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# Destress Application

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## **Abstract**

With Mental Health becoming a prevalent concern globally, it is important to find innovative and productive ways to tackle this, and what better way to do this than to creatively make a virtual stress ball app, which is inspired by the therapeutic nature of its physical counterpart. Important findings about the power of using colours to control emotions, and the use of minimal app designs to promote positive user experience, greatly contributed to the design of the app and surveys. Additional information about the significance of sound in the system, and how prevalent negative mental health is in individuals, was discovered during the first survey.

The information gathered was then used to optimally design the Destress application. While developing the app, a lot of problems arose, although most of them were solved and the app was completed. Then, the app was tested and managed to pass most tests, and most importantly had a great user evaluation, thus successfully achieving its purpose of promoting positive mental well-being.

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## Introduction

Within our current generation (post Covid-19), stress and other negative factors continue to become a significant issue, in terms of mental health [1]. This cannot only affect a person's well-being but also their emotional poise and overall life satisfaction. The consequences of this can be fatal not only to the individual but to the society they reside in as well. A majority of crimes and anti-social behaviours have been correlated with negative mental health [2]. Therefore, the emphasis on finding ways to tackle this must become more prevalent, and what better way to do this than to find innovative methods to combat stressors that have bad effects mentally.

The main purpose of this project is to investigate the advantages associated with using a stress ball as an object that tackled negative mental health and implement those benefits into a virtual app that could help users on a global scale. This offers a creative way to deal with stress or anxiety, by being able to conveniently scale this product virtually, and by giving anyone the flexibility to release pressure, whilst encouraging calmness. Also, the effectiveness and usability of the application created would be analysed to see if it benefitted individuals, did nothing, or had an overall bad influence on them. Therefore, not only would research papers be relied upon, but an evaluation from the actual system as well.

To conduct the research, as much information about the psychology of stress balls and mobile applications would be gathered and studied as much as possible. This would also be supported by non-intrusive data gathered by random individuals through a survey (see Appendix A). To be clear, the data collected will completely meet ethical standards, and will not provide any form of risk to the individuals that participate.

After as much credible information and ethical data is collected, the Destress application will be created to utilise these, and to provide an optimal experience that would effectively meet its purpose. However, recommendations and opinions of people will be taken more into account than research data, as the application is catered to user experience. Furthermore, a user evaluation of the completed application will be conducted through a survey (see Appendix C), so that if the overall effects of the app are negative, a great amount of effort will be put to reconstruct as much time as time allows to make sure it is not.

In conclusion, the awareness of the importance of Mental Health has been an increasing topic in recent years, so creating a cross-platform mobile application that targets certain aspects of mental health, in particular stress and anxiety, would be a great way to promote a solution to problems relating to this. To achieve the solution, plans have been made to digitalise the famous "stress ball" that has been therapeutic and been used to 'de-stress' (or in other words reduce stress from) people that use it. The app will not only be created to appeal to the touch aspect of the five basic human senses but will also make sure that the sight and hearing aspects are stimulated as well. To do so, the Destress application will contain very visually-pleasing graphics and enjoyable sounds.

## Aims & Objectives

The revised aims that the Destress Application project intends to apply include:

- To encourage the use of mental health applications by making their use pleasant.
- To calm down anxiety in individuals.
- To target stress in people.
- To make the application's use more prevalent and increase the dopamine effect in individuals.
- To implement an application that contains these features

The structured objectives for the development of the Destress application that will be followed are:

**01.** Find out the most optimal programming language for the development of visually pleasing mobile application interfaces

**02.** Complete Detailed Proposal

**03.** First important supervisor meeting

**04.** Class diagram construction

**05.** Creating & conducting the first survey (figuring out the optimal graphical interface and sound choices)

**06.** Studying and practising JavaScript + React Native

**07.** App Development

**08.** Second important supervisor meeting

**09.** Creating & conducting the second survey (knowing the percentage of people who were calmed down by the app, and the percentage that were not)

**010.** Project video preparation

**011.** Dissertation write-up (minimum 200 words a day)

**012.** Making sure everything is submitted

**013.** Project presentation

## Background Information

### The Psychology Behind a Virtual Stress Ball

Virtual stress balls, which are applications that try to embody stress balls as much as possible, are designed to assist users with controlling their stress or anxiety. Even though it is quite difficult to simulate every single property of a real-life ball on a digital screen, efforts have been made by different developers to try to apply these properties as much as possible or to provide very simplistic versions that support other main aspects of their app. However, what is the psychology behind these amazing objects, and how are they good at supporting users in managing their mental health?

When looking at the basis of virtual stress balls, or any stress ball in general, it gives individuals an outlet where they can release tension that weighs them down. When human beings undergo stress, they tend to get physical symptoms, like increased heart rates and physical tensions, for instance [3]. Therefore, when they interact with the object, they can mentally focus on it [4], which would automatically redirect their stress and anxiety. The basis of this is extremely important in tackling the strenuous physical and emotional side effects associated with stress.

Another advantage of the virtual stress ball on people's psychology is the sense of power and control it gives individuals. The feelings associated with being stressed and overwhelmed could lead anyone to feel like they have no autonomy over their thoughts or the way they feel [5]. Just simply giving these people an object that they can control and interact with to their liking can have them feel empowered and confident.

Also, when looking at the virtual stress ball as a support tool, we can see the amazing ways that it can help in other mentally healthy activities, like yoga or meditation, for instance [6]. In the instance where a person is already self-aware of their emotions when they perform mindful activities, they can use these apps to continue to extend that autonomy over themselves. Therefore, they can strategically incorporate it as an extension to a routine, so that they smartly work on aspects that the rest of the routine would not properly tackle.

On the other hand, there are some beneficial properties that virtual stress ball offers that cannot be replicated on a real-life stress ball. The tapping gestures on digital screens, for instance, that are proven to be very satisfying when used with certain haptic feedbacks, can be utilised to provide a better experience for users [7]. Even though the 'feel' of the virtual stress ball will be different, the amazing feeling of tapping could be used instead to make the users happy.

In summary, virtual stress balls are great instruments that not only give users the control or autonomy to release tension with the physical outlet it provides, but it also acts as a great supportive tool for other mindful activities. Even though it is known that a virtual stress ball cannot replicate every physical benefit of a real-life one, it can still provide other advantages that can replace them. Thus, all these amazing benefits make these objects an amazing innovative tool that can be worked on, with other factors that contribute to its effectiveness, to globally support individuals going through mental health complications.

### **The Psychology of Colour on Mental Health**

An abstract component that makes up everything in the world, colour is very significant in the emotions and moods that a human being can associate it with. Colours have the power to cause certain feelings and reactions [8], so studying the methods of how it does so can be utilised in promoting positive mental health.

Looking at the most popular favourite colour, blue [9], the positive effects could be studied and implemented for a greater user experience. This colour is linked with the water and the sky, and thus can evoke a feeling of calmness and peace, because of how tranquil they are associated with. Research shows that blue has also been utilised by healthcare, such as the NHS for instance, to calm down patients [10].

Another colour that can be looked at is green. This colour is associated with the natural serenity of nature, and can evoke feelings of being at peace with one's self and growth. Green can be seen in furniture and home designs, especially in very urban homes, to provide the illusion of being connected with nature, and to calm them down from the anxiety of being in a hustle-filled and unhealthy environment of a city [11].

When most people imagine energy, happiness and positivity, yellow is a well-known colour that has been linked to these. This cheerful colour can be seen in media that tries to showcase a 'bright' tone [12]. Research shows that yellow can be used to promote warmth and safety, although have also been linked to agitation when too much is shown [12].

Having the reputation of being associated with intensity and passion, the exciting and energetic red colour has the power to also greatly influence emotions like other colours. However, due to the social implications of red being associated with 'bad', this colour is known to increase the chances of stress and anxiety [12].

Extending on social implications of colours, some colours could have more meaning to certain social groups than others, and thus evoke more (or less) emotions within them. White, for instance, is known to be associated with purity and cleanliness in the Western world [13], thus creating more feelings of serenity with this group when compared to others. On the other hand, if we look at the same colour in East Asia, it is usually a colour that represents death and mourning within their community [13]. Therefore, white would more likely evoke negative feelings for them, more than any other community.

As can be seen, colour is a very powerful tool, and it has been gaining popularity in different types of mental health treatments and therapy. For example, art therapy is a type of effective treatment that encourages healing within patients by expressing their emotions through art [14]. Another treatment that promotes positive mental well-being is Chromotherapy, which is also known as colour therapy. This practice involves the use of light of different colour spectrums to target a patient's emotions, in order to physically or mentally heal a certain illness [15].

