled these interventions.
$stmt2 = $conn->prepare("SELECT program_length, target_time, restart_program
FROM `coach_intervene` WHERE client_id = ?");
$stmt2 -> bind_param("i", $client_id);
$stmt2 -> execute();
$stmt2 -> store_result();
$stmt2 -> bind_result($program_length, $target_time, $restart_program);
$stmt2 -> fetch();
```

Figure 5.8: Retrieving intervention status from the database (image by author).

The database is checked for active wellbeing programs by retrieving wellbeing programs with an `$end_date` that is greater than or equal to today's date, see Figure 5.9. If there is one, the `$numrows_program` variable will equal `1`, if there is not it will equal `0`.

```
//check if there is an active program.
$stmt3 = $conn->prepare("SELECT id FROM program WHERE client_id = ? AND end_date >= NOW()");
$stmt3 -> bind_param("i", $client_id);
$stmt3 -> execute();
$stmt3 -> store_result();
$numrows_program = $stmt3->num_rows;
```

Figure 5.9: Retrieving active wellbeing program from database (image by author).

If the \$next_position is equal to 6 and \$numrows_program equal to 1 the \$display variable is set to 'none', see Figure 5.10. When displaying the button the CSS display property is set to 'none', removing the button from view. If there was no active wellbeing program, \$numrows_program is set to 0 and \$display set to 'block' and the create wellbeing program button visible. The same algorithm controls the visibility of interventions, depending on if they are enabled or not.

```
//print out button options with answers from the database
while($stmt -> fetch()){
    if($question_id == 1){
        //if there is an active wellbeing program, set button to hidden.
        if($next_position == 6 && $numrows_program == 1){
            $display = 'none';
        //If an intervention is disabled, set button to hidden.
        }elseif($next_position == 7 && $program_length == 0){
            $display = 'none';
        }elseif($next_position == 8 && $target_time == 0){
            $display = 'none';
        }elseif($next_position == 9 && $restart_program == 0){
            $display = 'none';
        }else{
            //if no active wellbeing program, or an intervention is enabled, display the button
            $display = 'block';
        }
    }else{
        $display = 'block';
    }
    echo"<form method='POST' action='dialoguerercurring.php'>";
    echo" <button type='submit' style='display: $display;' class='btn btn-primary mybtn my-2'>
        <input type='hidden' value='$next_position' name='answer'>";
    echo"$answer";
    echo"</button>";
    echo"</form>";
}
```

Figure 5.10: If there is no active wellbeing program, display a button to create one, else do not display the button.

If an intervention is enabled, display a button to start it, else do not display the button (image by author).

5.1.3 Dialoguewellbeing.php

If \$question_id is equal to 6 the all-time average wellbeing ratings are retrieved from the database, see Figure 5.11. The ratings are displayed and the virtual coach recommends to start the wellbeing program linked to the lowest average rating.

```
if($question_id == 6){
    //get wellbeing question rating all time averages
    $stmt1 = $conn->prepare("SELECT AVG(question_one), AVG(question_two),
    AVG(question_three), AVG(question_four), AVG(question_five),
    AVG(question_six) FROM wellbeing_rating WHERE client_id = ?");
    $stmt1 -> bind_param("i", $client_id);
    $stmt1 -> execute();
    $result = $stmt1->get_result();
    $stmt1->close();
```

Figure 5.11: Retrieve all time average wellbeing ratings from database (image by author).

The wellbeing averages are put into an array, see Figure 5.12. The minimum value is stored in the \$min variable. The array_keys(); function finds the position of the minimum value in the array. Another array is created to store the wellbeing program title along with the wellbeing average ratings.

```
//put average ratings into an array
while ($row = $result->fetch_assoc()) {
    $average_array[0] = $row['AVG(question_one)'];
    $average_array[1] = $row['AVG(question_two)'];
    $average_array[2] = $row['AVG(question_three)'];
    $average_array[3] = $row['AVG(question_four)'];
    $average_array[4] = $row['AVG(question_five)'];
    $average_array[5] = $row['AVG(question_six)'];
}
//get the minimum average progress rating
$min = min($average_array);
//get the position of the minimum average in the array
$min_keys = array_keys($average_array, $min);
//convert minimum average position array to a string
$min_keys = $min_keys[0];
//assign the wellbeing rating average to its string name.
$question_type_array[0] = htmlentities("Social Connectedness = ". round($average_array[0],2));
$question_type_array[1] = htmlentities("Sleep Quality = ". round($average_array[1],2));
$question_type_array[2] = htmlentities("Contentment = ". round($average_array[2],2));
$question_type_array[3] = htmlentities("Resilience = ". round($average_array[3],2));
$question_type_array[4] = htmlentities("Self Care = ". round($average_array[4],2));
$question_type_array[5] = htmlentities("Non Reactivity = ". round($average_array[5],2));
```

Figure 5.12: Storing all time average wellbeing ratings in an array. Finding the minimum value and its position in the array. Creating an array with wellbeing program title and average rating (image by author).

If the \$question_id is equal to 6, the wellbeing average data displays. Question 6 in the database is blank, so no question is retrieved. Instead a custom question is created and displayed, see Figure 5.13. The custom question recommends the client starts the wellbeing program that is linked to the lowest average rating. The \$question_type_array at position \$min_keys holds the lowest average rating. Now the client can choose to start the recommended wellbeing program. All wellbeing average ratings are displayed with a while loop for the client to see.