In summary, learning the psychology of colour and utilising its power, can effectively be used to influence a targeted individual. Different colours can cause people to react and feel something different, in a broad sense, although it can also evoke feelings in different groups of people based on their experience with that colour. However, trying to tailor the use of colours to specific groups of people will not be the main focus of this research, as it will only be used to promote positive mental health for as many people as possible.

### **The Importance of Colour in Mobile Applications**

As discussed in the previous section, colour is a very vital tool that can control certain emotions in people, so it would make sense to optimise this power in apps, especially when trying to influence a positive mental well-being through it. For instance, the colour green has been used by certain finance companies, like 'Cash App', as a branding method to encourage users to associate the app with the desirability of money [16]. Not only has it been used in strategic branding techniques, but also is a significant component that makes up app designs, in order to increase user engagement and experience [17]. Using colour correctly can promote better app usability, and using it wrongly can create frustration among users.

As mentioned, colours used the right way in apps can enhance how well the app can be used. A study found out that colour can affect visibility, memory, and an individual's

attention span [18]. For instance, a red button that contrasts very differently from the app's background colour, or the surrounding elements' colour, can be used as a form of encouragement to click on it. In fact, another study by the Hubspot shows that changing a button's colour from green to red had increased the number of presses on that button by 21% [19]. On the other hand, red could be used to provide a warning to users about something, as the colour is mostly socially recognised with danger.

The important aspect of this research is the colour's use to control the emotional responses of the individual that use the app, based on the purpose of it. Red and yellow, for instance, can be seen in fast-reaction-based video games, like the racing game 'Asphalt 8: airborne+' or 'Fruit Ninja', to possibly induce feelings of excitement in the gamer. When looking at colours that showcase passion and love, like red and purple, they are mostly included in dating apps, like 'Tinder', 'Badoo', or 'Match' for instance. Therefore, colour is an important thing to consider when you are trying to reach a certain target audience.

Furthermore, it is crucial to consider colour options for users with disabilities when trying to be more inclusive. Some visually impaired people, for instance, find it hard to tell the difference between some colour patterns, thus this would confuse them in certain situations or be more problematic in more critical events. Luckily, there are certain specifications and guidelines like the WCAG (Web Content Accessibility Guidelines) [20] that support these users by showing developers specific colour schemes that can counter this problem.

In conclusion, colour is a very significant element in mobile applications, which can be tuned to influence how we want our users to feel. Increasing usability and changing how users behave or respond are some of the ways that developers can influence users through colours. Understanding colours to choose for target audiences, and the accessibility guidelines, could help apps have a greater reach and influence, as well.

### **The Psychology and Importance of Minimalistic App Designs**

As seen and emphasised, by big tech companies like Apple for instance, minimalism with app designs has become an extremely popular concept in recent years. The point of this concept is to use as minimal design usage as possible, in order for the UI to look organised, simple and clean. As the attention span of individuals reduces over time [21], minimalistic app designs can provide a better user experience, by increasing focus on important components and reducing distractions [22]. Even though the idea of having an interface that is simpler to reach a greater audience might seem counterintuitive, the psychology of this will show why this makes sense.

The first important principle to consider when understanding why a minimalistic design works so well is the psychological concept of the 'paradox of choice' [23]. If a random individual is presented with 2 options, the person is able to analyse which option they would pick in a short amount of time and thinking. However, if that same person was presented with a hundred options, the person would become more frustrated in trying to consider so many options at the same time, as more time and brain energy would be required to analyse through every option fairly. Therefore, the chances of decision paralysis would increase, thus



increasing the likelihood that the individual would have a bad user experience with the app. Reducing the number of options would, as a result, decrease not only complications with the system but with the individual's processing load.

The second psychological concept that we must consider, as well, is the idea of cognitive fluency [24]. The natural instinct of human beings is to enjoy activities that seem simpler, as dopamine is likely to be released with the completion of them. Therefore, this can be implemented in apps by making it more understandable to users, by reducing the amount of information they need to process.

Also, as can be noticed with the idea of minimalism in general, and with minimalistic apps, there is this emphasis on having as many blank canvases as the app can contain [25]. The IOS system, which is known to have a great reputation with user experience, utilises as many blank spaces as possible, for instance. This is an important psychological concept as it acts as a cognitive breather for humans. White is known to reduce eye strains and decrease cognitive load, while improving the visibility of texts and other components.

All these psychological factors are the reasons to why minimalistic app designs work so well, and why users rank apps that implement this to a higher standard than apps that applied more "effort" to their designs. So how can these principles specifically be applied and optimised in applications?

The first way that this can be done is by reducing the number of pages that the user navigates through. The fewer the pages, the better, as it reduces the complications of the 'paradox of choice'. Even though developers might think that adding more pages would allow their app to provide more functionality, it would still be better to prioritise usability than functionality, because what would be the point of providing so many things to users if they cannot use everything comfortably or well. However, this would not apply to particular niche systems where it would be crucial to have those complicated options.

Another way that these principles can be applied to improve apps for users significantly is by making the functionality of the app itself simpler, so that the number of people that can use your app increases. The more people that can use your app, the more global reach and effect that it can have. This is likely to become more apparent if the app has great reviews for usability, thus increasing how valuable the app is perceived, and further increasing the exposure of the system to more individuals.

In summary, a minimalistic app design can be used to take away unnecessary stress from users, thus having some positive influence on mental health both directly and indirectly through the effects of some psychological principles. Making the interface simpler will, thus, make decrease cognitive load, increase focus on necessary components of the system, improve its usability, and increase the reach of the app to more people from its great reputation with its ease of use. Therefore, the application could have better user engagement and retention.

## **The Combination of All These Aspects to Provide an Optimal App User Experience**

In conclusion, the great use of colour combined with a smart minimalistic app design are two important things that contribute to a great user experience for systems. The right colours can be chosen by developers to calm down users, while the simpleness of a minimalistic app design can increase the effect of this, by the ease of use and reducing the frustrations with a high cognitive load.

For colours, a palette containing different shades of the colours discussed will be included in the app design, with the exclusion of orange and red. However, data from the survey (see Appendix A) could contradict this research, if more users pick the palette containing red and orange. So, If this is the case, more research and surveys could be conducted, in order to eventually reach a middle ground as to what colours to use in the app to promote a great mental well-being.

Pertaining to how the Destress Application will be designed, there will not be a complex background that will be distracting from the main stress ball object. There will also not be a lot of pages that the user can navigate through, only the important ones. Also, even though the recommendations of users will be extremely valued and taken into consideration, only a few will be added, so that the application does not incorporate so many things that would make the app complicated to use.

## **Design**

### **The Components of the System and How They Are Organised**

The application comprises of three screen views that are all controlled and managed by a navigation controller file. There is the animation view that provides a friendly and nice welcome into the app, the main view which is the most important view that contains the main stress ball itself, and the settings view which contains all the necessary components for tweaking the main view into the user's preferred state. These three views are enough to make sure that the app isn't too daunting for user experience, by making sure that there are not too many views to navigate around in order to provide the important app functionality.

As an application that focuses on positive user experience in order to promote the stimulation of great mental health, the animation view as a cordial introduction to the application was necessary to place in it. There are two options on how the animation view is going to appear. It would either be shown for a certain amount of time, and then transition to the next view, or there would be a button on the view that would have the user click on it and transition to the next view when they deem that they are ready to start using the app.

To have a place to contain all the important aspects of the application and where most of the relaxing would take place would be in the main view. This view would contain the stress ball itself that would be centred in it and have a reasonable dimension to make sure that it is not inconveniently too large or too small for the screen for anyone using it, especially when the stress ball would have to morph around. A button, with the appropriate labelling, is also included to make sure that you can navigate from this view to the next.

The third and final view, the settings view, is extremely necessary to be included, in order for the user to tailor some of the main view's default state to how it would benefit them the most. Other than the setting's title and the button that allows them to navigate out of the setting's view, there would be five additional buttons that would actually change the main view's state. As the app would have background music, the first button gives the user the power to either mute background music or to play it back again. The second button would allow the user to either stop or resume the vibration haptics felt when you press on the virtual stress ball, whilst the third button gives the same power but with the sounds that play when you press on the stress ball instead. Finally, the fourth button changes the main view's background colour based on different colour palettes, while the fifth button changes the type of sound played when you press on the stress ball.

### **The Data Structures and Algorithms Used by The System**

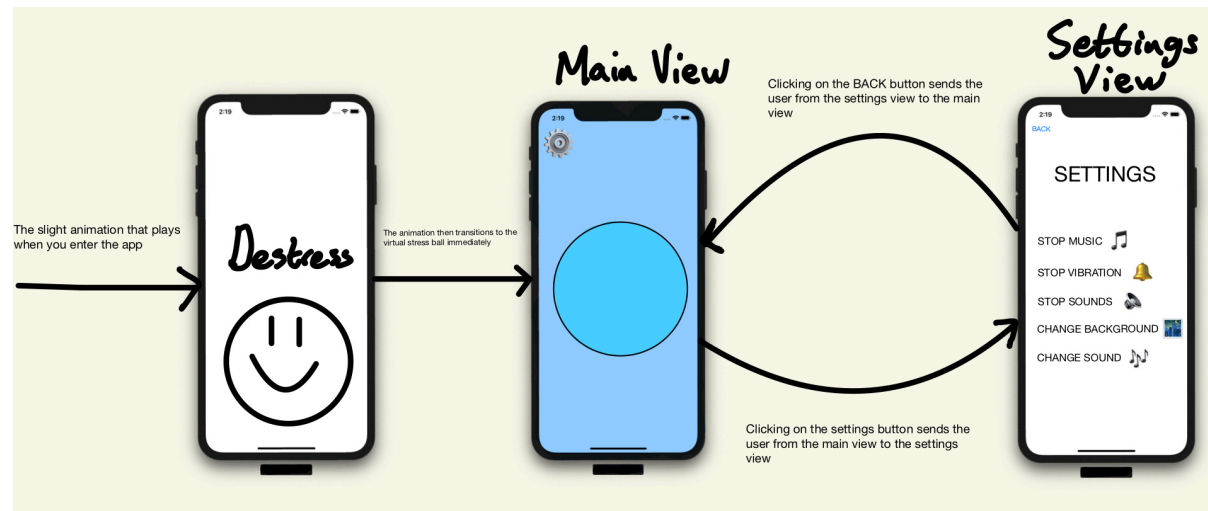
Before looking at the data structures to be implemented in the app during the development process, the React Native platform itself uses a data structure based on trees, under the hood, to display the components, which are similar to reusable functions that take defined properties as inputs and outputs the UI description, that are rendered and displayed on each screen in a hierarchy form. This in-memory data structure is called React Virtual DOM (Document Object Model) and is more efficient than updating the actual DOM, because the actual one is more restrictive when it comes to updates [26]. The main view in the destress app, for instance, has the Canvas component layered as the child node of the SafeAreaView component, thus you can make changes to the parent node, like the background colour for instance, and it would immediately change the same parameters in the child nodes. These components (nodes) are searched through using the Reconciliation algorithms, which is the "process of recursively traversing a tree to know the DOM tag elements of a React application's component tree" [26]. The Reconciliation algorithm would normally take an  $O(n^3)$  time complexity, although heuristics are used to reduce the time complexity to  $O(n)$  [27].

In the app, arrays are the most commonly used data structure that would be implemented, in order to store a specific type of object. The different colour palettes that will be switched in the main view based on user preference, and different stress ball tap sounds, will be stored at their respective arrays. Also, an array will be used to store the state of points that are used to render the stress ball itself. In most cases, a linear search would be used to iterate through the array, thus having an  $O(n)$  time complexity and an  $O(1)$  space complexity. However, in the 'animate()' and 'deAnimate()' algorithms that are used to render the stress ball after being tapped and left for a certain amount of time, both the time and space complexity could be considered  $O(n)$ , with  $n$  being the amount of points on the ball that is being moved around with each fps (frames per second).

Another important data structure used in the app is stacks, particularly used for the navigation controller. The navigation controller stack adds/pushes views based on the order that they are called using the 'props.navigation.navigate()' function with an  $O(1)$  time and space complexity, starting with the initial route/view being added (the animation view in this

case). The `'props.navigation.goBack()'` function then acts as the 'pop' implementation of stacks with an  $O(1)$  time and space complexity as well, making the app go back by to the previous view stored by the stack.

## The Design of The User Interface, including The Screen Mockup



## The Flow of Navigation From One Part of The UI to Another

The flow of navigation is handled in a separate file that acts as the navigation controller. The navigation controller stacks the views in the order that they are called and can be “popped out”, as previously explained in detail. With there being only three screen views, there is an ease of navigation, and the navigation controller stack does not have to store a lot of views that would inherently cause the system to slow down for stacking too many of them.

Between the three screen views, the animation view will be the first to display and will navigate to the main view next, based on one of the two options discussed previously. The important thing to note is that after the animation view navigates to the main view, it will not be able to navigate back to the main view, because it would be pointless for the user to be welcomed to the app multiple times as they are already in it. From the main view, you can only navigate to the settings view from a gear-like button. Once you are in the settings view, you can go back to the main view through the back button, and this will pop this view out of the navigation stack, in order for the user to be able to seamlessly navigate between the main view and the settings view infinitely as many times as they would like.

## Implementation (Realisation)

### How the Development was Tackled

To make sure that the app was developed properly, and with the right amount of research, the objectives (that have been stated previously in the 'Aims and Objectives' section) were formed and followed in order. Particularly the O1, O5, O6, O7, and O9 objectives were critical in the progress of the developmental process.

The first objective was an important foundation in making sure that complex 3D graphics could run without any lag, delays or additional issues. To make sure that these amazing graphics could reach a broader audience, a powerful cross-platform language must be used, and React Native was the most viable option for this coverage and power. React Native comprises of a versatile mobile development framework that gives developers the ability to create native mobile applications employing JavaScript, HTML as well as CSS [26]. Within the domain of graphic rendering capabilities, React Native has achieved an amazing reputation for its ability in developing complex three-dimensional graphics comparable to those generated by native apps of certain companies (like Swift in IOS, for instance) [28].

Also, React Native has the capability to generate 3D graphics that closely resemble those in native applications because of its use of identical rendering engines [28]. This leads to developers having access to the same tools as they create their projects, thus leading to a software system that cannot be differentiated from a standard application since React Native and native apps work with matching software components.

Additionally, this framework has a reputation for being easy to manage, compared to other development platforms and tools. Without needing to acquire or learn many different programming languages or frameworks, developers can create intricate three-dimensional graphics using just React Native. This factor makes it an admired selection amongst programmers who desire the creation of elaborate 3D graphics without feeling the need to master new coding methods and structures.

Finally, the speed with which React Native promotes the development of these complex three-dimensional graphics enables developers to greatly reduce the time and effort that they put into their research and trials, thus making sure that there is no unnecessary time wasted before deployment. Also, due to the fact that this framework is open-source, it requires no fee for utilisation purposes and can be improved with the many available libraries that are continuously being improved [28]. Therefore, people that use React Native as a developmental tool will certainly benefit from reduced expenditures and more resources during its implementation process.

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For how the app was constructed, a large part of the background research and survey results (see Appendix B) from the fifth objective were used. Before sending out the survey (see Appendix A), information about the desired colour palettes for the background colours and whether the app is necessary in the first place was needed. Therefore, time was spent constructing these questions in order for them to be as non-intrusive and respectful as possible. After constructing the right questions and deploying the survey, results about the amount of people struggling with their mental health and their interest in the virtual stress ball app promoted its development, with 52% of respondents admitting to struggling with their mental health and a further 76% showing some sort of interest in the virtual stress ball (see Appendix B). Also, a lot of the recommendations were centred around adding music and sounds, which emphasised not only the need to add them but to evaluate if the options were nice during the evaluation stage (see Appendix B).

When it came to the actual programming of the application, the sixth objective came into play. After the necessary study and practice were done at the sixth objective stage, the visual studio IDE was set up with all the necessary modules and dependencies imported. (Include some examples of the dependencies and modules). Then, folders were created to separate and organise different files based on their functionalities, like the sounds folder containing MP3 files and the screens folder containing JS screen view files, for instance. When all these necessary files and folders were created, the navigation controller was then worked on to connect all these views using the 'NavigationContainer' in the main App JS file and the navigation 'stack' in the navigation handler JS file, both imported from the 'react-navigation' library. The button would then be placed and connected between each view, using the navigation controller, in order to smoothly navigate through them, as elaborated in the 'Design' section.

Working on the main view (presented as the Home.js file in the application) was quite difficult, due to the actual implementation of the stress ball. A spline object imported from the user 'georgedoescode' was used due to its resemblance to a sphere and its morphing properties [29]. Due to the lack of documentation, it is not completely clear how the object functions, but from the source code it is inferred that it accepts points (the amount contained in the object where the movements would take place), the tension (the pulling power of the spline) and whether the spline is a closed object (thus influencing how the points move) and outputs the path of the spline at that moment. The object was displayed on a canvas component that allows it to smoothly morph, and a 'GestureHandlerRootView' to make sure that it can be pressed. Moreover, the spline moves based on the movement of six points scattered around it, as more or fewer points would make the ball seem unnaturally stressed on. For the ball to change based on each frame-per-second, the 'useValueEffect' and 'useComputedValue' hooks were used to update it based on the clock variable, especially with the help of the 'animate()' and 'deAnimate()' functions that were stated in the 'Design' section. A timer, and flag that is used to monitor if the spline was touched, are used to make sure the ball animates for a certain amount of time and then goes back to its normal state if it is left untapped for some time, and the tap gesture resets these.