```
//if question equals 6 print out average rating details
if(isset($_POST['answer'])){
    if($question_id == 6){
        $question_six = "The recommended wellbeing program will improve your lowest average score
        : $question_type_array[$min_keys]";
        echo"<p class='mytext'>$question_six</p>";
        echo"<div class='myalign'>";
        echo"<div class='myrightblock'>";
        $limit = COUNT($average_array);
        $counter = 0;
        while($counter<$limit){
            echo "<p class='mytext mb-0'>$question_type_array[$counter] </p>";
            $counter++;
        }
        echo"</div>";
        echo"</div>";
    }
}
//End of question 6 conditional print out
```

Figure 5.13: Printing out the wellbeing average ratings with recommendation to start the wellbeing program that links to the lowest average score (image by author).

Normally the \$answer and \$next_position are directly linked. In this case the \$next_position must link to the lowest average rating. To achieve this the array position of the lowest average is added to the \$next_position, see Figure 5.14. Now the state of the next page is dependent on the \$min_keys value from the current page. There are two answers in the database for question 6. One is ‘Start recommended program’, the other is ‘I will choose’. ‘Start recommended program’ has a \$next_position value of 7. ‘I will choose’ has a \$next_position value of 14. If the lowest rating has an array position of 2 and the client chooses ‘Start recommended program’ the value posted to the next page will be $7+2=9$. The array starts at zero, so the wellbeing program type is 3. When 9 is posted to the next page it is used to create a session variable equal to 3. The client is redirected to createprograms.php and the session used to create wellbeing program type 3. They have an alternate option to choose their own wellbeing program.

```
//print out button options with answers from the database
while($stmt2 -> fetch()){
    echo"<form method='POST' action='dialoguewellbeing.php'>";
    echo" <button type='submit' class='btn btn-primary mybtn my-2'>
        <input type='hidden' value='";
    if(isset($_POST['answer'])){
        if($question_id == 6){
            echo $next_position + $min_keys;
        } else {
            echo $next_position;
        }
    }else{
        echo $next_position;
    }
    echo"' name='answer'>$answer";
    echo"</button>";
    echo"</form>";
}
```

Figure 5.14: Displaying the wellbeing average ratings and recommend starting the wellbeing program that links to the lowest rating (image by author).

5.2 Testing

The black box testing strategy was used throughout development. When one component was built it was tested with various inputs, using boundary analysis if required, to observe its functioning. If it functioned as desired the test was passed. If it did not function correctly, some reconfiguration or additions to the code were performed.

5.2.1 Testing Plan

ID	Use case ref	Description of Test	Test Initialisation	Test Inputs	Test Procedure	Expected Results	Passed?
01	UC 3.2.1	Test to make sure the correct question, answer and next_position are retrieved from the database	Build dialogue database with correct data	question_id, table name and rows	Write a test query in phpMyAdmin to make sure the correct data is retrieved. Then use the query in PHP. Create test variables and display them to screen in browser	The correct values were retrieved from the database and displayed on the screen	Yes
02	UC 3.2.2	Make sure meditate.php posts seconds, minutes and	Load meditate.php	Meditation time in seconds,	Choose time, select start	The meditation will start with the correct seconds, No – seconds and hours	

		hours to timer.php, then creates time and seconds sessions to be used on timer.php		minutes and hours		minutes and hours	needed various readjustments
03	UC 3.2.3	Make sure live meditations appear with the correct details on community.php	Start a live meditation on meditate.php	Input meditation length	Load community.php and check live meditations	Live meditation will show with correct profile picture, name, city, country, length and experience level	Yes

See Appendix G for testing continued.

Chapter 6. Evaluation and Conclusion

6.1 Survey Responses

6.1.1 Create Meditation Program

Creating the eight-week meditation program is very successful. It can record home practice of an MBSR course or for personal use. A lot of information is presented on the progress.php page. Some people are more impulsive and want instant results. They do not want to read detailed stats. A more condensed GUI with less information would improve this. Perhaps an additional option to view more information if desired could be added.

How would you rate creating the eight week meditation program?

9 responses

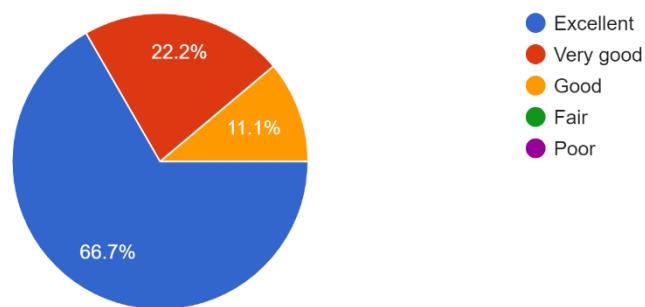


Figure 6.1: Survey response for creating eight-week meditation program (Google Forms, 2020).

6.1.2 Meditation Timer

The meditation timer serves the purpose well. A client can meditate for any length of time, up to 10 hours. There is a useful meditation guide for beginners. The GUI is minimal to allow the client to focus on meditation. The gong is useful as a quiet reminder the timer is up. Guided meditations are good for beginners to learn the techniques. The system has been designed with an expectation that clients have an interest and experience in meditation. Many seasoned meditators would understand what pure meditation is with a countdown timer, although a beginner might not understand. An improvement is to focus more closely on the complete beginner's perspective. There could be more guidance and focus on beginner level techniques.

How would you rate the meditation with timer?

9 responses

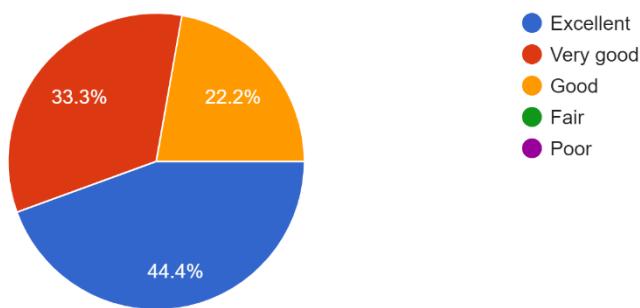


Figure 6.2: Survey response for meditation and timer (Google Forms, 2020).