After getting the right foundation for the main view, the settings view was then worked on as an extension of it in order to provide extra functionality. Five tappable buttons were created below the 'SETTINGS' heading, and each had its own gesture handler function. Moreover, the play/stop buttons updated their respective flag variables shared between the main and settings views using 'props.navigation.setParameters()', while the 'change' buttons updated their index variables between these same views the same way.

When these flag and index variables became connected between the two views, the main view was further worked on, in order for the ball sound, vibration, background music and colours to be implemented. The audio and haptic libraries were imported to handle the first three functionalities, while the background colour is directly handled by the returned components. As a result of this, the ball sounds and background music are loaded asynchronously by their respective functions with the help of the 'Audio' module, while the haptic vibrations are loaded asynchronously directly in the gesture handler with the help of the 'Haptic' module, and they can all be played if they are enabled to do so using their

respective flags. However, the change of background colour happens a bit differently in that it uses its index to select from a selection of colour palettes (an array of arrays containing strings specifying specific colours), and directly loads the colours to their respective components.

Finally, the animation view was dealt with after the completion of the other views. This view was simply coded to display the text components and to use the 'TouchableOpacity' component as a button-like functionality, so that this view can navigate to the main view. Additionally, the colours from the first indexed colour palette were used to fill in the background colours to complement the main view, as well.

To wrap up the development, discover problems, and get further recommendations for future issues to work on in the system, the ninth objective stage was a great opportunity to evaluate the application created. 75% of the respondents were satisfied with the colour palettes, and there were no issues reported with the sounds and music chosen (see Appendix D). However, there were some reports about the smoothness in the transition of the background colour when changing it in the settings (see Appendix D). Plenty of efforts were attempted to fix this, but would just have to be another future project.

### **What was Developed and How it All Works**

The final product met the initial requirements and design process, being a virtual stress ball application, called Destress, which the user can press and play with to calm them down. The app welcomes the user, and then they can click on the red button that says 'click here to begin' to start playing with the main stress ball itself. While the user is playing with the stress ball, there is calm music that plays in the background by 'Lesfm' [30]. Also, when the user presses the ball, a haptic vibration and sound plays. The sound, and also the background by choice, can be changed in settings to any other option that the user chooses. The stress ball itself starts morphing as you tap it repeatedly, and goes back to its original state when you leave it for some time.

At the moment, from many online options, only five sound choices and three background colour palettes can be chosen by the user. The sounds individually resemble a pop, coin, alien beam, popped bubble, and knocked item respectively. Additionally, these sounds and the haptic vibrations can be stopped using the settings page. Considering the background colours: the blue, pink and green-focused palettes can be switched between on the app, as well.

### **A Technical Achievement to Highlight**

Something incredibly important that the Destress application managed to do was to successfully calm people down. This can be seen by the results of the evaluation survey, particularly when the users were asked if the app had a calming effect on them. 75% of the respondents agreed that the app calmed them down, and 50% of them were likely to recommend this app to others to calm them down (see Appendix D). In other words, the main objective and purpose of this project was achieved.

## **What went Well**

From the many things that worked out amazingly, the overall one would be the completeness of the application. The app was able to function properly, be of use and receive a good overall user evaluation. No respondent of the user evaluation rated the app anything below a three (with 5 being amazing and 1 being awful), and over 80% of them rated the app a 4 or above (see Appendix D). Since the app achieved its purpose and had a great overall user experience, it would be an amazing product to release in the market to tackle negative mental health.

An implementation that went extremely well, and with no errors whatsoever during the development process, was the haptic feedback. Every other functionality had some sort of error initially or required a lot of reading through different documentation to completely understand and implement, but the haptic vibration was yet so simple, yet a great milestone for the system.

A lot of other things were greatly done in the app, like: the dimensions of the objects, the way the sounds and music are played, the smoothness of the navigation between all views, the stress ball morphing on command, the implementation of the background colours, and many more.

## **Problems that I Encountered**

Due to the difficult nature of app development, especially when one person is developing an application, there are bound to be problems that cannot be avoided when trying to carry out certain functionalities. Even though most of them were able to be solved, there are still a few that would either be solved with more time or might not be solvable at all. From all problems considered, there are two main ones that were solvable and another two that could not be solved. Before diving into these main problems, some other notable ones are: Learning a whole new language and front-end development, understanding and implementing the maths needed to morph the 3D graphics of the spline object, importing the necessary and most optimal libraries to help with the application, trying to convince people to fill in the surveys and evaluations, and others.

The first big problem that was encountered was that the stress ball would not morph properly when the 'TouchableOpacity' component surrounded the canvas holding the spline object. Even though the component was recommended by a lot of documentation as a way to handle taps, this caused the ball to not morph sometimes or to make it opaque when tapped on. A lot of effort with changing the type of view enclosing the different components was made, and successfully the 'GestureHandlerRootView' was the best option as it allowed gestures to be performed on objects without the negative side effects of the other components.

Another complicated issue arose when handling the sound on the app. The 'Sound' module that came with the React Native app would not load any MP3 or WAV file, no matter their size. Initially, different methods of how to unload the sound using the same module were tried, including the 'useRef' hook that was meant to enclose the MP3 file before extracting it, but none of them could extract the audio files. Then, the 'Audio' library from 'expo-av'

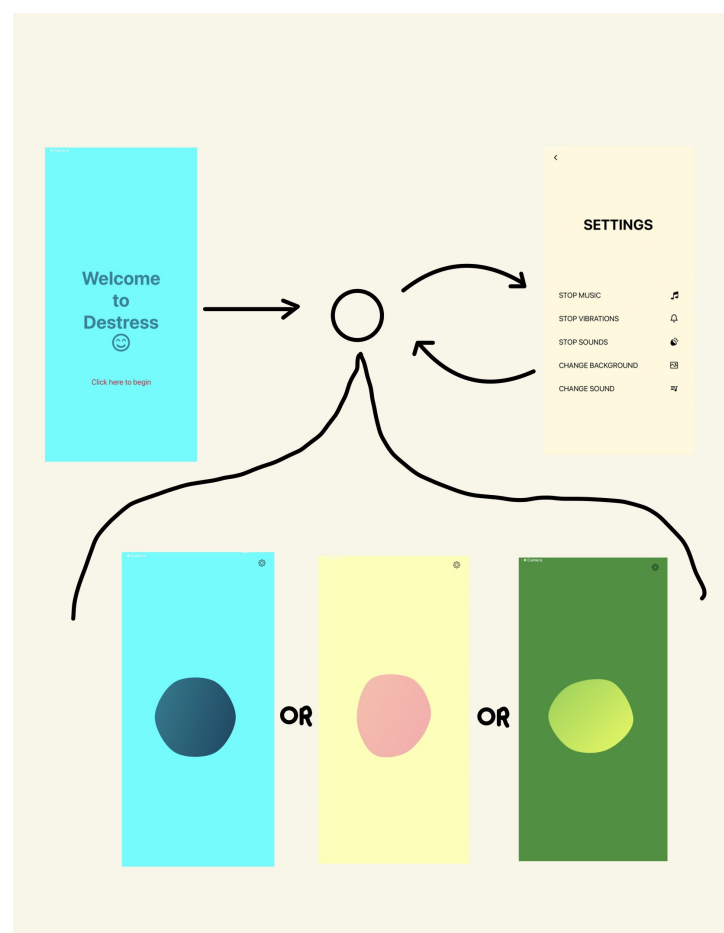


was discovered, and even though some implementations of the imported module did not work, there was one found that was able to, fortunately, load the sounds.

However, something that did not go as perfectly as planned was how the stress ball morphs, specifically with not being able to do so at specific positions of the stress ball. Due to the complicated nature of the spline object and how the 3D illusion is generated, it uses the random 2D path of a set of points to give users the 3D visuals that they see. However, with the points being spread around the edges of the spline (no matter how many points there are), there is no known maths technique that could be used to move the points in a way that they could give the illusion that the object is being tapped anywhere near the centre. If there was a way to position the points in the spline in convenient locations that would allow for reasonable calculations, then this issue could potentially be solved. Therefore, this is a problem that is deemed solvable in the future.