6.1.3 Wellbeing Programs

Having wellbeing ratings that are linked to wellbeing programs is a novel way to monitor the success of a client. The wellbeing programs are good for focusing on and developing one mindfulness meditation technique. All of the core mindfulness meditation techniques are available which is good for beginners and intermediate levels. Some of the wellbeing programs link to the guided meditations to help learn the techniques. One way to improve the system is add more detailed descriptions of what the wellbeing program consists of. Some clients might not want to read a long description, but it could be done in a way that is engaging.

How would you rate the wellbeing programs?

9 responses

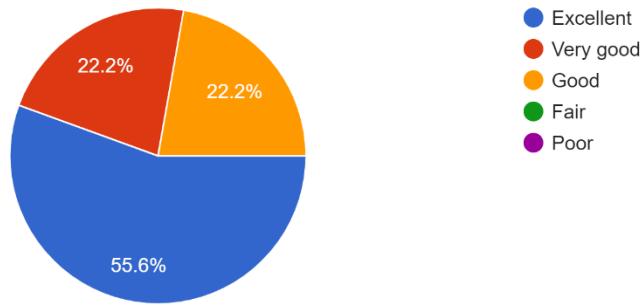


Figure 6.3: Survey response for wellbeing programs (Google Forms, 2020).

6.1.4 Time and Wellbeing Charts

The charts are an excellent way to monitor progress in detail. Clients can see how wellbeing programs and interventions have affected their progress. The wellbeing rating questions are thought provoking and make a client look deeply at themselves and the things they can improve. Seeing the meditation time over a period of weeks and how it connects to the time target is very affective. There is a sense of satisfaction of hitting the target and achieving a goal. One way to improve the system could be to work on reminding the client of the positive benefits of meditation and improving the mechanism of reward. Extra awards could be achievement milestones, or extra community feedback.

How would you rate the meditation time and wellbeing rating charts?

9 responses

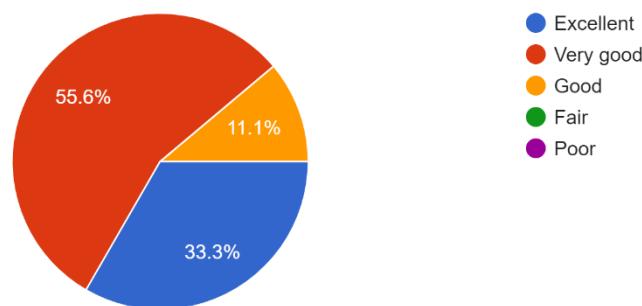


Figure 6.4: Survey response meditation time and wellbeing rating charts (Google Forms, 2020).

6.1.5 Experience Point and Level Up System

The level up system is very good. It gives a quick snapshot view of experience points gained from meditation and wellbeing programs. Showing the experience level on the live meditations is good for

displaying a client's progress to the community. A way to improve the system is to make each next experience level require extra experience each time. The system currently requires the same amount of experience each level. This might increase client engagement and rating of the experience system.

How would you rate the experience point and level up system?

9 responses

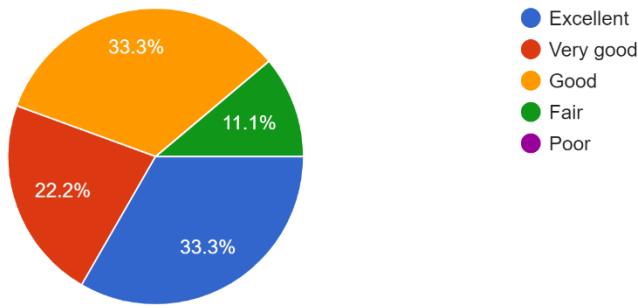


Figure 6.5: Survey response for experience point and level up system (Google Forms, 2020).

6.1.6 Coach Messaging System

The messaging system provides a good way for the client to reach out to the human coach for help. The message notification system for the human coach is very good for monitoring the client. All message notifications are visible on the admin home page, so they cannot be missed. This allows the human coach and clients to stay closely connected. It could be an improvement to have message notifications for the client side, although the main purpose of the chat system is for the client to ask the human coach for help so they can enable an intervention.

How would you rate the coach messaging system?

9 responses

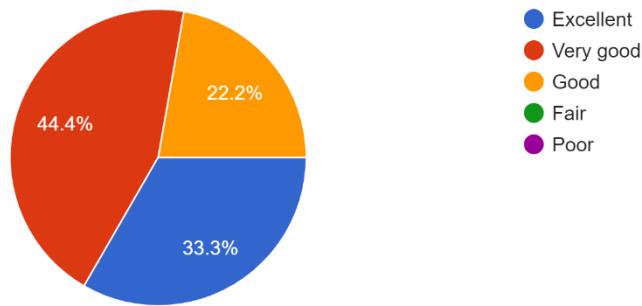


Figure 6.6: Survey response for coach messaging system (Google Forms, 2020).

6.1.7 Interventions

The interventions are a good way for the human coach to tailor the experience for a client. Lowering the meditation time target makes the meditation program easier. Changing the wellbeing program length makes it easier to complete 100% and enables starting a new wellbeing program sooner. Restarting the program is useful for clients with minimal, or consistently negative feedback. Having a fresh start can increase client motivation to do better this time around.

How would you rate starting an intervention?

9 responses

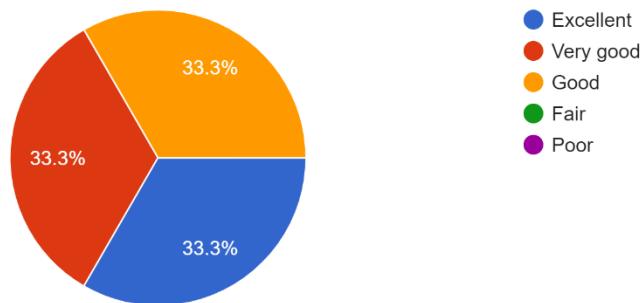


Figure 6.7: Survey response for starting an intervention (Google Forms, 2020).