An issue that was a complete dead end when attempting to solve multiple times, was the transition of the background colour when you switch it in the settings. Not only was this an issue noticed in the app development, but it also came up as an issue in the app evaluation (see Appendix D). Changing the type of view components containing the background colour (like to the 'AnimatedView' component, for instance), and changing the way the variable containing the background colour was rendered (like using the 'useState' hook to update the view based on the system's internal clock instead of updating based on the updated variable, for example) were some of the many attempts made in order to tackle this problem. As stated before, this could potentially be solved in the future, although may not be something viable unless the whole code base changes.

### Picture of Final Developed App



## Testing & Evaluation

To make sure the Destress application works properly in functionality and performance, and meets the user requirements, there were a series of tests performed alongside an evaluation at the end. To do this, a White Box testing method was used to check whether the system's code base was written well and does what it needs to do, and a Black Box testing method was also used to test the functionality of the application as presented to users without the code base. Unit testing, integration testing, and acceptance testing (which is testing through user evaluations) are additional techniques that were used, as a supplement to the previously mentioned methods, to assure that the system was as bug-free as possible. After passing most of the tests, the application was certified as mostly bug-free.

For the Black Box testing, the Destress application was tested from the user's point of view through the running app itself, and by testing every button from every view. Eventually, all of them functioned successfully, as they were able to smoothly navigate through the app, and the settings buttons were able to purposefully change the functionality of the main view. After this, the main object (which was the stress ball itself) was thoroughly tested. To do this, different gestures were applied to the ball, and it intentionally responded to just the tap gesture. Then, the same object was tapped at different speeds, to see how long it would take for the ball to morph then go back together, and how fast the ball could morph, as well. Also, some stress testing was applied to see how the ball would react to extremely fast taps, to which it still passed. Finally, the ball's boundary cases were tested to see how it would react if it were tapped just outside its edges, on its edges, and just inside its edges.

For White Box testing, every statement in the source code was tested to make sure that each of their behaviour was correct. All of the if-else statements in the program were provided with different edge cases to see how the system would react. For instance, the statements containing flag values were tested using true, false, null, 0, 1, and another random numerical value, in order to see if the statement would run or not. For the only two for-loops in the code base, even though the points were of a fixed size of 6, the loops were still tested in case more points were included. The loop was iterated for 1000 points, 0 points, and -1 points to see the behaviour of the program in each case. Successfully, the program was able to function in all reasonable test cases.

Finally, the extra testing methods were then performed to give the app an extra layer of assurance for deployment. These methods are:

- **Unit Testing-** This type of testing focuses on testing individual components, functions, and/or modules on their own to make sure that they perform their specific tasks. For the app, each individual component presented to the app was tested to see if it served its purpose, and each unit code block was also tested to see if it functioned as well. The 'Animate()' function, for example, was sectioned out using Virtual Studio's debug mode, in order to see its behaviour using different variables and whether it would terminate.
- **Integration Testing-** This is a method used to see the interactions and communication between different units of the app. This is to make sure that the app's different components work together with no issues. In the application, it was used to see how the transition between different views was and to see if data could correctly be passed from one view to the other, from adjusting the settings to what is presented in the main view) Even though the app managed to pass data between the view with no issue, the UI still could not pass the test of the transition of background colours.
- **Acceptance Testing-** Otherwise known as testing through user evaluation, this method focuses on evaluating the app from the user's point of view. The user gets to determine the app's ease of use and their overall experience. To achieve this type of test, a survey was conducted for the sole purpose of user evaluation, and it managed to get 8 responses (see Appendix C). Questions were asked, overall, about the app meeting requirements and the detection of errors from the user's point of view. As mentioned before, the app was able to meet the requirements, although the background colour transition bug was still detected by end-users, but not as a big problem.

## Conclusion

With the goal of finding an optimal way to create an app that focuses on positively impacting the mental well-being of individuals, a thorough research was conducted to make sure that it was designed properly for this purpose. Key findings about the power of using the right colours to evoke certain feelings from users, and doing this in conjunction with a simplistic app design to reduce stress, was greatly emphasised in order to create an optimal user experience and to complete the purpose of the project. Also, findings about red and yellow discouraged their use due to their negative associations with stress and anxiety.

However, even though these colours and other findings were an essential basis in the creation of the Destress application, it was still necessary to prioritise the data from ethical surveys to see if they would back the findings or cause more confusion. To no surprise, the results from the survey were able to confirm some of the research findings, and even emphasise how necessary the app is, as it was shown that over 80% of the respondents were struggling with stress and almost 70% of them were facing anxiety (see Appendix B). Most respondents additionally recommended nice/calming music, so this was also prioritised in the design of the app (see Appendix B).

As mentioned before, the recommendation was added to the design of the app, although it is important to note that the whole design basis originated from the data collected from the key findings of the research and the surveys. A minimalistic app design with three views was

decided on, which would contain three views: an introductory animation view, a main view containing just the beautiful stress ball itself and a button to navigate to the next view, and a settings view that would change the functionality or design of the main view.

When it came to the actual development process of the app, certain objectives largely contributed to the completion and quality of it. Also, necessary data structures like arrays, stacks and a tree-like DOM structure, were greatly effective in implementing the design ideas, together with beneficial and imported libraries. Additionally, a variety of background colours and sounds were programmed into the system, as recommended. Then, the app was tested after completion to uncover bugs. Black box and White box testing were used as the main testing methods, and then additional testing methods like unit testing, integration testing and acceptance testing (from user evaluation) were used as supportive testing methods. Successfully, the system managed to pass most tests and evaluations.

Even though the Destress application managed to achieve its main requirement, and a number of things went smoothly with it, there were still some problems that were encountered during the development process. A lot of issues like the ball not morphing properly and the sound not loading were solved, but certain issues with the perfection of the ball morphing and the background colour not transitioning properly could not be solved. However, these unsolvable problems did not negatively affect the overall evaluation of the app (see Appendix D).

## **BCS Project Criteria & Self-Reflection**

Not only does the Destress application meet the ethical guidelines, but it also meets the 6 BSC project criteria for honours year projects. The criteria the application meets include:

1. The ability to apply practical and analytical skills attained during the degree programme: The application consists of app development principles, and the data structures and algorithms, that I was taught in the second year to ensure that the application is developed well and runs smoothly. Like the implementations of stacks and arrays, for instance, and being able to analyse the time complexity of any algorithm based on the code base. Also, the knowledge of how to analytically plan how we are going to document, create, and test our program through our Software engineering module is being implemented in this project. All the major testing techniques used on the system, for example, were mostly taught in the same module.

2. Innovation and Creativity:

Even though there are other applications, such as “Stress Ball - Anxiety Relief” and “Squishy Time!”, that share many functionalities with the Destress application, they do not offer a simplistic, convenient functionality and optimal user interface, with amazing experience. My app will be unique in the graphics tailored to relieve users and improve user experience. After researching these apps, it was clear that not much effort was put into the graphics of the stress ball itself.

3. Synthesis of information, ideas and practices to provide a quality solution together with an evaluation of that solution:

With information from different research sources, and different ideas/data gotten from different people through the surveys, the Destress application combines all of these to provide an amazing and functional system. For example, in a broad sense, the research about react native being an amazing framework for this project led me to implement skills learnt at university to it, in order to create the app, in accordance with recommendations gotten from surveys (such as the implementation of good sound, for instance). Then, the prediction was evaluated by users, as seen in the research process and appendix.

4. The project meets a real need in a wider context:

As explained in the introduction, it is common knowledge that mental health has been an important topic worldwide, especially with the increased rate of people feeling stressed and anxious after the COVID-19 pandemic [1]. To tackle this issue, the Destress application is going to be optimised through research and proper development.

5. An ability to self-manage a significant piece of work

This criterion can be seen in the completed project. A reasonable amount of research was done to aid the creation of the app, then it was completed and evaluated. This was done with the help of the well-planned project plan initially created in the detailed proposal, and was followed in order to avoid any issues that may arise down the line of the development process. Also, the whole work was done by myself, with the contribution of the opinions of the project supervisor and survey-takers.

6. Critical self-evaluation of the process

I am very proud of how the whole development process went, and how I was able to achieve the project's purpose. The application was able to work, be functional, and was able to get great user evaluations. Also, not only has the project given me the opportunity to recognise more strengths of mine, but it has also made me see that I have significant areas that I have to work on.

When it came to planning and organising the project, I did quite well in doing so. I was able to create a detailed plan on how I was going to go about the research, completion of the app, and the evaluation. While doing this, I was able to organise the project plan to leave a lot of time to avoid the chances of overrunning the time given to complete the project. Therefore, I recognise this as a valuable strength.