6.1.8 Free Form Survey Responses

"I think it is a very worthwhile tool for growth in well-being. I liked the question, has doing this meditation brought you closer to others? I also felt it helped me in the areas of self-awareness, and the importance of sleep and of self-care. Regarding the web app, I found it easy to navigate. I myself was doing the meditations each day (2 30 minute sessions) but was not good at recording them on the app. I am very grateful for the insights that this coaching app have given me." Gerard McCloskey, gmcclos@gmail.com.

"Site is easy and straightforward to navigate. Timer allows use of own meditations if preferred but also benefits from selection of good quality guided meditations, varying in length and style, ideal for beginners and seasoned fans alike. Good quality audio, clear and easy to listen to. Virtual coach enables progression, encourages ability to relax, refocus and deal with daily challenges. Charts are good visual aid to progress achieved over time." Chris Grech, chrisgrech@outlook.com.

6.2 Evaluation

The freeform responses highlight many strengths of the project. Although one respondent already had a meditation routine but was not that good at recording them on the app. This indicates the GUI of the app is not intuitive enough. That respondent is over 60 years of age and has a slight technology

phobia, which plays a role. Catering to this age range is important because MBSR is for people of all ages that want to reduce stress. The process of recording a meditation session could be made easier by reducing the number of features to navigate, especially on mobile resolution. In section 6.1.1 the create meditation program received 66.7% excellent score, whereas charts section 6.1.4 received 33.3% excellent. Creating the meditation program was straight forward and intuitive whereas the charts are an extra feature that include detailed stats. It appears the respondents have a more positive view of the streamlined intuitive experience, as oppose to the more in-depth analysis. An overall improvement would be to focus on a streamlined GUI experience.

The virtual coach representation might benefit from a more humanoid figure. It could be developed in various ways, 2D or 3D. Incorporating the MBSR digital program into an app deployed on Amazon's Echo could be a promising solution. The virtual agent on Echo, called Alexa, could guide a client through an MBSR digital program. Alexa can change the lighting in the room to more relaxed colours and reduced brightness. Having Alexa make reminders about when to meditate could be quite engaging for clients, because Alexa is always on. The software is a concept demonstrator and not ready for commercial release. To make it releasable it needs an in app sign up process, or a paid for subscription system. The system was built for desktop, tablet and mobile resolutions running Windows or Android and extensively tested on Google Chrome. To be releasable it needs extensive testing on all operating systems and browsers.

There are many MBSR in person courses available. Linking with an MBSR company to produce a digital solution for them could be a direction to take the system. It could take an official MBSR design and become an online MBSR course. If the system was reconfigured to manage the home practise of an in person MBSR course, the MBSR practitioner could monitor their client's home practice closely and everyone enrolled on the course could connect throughout the week. The virtual coach image could be changed into a likeness of the MBSR practitioner. A synthetic voice like theirs could be created, or their voice recorded. They could record their guided meditations and add them to the system.

6.3 Conclusion

The system incorporates in person MBSR into a virtual program. It improves on the model by adding constant monitoring, constant feedback, the ability to change techniques more quickly, and more contact with the community. Turning the expertise of an MBSR coach into a virtual coach is a promising solution. The system has many rewarding features throughout the eight weeks that include guided meditations, daily progress monitoring and achievements, wellbeing programs, live community features, virtual coach and human coach support. The GUI is well presented, relaxing and calming with an element of light heartedness. The virtual coach dialogue algorithm is robust. It could be expanded into a conversational agent. For future directions, the system GUI could be streamlined and aimed more closely at beginners. The system can go in many directions, the most interesting could be to create a companion web app, linked to an in person MBSR course provider with a more humanoid virtual coach resembling the real life MBSR teacher.

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Appendix A: Changes to Original Specification

The following section details the changes and omissions from the original project brief. All other parts of the original brief are included in the project.

Client changes

Instead of adding chat, making friends and starting groups, the primary community features are the ability for all clients to see who is meditating live and what level they have progressed to. This brings individual client progress into the public domain. Seeing another client is meditating live can motivate them to meditate and progress to a higher ranked member.

Human Coach Changes

The plan to have meditation practitioners upload their guided meditations to the site and have client's review and rate them has been removed. The chosen model has one primary meditation human coach. Guided meditations are available.

Advice Changes

The phrase 'psychological questions' is no longer used. The phrase is replaced with wellbeing questions. It is a more accurate description of the type of questions and more closely reflects the theme of a meditation program. Several types of advice were not used. The best ones were chosen.

Meditation Changes

Guided meditation experience points are awarded based on length of time, the same as a normal meditation. The reward system is based on experience points. Points are not awarded for consecutive days. The clients can show their experience point level while live meditating, they cannot publish it anywhere else. The above changes were made, and the current experience point system was accepted and included.

Progress Changes

The ability to view average time meditating is not included. It is possible to view all meditation time stats for every day since starting the program which is a more comprehensive solution.