Also, I was able to develop better problem-solving skills, due to solving a great amount of issues that arrived (some of them mentioned and shown in the 'Implementation' section). With every technical problem I faced, I was able to do thorough research, through credible documentation, to get an idea of how to solve it. Even if there were problems I could not solve, or there was not any documentation to support its solution, I was still able to creatively use the knowledge that I had to try new things to solve them. An example of this was when I could not find any detailed information written about how the spline object functioned. So, I had to test the spline with different inputs to detect its behaviour and optimise it for the use of the app.

Even though I managed to find out these great things about myself, I was also able to see problems that I need to work on. The first of these problems was the fact that I underestimated the number of personal issues that I would face, during the time of development, which would cause a lot of time overrunning issues. Due to periods of intense illnesses and other personal problems, the project was pushed back by a lot. Even though I had included a lot of spare time in the project plan to tackle this, I realised I should have included more. Thus, underestimating is an issue that will be worked on immediately.

Additionally, another weakness I need to work on is asserting my actions, especially when it comes to surveys. Even though I made different attempts to promote my surveys online, I should have taken the initiative to discuss with strangers in person, once I saw that I was not getting the amount of survey interactions that I wanted. If I had done this, the surveys would have more likely gotten more responses and would have led to more data that would help support the research.

Overall, the process of properly developing an app was very rewarding, as I got to learn more about psychology and app development. I was also able to reflect more on my strengths in project planning and problem-solving while learning that I need to work on my underestimations and assertions to actions. I am excited to apply these lessons learnt to my next development projects.

## References

- [1] K. Kontoangelos, M. Economou, and C. Papageorgiou, "Mental Health Effects of COVID19 Pandemia: A Review of Clinical and Psychological Traits," *Psychiatry Investigation*, vol. 17, no. 6, pp. 491–505, Jun. 2020, doi: <https://doi.org/10.30773/pi.2020.0161>.
- [2] M. Basto-Pereira and Â. Maia, "Persistence in Crime in Young Adults with a History of Juvenile Delinquency: the Role of Mental Health and Psychosocial Problems," *International Journal of Mental Health and Addiction*, vol. 16, no. 2, pp. 496–506, Nov. 2017, doi: <https://doi.org/10.1007/s11469-017-9847-7>.
- [3] H. Blake, "What happens to your body when you're stressed," *The Conversation*, Aug. 07, 2017. <https://theconversation.com/what-happens-to-your-body-when-youre-stressed-81789>
- [4] Stalvey, Sheryl | Brasell, Heather, "Using Stress Balls to Focus the Attention of Sixth-Grade Learners.," *Journal of At-Risk Issues*, vol. 12, no. 2, pp. 7–16, 2019, Available: <https://eric.ed.gov/?id=EJ853381>
- [5] M. Muraven and R. F. Baumeister, "Self-regulation and depletion of limited resources: Does self-control resemble a muscle?," *Psychological Bulletin*, vol. 126, no. 2, pp. 247– 259, 2000, doi: <https://doi.org/10.1037/0033-2909.126.2.247>.

- [6] B. Xia, Y. Yuan, X. Zhenzhen, C. Libai, D. Juan, and L. Yuanmeng, "Effects of smart stress balls in functional exercise of patients with midline catheters," *Chinese Journal of Modern Nursing*, vol. 26, no. 30, Oct. 2020.
- [7] E. Koskinen, T. Kaaresoja, and P. Laitinen, "Feel-good touch," *Proceedings of the 10th international conference on Multimodal interfaces - IMCI '08*, 2008, doi: <https://doi.org/10.1145/1452392.1452453>.
- [8] J. K. Courtis, "Colour as visual rhetoric in financial reporting," *Accounting Forum*, vol. 28, no. 3, pp. 265–281, Sep. 2004, doi: <https://doi.org/10.1016/j.accfor.2004.07.003>.
- [9] W. Jordan, "Why is blue the world's favorite color?," *Yougov.com*, May 12, 2015. <https://today.yougov.com/topics/international/articles-reports/2015/05/12/why-blueworlds-favorite-color>
- [10] M.-J. Shin and S. Westland, "AIC2013 -12th International AIC Congress 1413 poster session two Colour Palettes in Healthcare Brand Logos," 2007.
- [11] F. Koop, "Colorful urban environments, even in virtual reality, can help city-dwellers' wellbeing," *ZME Science*, Jun. 20, 2022. <https://www.zmescience.com/science/newsscience/colourful-urban-environments-20062022/> (accessed May 11, 2023).
- [12] "Color Wheel Pro: Color Meaning," *Color-wheel-pro.com*, 2006. <http://www.color-wheelpro.com/color-meaning.html>
- [13] K. Cherry, "How White Impact Moods, Feelings, and Behaviors," *Verywell Mind*, Apr. 24, 2021. <https://www.verywellmind.com/color-psychology-white-2795822>
- [14] C. A. Malchiodi, *Handbook of Art Therapy*, 2nd ed. New York: Guilford Press, 2012.
- [15] C. Valnet, *Chromotherapy - The Power of Colors*. Edizioni R.E.I., 2019.
- [16] W. E. Team, "Psychology of Color in Financial App Design," *Windmill*, Apr. 26, 2022. <https://www.windmill.digital/psychology-of-color-in-financial-app-design/> (accessed May 11, 2023).
- [17] J. J. L. Martinez, "A Study of Colour as an Attribute that Intensifies User's Engagement in Game Plays," *The International journal of Multimedia & Its Applications*, vol. 4, no. 2, pp. 1–20, Apr. 2012, doi: <https://doi.org/10.5121/ijma.2012.4201>.
- [18] M. A. Dzulkifli and M. F. Mustafar, "The influence of colour on memory performance: A review," *The Malaysian Journal of Medical Sciences : MJMS*, vol. 20, no. 2, pp. 3–9, Mar. 2013, Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3743993/>

- [19] J. Porter, "The Button Color A/B Test: Red Beats Green," [blog.hubspot.com](https://blog.hubspot.com/blog/tabid/6307/bid/20566/the-button-color-a-b-test-redbeats-green.aspx), Aug. 02, 2011. <https://blog.hubspot.com/blog/tabid/6307/bid/20566/the-button-color-a-b-test-redbeats-green.aspx>
- [20] A. Zhao, "Colour Contrast Based On WCAG 2.0," [oda.oslomet.no](https://oda.oslomet.no), 2015, Available: <https://hdl.handle.net/10642/2602>
- [21] "Do we have your attention? How people focus and live in the modern information environment THE CENTRE FOR ATTENTION STUDIES," 2022. Available: <https://www.kcl.ac.uk/policy-institute/assets/how-people-focus-and-live-in-the-moderninformation-environment.pdf>
- [22] B. B. S. on Nov 29 and 2022, "The Effect of Minimalist UX Design on Users - Authentic Jobs," [authenticjobs.com](https://authenticjobs.com/effect-minimalist-uxdesign-on-users/), Nov. 29, 2022. <https://authenticjobs.com/effect-minimalist-uxdesign-on-users/> 11/05/2023, 11:14 a
- [23] A. Oulasvirta, J. P. Hukkinen, and B. Schwartz, "When more is less," Proceedings of the 32nd international ACM SIGIR conference on Research and development in information retrieval - SIGIR '09, 2009, doi: <https://doi.org/10.1145/1571941.1572030>.
- [24] C. Unkelbach, "The Learned Interpretation of Cognitive Fluency," *Psychological Science*, vol. 17, no. 4, pp. 339–345, Apr. 2006, doi: <https://doi.org/10.1111/j.1467-9280.2006.01708.x>.
- [25] C. K. Coursaris and K. Kripintris, "Web Aesthetics and Usability," *International Journal of E-Business Research*, vol. 8, no. 1, pp. 35–53, Jan. 2012, doi: <https://doi.org/10.4018/jebr.2012010103>.
- [26] W. Wu, "React Native vs Flutter, cross-platform mobile application frameworks," thesis, 1AD
- [27] S. Dilshan, "React reconciliation and diffing algorithm and how it reduce the complexity to  $o(n^3)$  to Linear  $O(N)$ ," Medium, <https://shiharadilshan.medium.com/react-reconciliation-and-diffing-algorithm-5faa9531175> (accessed Apr. 9, 2023).
- [28] A. E. Fentaw, "Cross platform mobile application development: a comparison study of React Native Vs Flutter," thesis, 2020
- [29] Francis, G. (2020) splinejs [source code] <https://github.com/georgedoescode>
- [30] O. Kaplunskyi, Just Relax. [pixabay.com](https://pixabay.com), 2021



# Appendices

## Appendix A: First Survey

### StressBall App Survey

#### Welcome to My Survey

The purpose for this survey is to help aid my project for the University of Liverpool.  
Please understand that you can drop out at any point you want to, as this survey is just voluntary.

## StressBall App Survey

I am conducting this survey, as a University Of Liverpool student, to help construct a mental health app that takes form as a virtual stress ball.

1. Have you been struggling with your mental health lately?

- ☐ Yes
- ☐ No
- ☐ Prefer not to answer

2. Have you ever struggled with any of these mental health issues? You can chose more that 1 or none of these.

- ☐ Depression
- ☐ Anxiety
- ☐ Stress
- ☐ Other

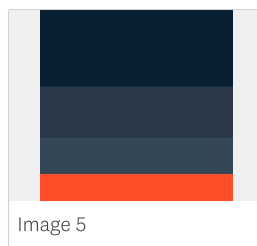
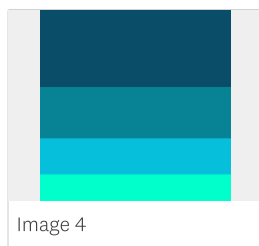
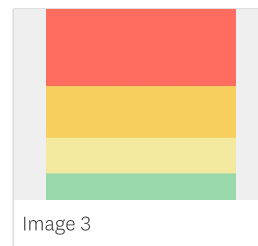
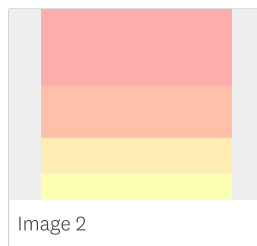
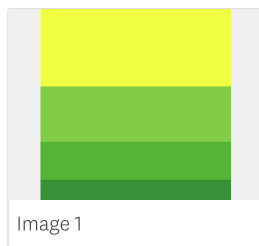
3. Would you be interested in a virtual stress ball that you can tap/play with to calm you?

- ☐ Yes
- ☐ No
- ☐ Prefer not to answer

4. From a scale from 1 to 5 (5 being extremely important and 1 being very little to no importance), how important are the use of right colours in calming you down?

- ☐ 5 - Extremely important
- ☐ 4 - Very important
- ☐ 3 - Somewhat important
- ☐ 2 - Not so important
- ☐ 1 - Not at all important

5. From these colour palettes, which would you consider to be the most calming?



- ☐ Not interested enough

6. Any other recommendation to what you want to see in the Stress Ball app?

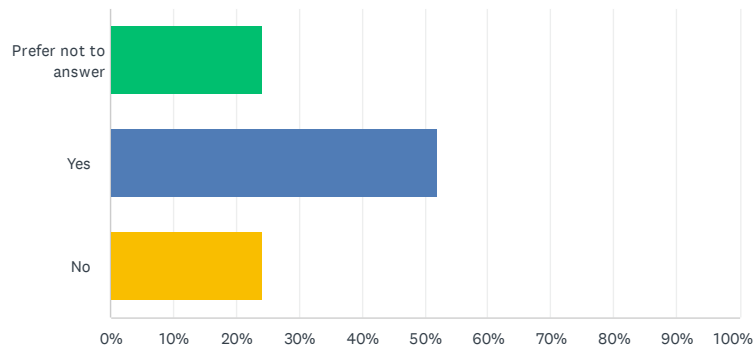
## Appendix B: First Survey Results

StressBall App Survey

SurveyMonkey

### Q1 Have you been struggling with your mental health lately?

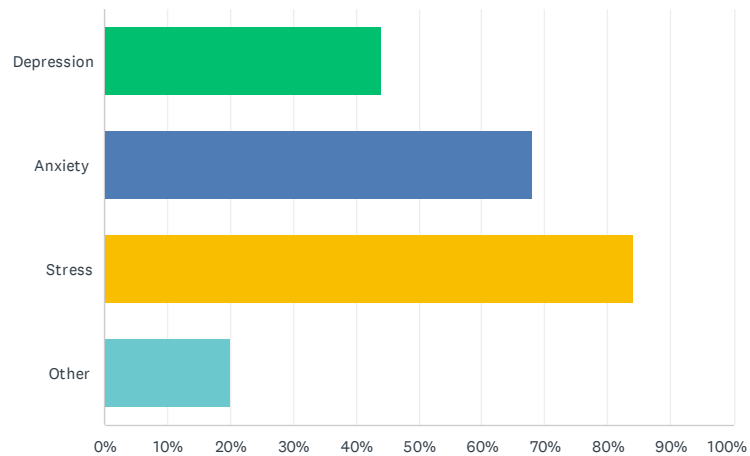
Answered: 25 Skipped: 0



| ANSWER CHOICES       | RESPONSES |    |
|----------------------|-----------|----|
| Prefer not to answer | 24.00%    | 6  |
| Yes                  | 52.00%    | 13 |
| No                   | 24.00%    | 6  |
| TOTAL                |           | 25 |

Q2 Have you ever struggled with any of these mental health issues? You can chose more that 1 or none of these.

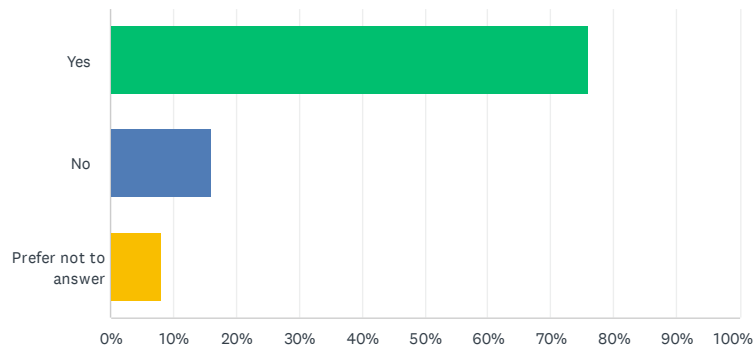
Answered: 25 Skipped: 0



| ANSWER CHOICES        | RESPONSES |    |
|-----------------------|-----------|----|
| Depression            | 44.00%    | 11 |
| Anxiety               | 68.00%    | 17 |
| Stress                | 84.00%    | 21 |
| Other                 | 20.00%    | 5  |
| Total Respondents: 25 |           |    |

### Q3 Would you be interested in a virtual stress ball that you can tap/play with to calm you?

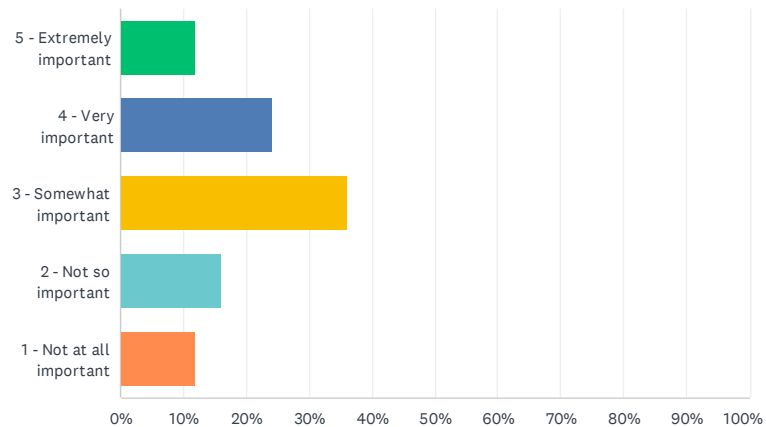
Answered: 25 Skipped: 0



| ANSWER CHOICES       | RESPONSES |    |
|----------------------|-----------|----|
| Yes                  | 76.00%    | 19 |
| No                   | 16.00%    | 4  |
| Prefer not to answer | 8.00%     | 2  |
| TOTAL                |           | 25 |

Q4 From a scale from 1 to 5 (5 being extremely important and 1 being very little to no importance), how important are the use of right colours in calming you down?