Appendix B: Dialogue GUI Desktop and Mobile Design Variations

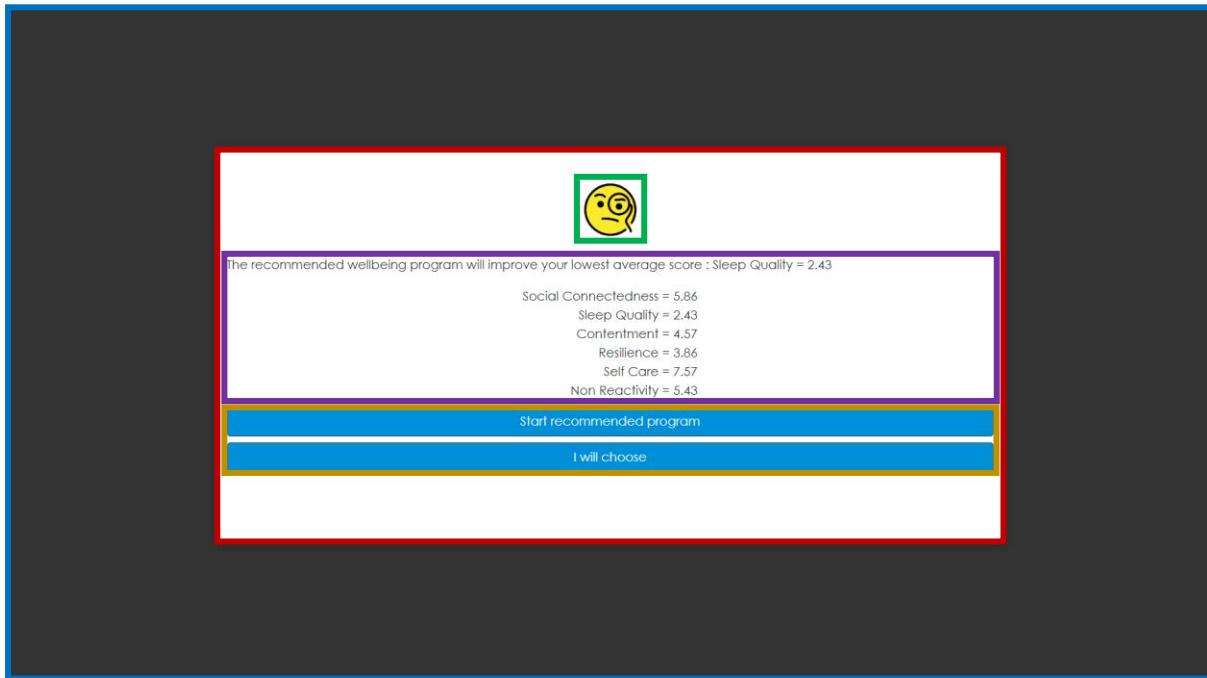


Figure 4.15: Dialoguewellbeing.php question six desktop GUI design (image by author).

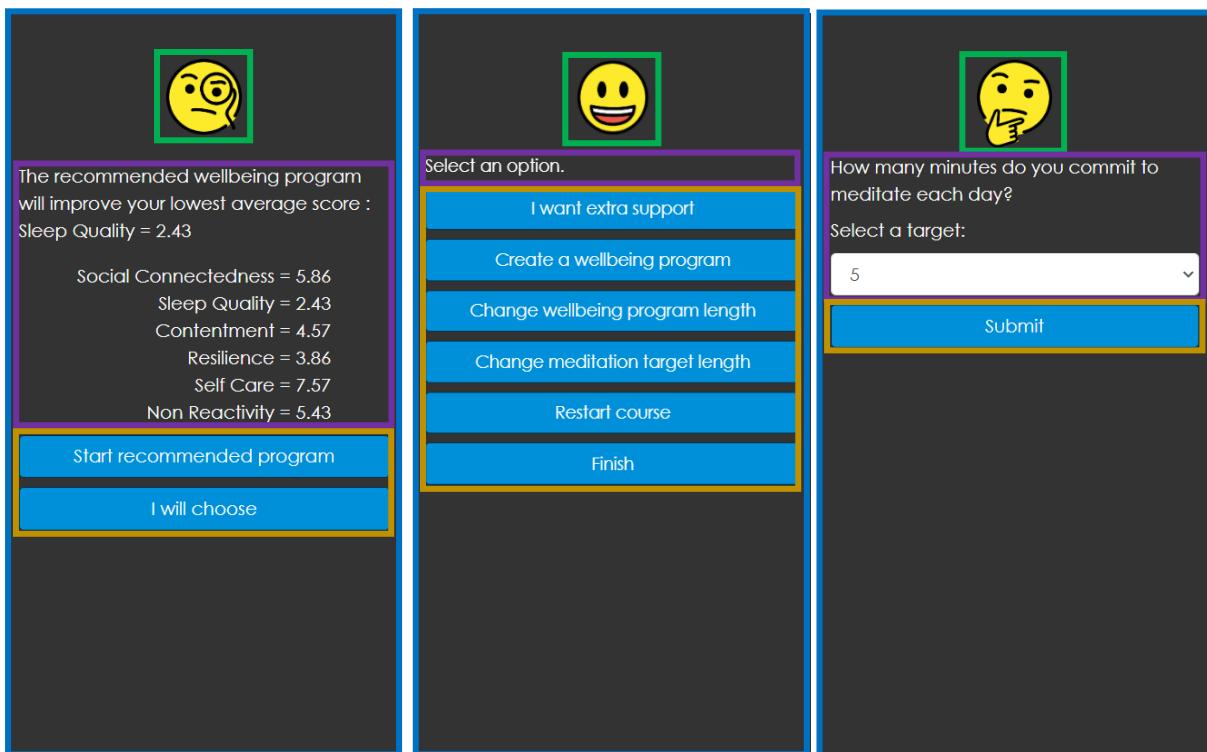


Figure 4.16: Dialoguewellbeing.php question six mobile GUI design (image by author).

Figure 4.17: Dialoguercurring.php question one mobile GUI design (image by author).

Figure 4.18: Dialoguetargettime.php question three mobile GUI design (image by author).

Appendix C: Meditate.php GUI Design

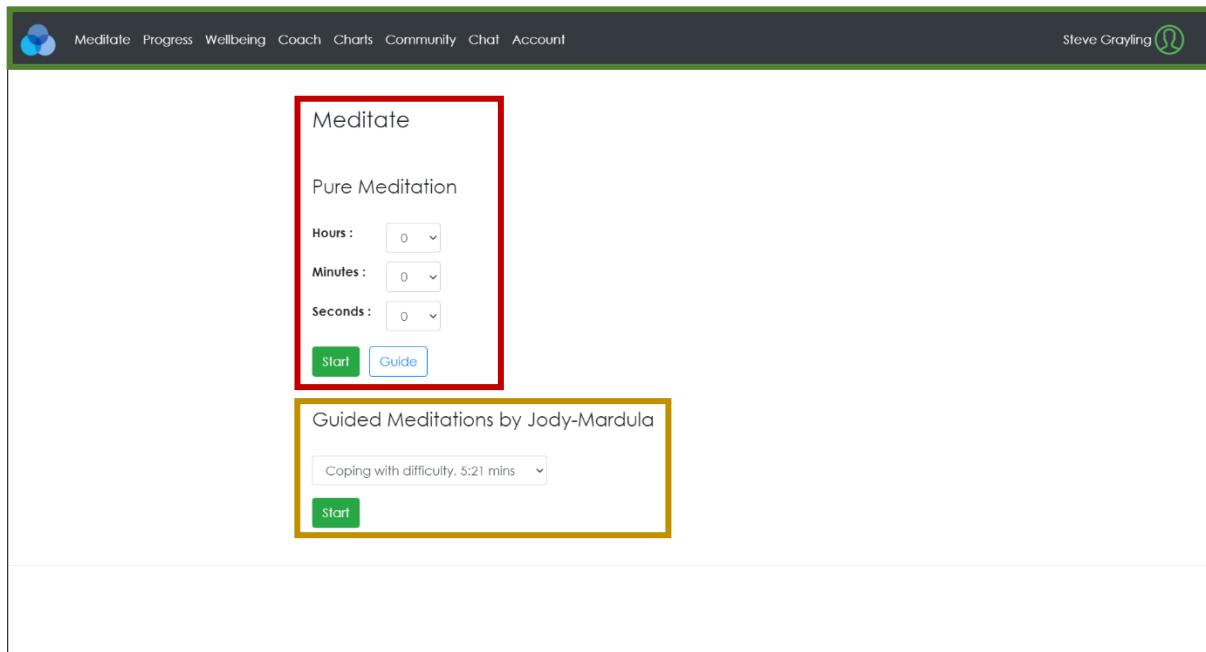


Figure 4.19: Meditate.php desktop GUI design (image by author).

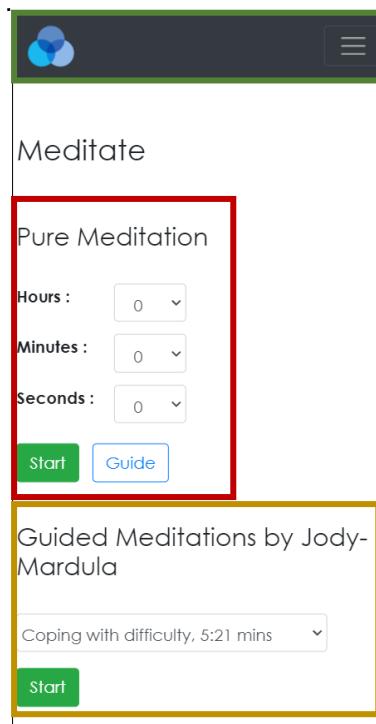


Figure 4.20: Meditate.php mobile GUI design (image by author).

Appendix D: Timer.php GUI Design

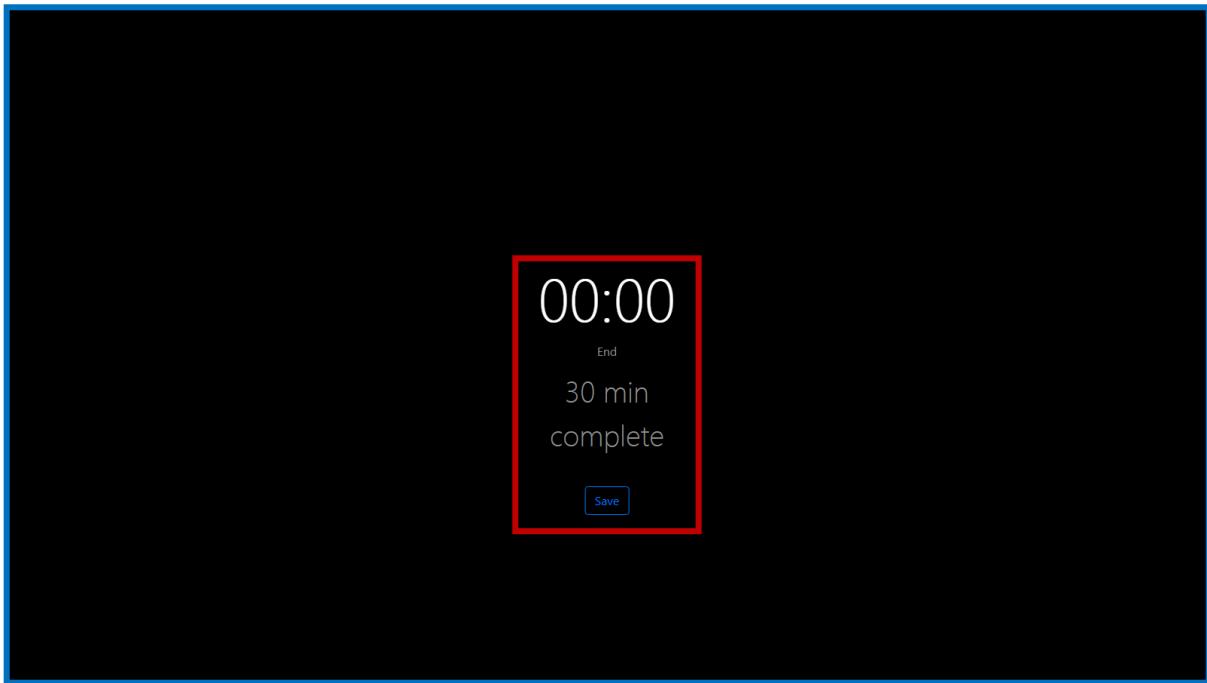


Figure 4.21: Timer.php desktop GUI design (image by author).