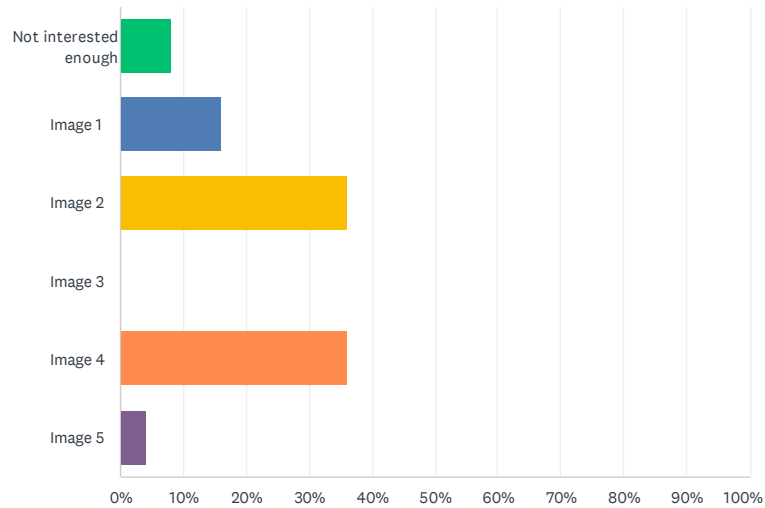
Answered: 25 Skipped: 0



| ANSWER CHOICES           | RESPONSES |    |
|--------------------------|-----------|----|
| 5 - Extremely important  | 12.00%    | 3  |
| 4 - Very important       | 24.00%    | 6  |
| 3 - Somewhat important   | 36.00%    | 9  |
| 2 - Not so important     | 16.00%    | 4  |
| 1 - Not at all important | 12.00%    | 3  |
| TOTAL                    |           | 25 |

### Q5 From these colour palettes, which would you consider to be the most calming?

Answered: 25 Skipped: 0



| ANSWER CHOICES        | RESPONSES |    |
|-----------------------|-----------|----|
| Not interested enough | 8.00%     | 2  |
| Image 1               | 16.00%    | 4  |
| Image 2               | 36.00%    | 9  |
| Image 3               | 0.00%     | 0  |
| Image 4               | 36.00%    | 9  |
| Image 5               | 4.00%     | 1  |
| TOTAL                 |           | 25 |



**Q6 Any other recommendation to what you want to see in the Stress Ball app?**

Answered: 12   Skipped: 13

## Appendix C: User Evaluation

### StressBall App Evaluation

#### Welcome to My Evaluation Survey

The purpose for this survey is to help aid my project for the University of Liverpool. Please understand that you can drop out at any point you want to, as this survey is just voluntary.

1. On a scale from 1 to 5, how would you rate your experience with this app (5 being amazing and 1 being awful)?

- ☐ 5
- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1

2. Did the app have any calming effect on you?

- ☐ Yes
- ☐ No
- ☐ Prefer not to answer

3. Were you happy with the way the colour palette was arranged?

- ☐ Yes
- ☐ No
- ☐ Prefer not to answer

4. On a scale from 1 to 5, how likely are you to recommend this app to other people to calm them down (5 being extremely likely and 1 being highly unlikely)?

☐ 5

☐ 4

☐ 3

☐ 2

☐ 1

☐ Prefer not to answer

5. Are there any problems you encountered in the app? if so, how much did it bother you?

6. Are there any recommendations or any extra functionality you would like to see in the future, for the purpose of improving your mental health?

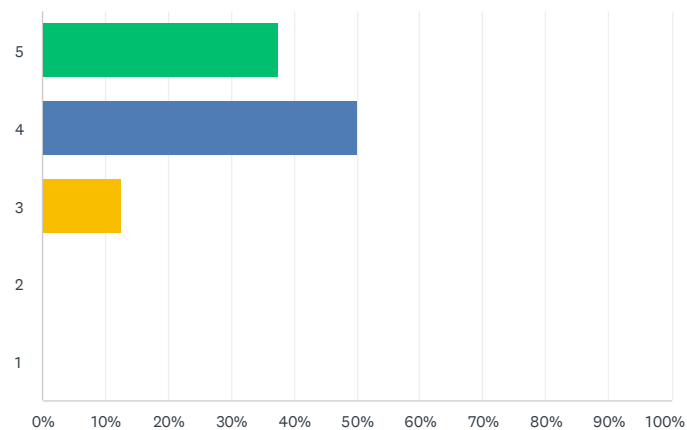
Appendix D: User Evaluation Results

StressBall App Evaluation

SurveyMonkey

Q1 On a scale from 1 to 5, how would you rate your experience with this app (5 being amazing and 1 being awful)?

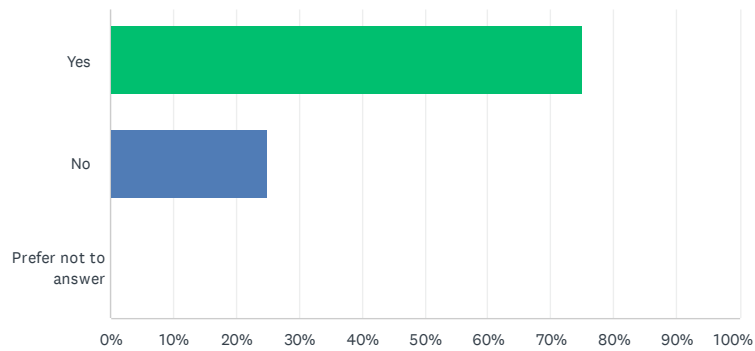
Answered: 8   Skipped: 0



| ANSWER CHOICES | RESPONSES |   |
|----------------|-----------|---|
| 5              | 37.50%    | 3 |
| 4              | 50.00%    | 4 |
| 3              | 12.50%    | 1 |
| 2              | 0.00%     | 0 |
| 1              | 0.00%     | 0 |
| TOTAL          |           | 8 |

## Q2 Did the app have any calming effect on you?

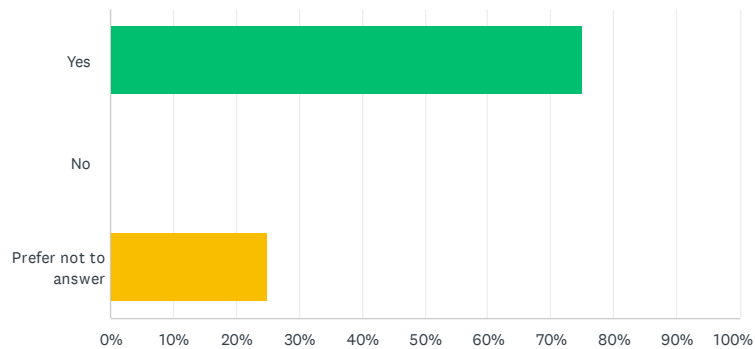
Answered: 8 Skipped: 0



| ANSWER CHOICES       | RESPONSES |   |
|----------------------|-----------|---|
| Yes                  | 75.00%    | 6 |
| No                   | 25.00%    | 2 |
| Prefer not to answer | 0.00%     | 0 |
| TOTAL                |           | 8 |

Q3 Were you happy with the way the colour palette was arranged?

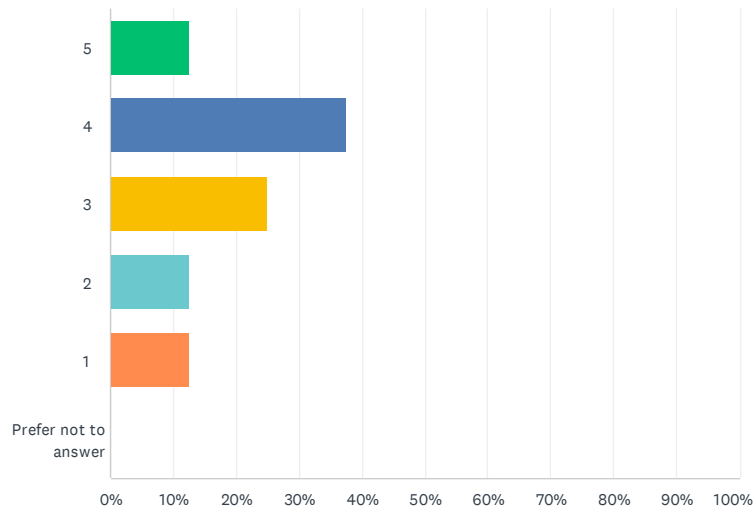
Answered: 8    Skipped: 0



| ANSWER CHOICES       | RESPONSES |   |
|----------------------|-----------|---|
| Yes                  | 75.00%    | 6 |
| No                   | 0.00%     | 0 |
| Prefer not to answer | 25.00%    | 2 |
| TOTAL                |           | 8 |

Q4 On a scale from 1 to 5, how likely are you to recommend this app to other people to calm them down (5 being extremely likely and 1 being highly unlikely)?

Answered: 8 Skipped: 0



| ANSWER CHOICES       | RESPONSES |
|----------------------|-----------|
| 5                    | 12.50% 1  |
| 4                    | 37.50% 3  |
| 3                    | 25.00% 2  |
| 2                    | 12.50% 1  |
| 1                    | 12.50% 1  |
| Prefer not to answer | 0.00% 0   |
| TOTAL                | 8         |

**Q5 Are there any problems you encountered in the app? if so, how much did it bother you?**

Answered: 5   Skipped: 3



Q6 Are there any recommendations or any extra functionality you would like to see in the future, for the purpose of improving your mental health?

Answered: 5   Skipped: 3