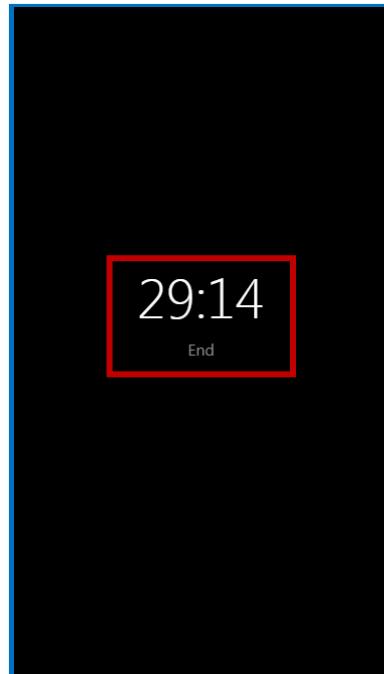
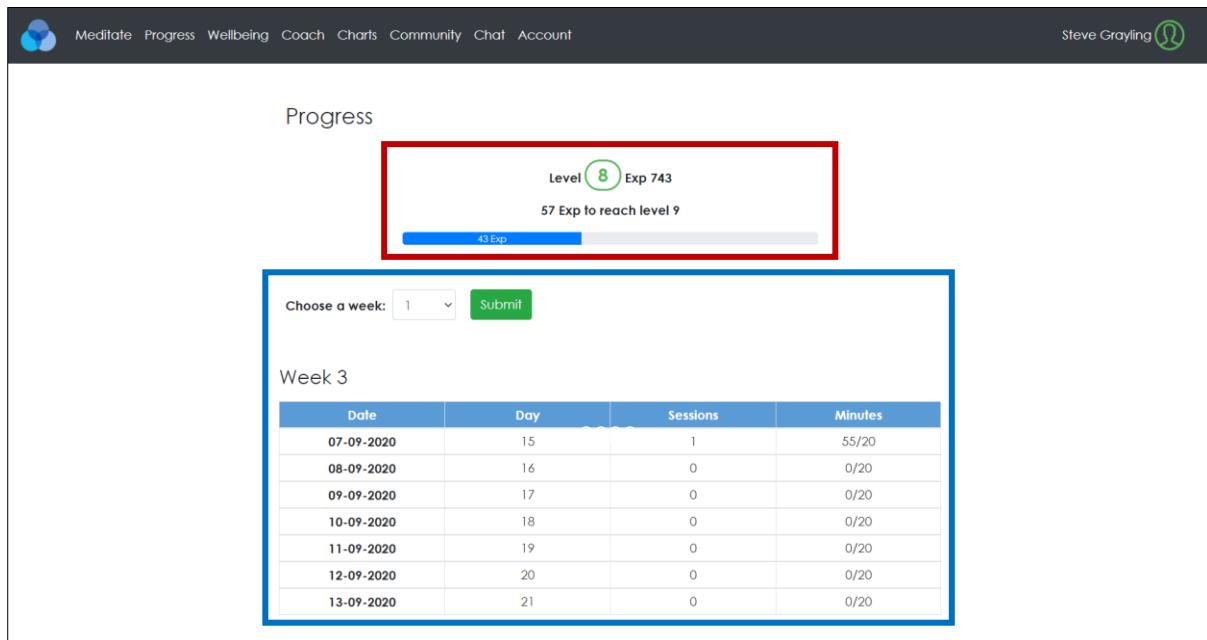


Figure 4.22: Timer.php mobile GUI design (image by author).

Appendic E: Progress.php GUI Design



4.23: Progress.php desktop GUI design (image by author).

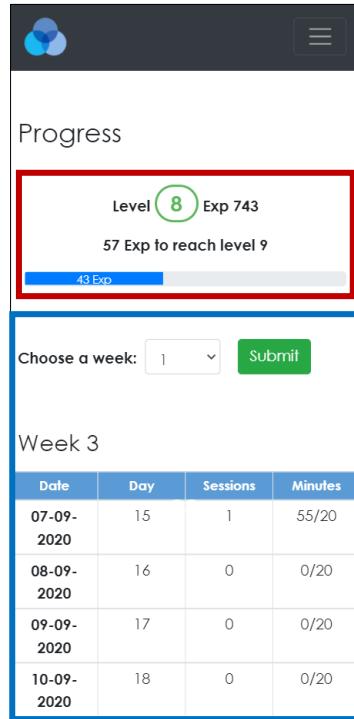


Figure 4.24: Progress.php mobile GUI design (image by author).

Appendix F: Dialoguetargettime.php Implementation

The \$question_id is used to display a select box, instead of the regular buttons. When the \$question_id reaches 3 a custom select option is displayed, see Figure 5.15. The select option is posted to the same page and converted to \$question_id. On every other question the regular buttons are displayed. For the finite state dialogue diagram see section 4.5.4.

```
//print out button options with answers from the database
while($stmt -> fetch()){
    if($question_id == 3){
        echo"<form method='POST' action='dialoguetargettime.php'>";
        echo "<label style='color:white'>Select a target:</label>";
        echo"<select class='form-control' name='custom'>
            <option>5</option><option>10</option><option>15</option><option>20</option>
            <option>25</option><option>30</option><option>35</option><option>40</option>
            <option>45</option><option>50</option><option>55</option><option>60</option>
        </select>";
        echo"<button type='submit' class='btn btn-primary mybtn my-2'>Submit";
        echo"</button>";
        echo"</form>";
    }else{
        echo"<form method='POST' action='dialoguetargettime.php'>";
        echo" <button type='submit' class='btn btn-primary mybtn my-2'>
            <input type='hidden' value='$next_position' name='answer'>$answer";
        echo" </button>";
        echo"</form>";
    }
}
```

Figure 5.15: Changing the button display to a select option at question three on dialoguetargettime.php (image by author).

Appendix G: Testing Continued

ID	Use case ref	Description of Test	Test Initialisation	Test Inputs	Test Procedure	Expected Results	Passed?
04	UC 3.2.4	Test to make sure the correct wellbeing program starts when selected	Create a wellbeing program	Wellbeing program type	Go through wellbeing program dialogue and select a program	The selected program is the one created after dialogue complete	Yes
05	UC 3.2.5	Make sure wellbeing program status is updated in the database when selecting it as complete	Create wellbeing program, load viewprogram.php	Wellbeing program complete	Select wellbeing program is complete for today's date	For the current date, the status will be updated in the database	Yes
06	UC 3.2.6	Make sure new message notifications are shown on adminchooseclient.php	Send a message to the human coach from dialoguehelpmessage.php	Message content	Load adminchoos eclient.php and check if there is a notification next to the client that sent the message	There will be a notification next to the client	No – some readjustment required to get the notification to show
07	UC 3.2.7	Register client and make sure all their details go into the database	Log in to admin section	New client details	Go to adminregisterclient.php and enter their details select submit	New client will be visible in the database	Yes
08	UC 3.2.8	Make sure all client tables are deleted from the database when client chooses restart program intervention	Set up client program and enable restart intervention	Select restart intervention	Go through restart intervention dialogue and confirm	All client tables from the database were deleted	No - Only one wellbeing program deleted, not all. Had to enter while loop to delete all

09	UC 3.2.9	Make sure timechart.php loads a custom range of dates selected by the client	Load time chart.php	Start date and duration	Select a start date and duration in days, select go	The meditation time totals for the chosen duration in days is displayed	No – had to improve MySQL query configuration
10	UC 3.2.10	Make sure interventions the client has taken on adminwellbeingchart.php are displayed	Start a wellbeing program length intervention for a client	Wellbeing program length	Load adminwellbeingchart.php see if the intervention is displayed	The intervention is displayed with correct date, when it was started, the previous length and new length	Yes
11	UC 3.2.1	Testing the title and sign in button display at all resolutions	Create custom CSS: max width, font size and padding	Title, font size, padding	Changing browser resolution and observing the result	Title and sign in button will look good on desktop and mobile resolutions	No – title too big for mobile size screen. Adjustments required
12	UC 3.2.1	Testing the display of a smaller background image at lower resolution	Create CSS to load smaller image at lower resolution. Upload smaller image to server	Image source, max width resolution	Loading the page in different resolutions to make sure both images load	Both images will load at the different resolutions. Loading the smaller image will reduce load time	Yes
13	UC 3.2.1	Test to make sure selecting an answer leads to the correct destination for each answer	Load dialogue from the beginning	Select every possible answer available	Starting at the top of each page select the first answer and work down. Test every possible answer combination	Answer selection will lead in the fashion programmed in the database, dependant on the \$next_position of each answer	No – not every destination had an entry in the database. Complete finite state map required
14	UC 3.2.1	Test to make sure the correct virtual coach image is displayed on each page state	Load the dialogue from the beginning	Each possible page state	Navigate to each state of the page and check the virtual coach	The displayed image will be the same as in the database	No – not every possible destination had image uploaded.

					image is correct		Image naming map required
15	UC 3.2.4	Test to make sure the wellbeing averages display correctly	Load the dialogue from the beginning	Go to question six	Make sure the wellbeing averages are the same as calculating the wellbeing averages by hand	The wellbeing averages are the same as the manual calculation	Yes
16	UC 3.2.8	Test to make sure create wellbeing program option is unavailable when there is an active wellbeing program	Make sure there is an active wellbeing program. Start the dialogue from the beginning	Program end date	Make sure there is no option to create a wellbeing program. Change the end_date of the active wellbeing program for boundary value analysis	Create wellbeing program option will remain unavailable for as long as the current wellbeing end_date is equal to today's date or greater. If less than today create wellbeing program option is available	Yes
17	UC 3.2.8	Make sure interventions are available when the human coach enables them	Enable interventions	The three different types of intervention	Enable each type of intervention and check it is available for the client	The interventions are available when enabled and unavailable when disabled	Yes
18	UC 3.2.8	Make sure changing program length works	Enable program length intervention	Program length	Go through programlength.php dialogue and change the program length	Program length will have changed in the database	Yes
19	UC 3.2.8	Make sure target time change works	Enable target time change intervention	Target time	Complete dialoguetargettimechange.php dialogue and	Target time will have changed in the database	Yes

					change target time		
20	UC 3.2.1	Make sure all 56 rows in both meditation_com plete and complete_exp_d etails tables have the correct data after creating a meditation program	Create a new client with no meditation program	Target time	Go through create meditation program dialogue and confirm	Meditation program is created with all the correct data, including chosen target time	No – week did not link properly, had to change algorithm. Code and tables needed readjusting
21	UC 3.2.2	Make sure guided meditations work with the correct seconds, minutes and hours	Load meditate.php	Select guided meditation	Press start with guided meditation	Guided meditation will start with correct time and audio playing	No – There were various problems with the server, had to store audio files on a server created especially for audio files. Had to readjust code