Hotei: User Interaction and Experience

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***Abstract*— To aid in helping students reduce their levels of stress a user interface must be designed as the sole sub component exposed to users of the Hotei app. This report outlines the challenges with user interface design for health applications and explores prior research done in the field. As a result, a design is presented making use of established design guidelines and principles.**

I. INTRODUCTION

Hotei is an iOS application coupled with an Apple Watch, aimed at helping students reduce their stress levels through the provision of personalized activity recommendations. As a result of reduced stress, the intention is for Hotei to have a positive affect on students' emotional wellbeing. A key component to the overall Hotei system is the user interface (UI). The job of a UI is to provide methods of interaction for the user to be able to communicate with the underlying system they are using. The design of such an interface concerns the design of aspects of the application that target a users' senses, allowing them to experience the effect of the application. This is primarily done through the use of visual elements, and can even include the use of sounds and vibrations on mobile devices. The importance of the user interface component is emphasised by that fact that it is the only component exposed to the user, and therefore has the greatest effect on their end experience of the application.

II. CHALLENGES

User Interface development for mobile health applications is challenging for primarily three reasons. Firstly, whilst many existing applications have useful functionality to help with users health and well being, many users find that they are not easy to use and require too much effort to experience the benefit from the app. An example of such effort is the amount of manual data entry required by diet applications to know what exactly a user has eaten and in what quantity [7]. As a result, around 50% of users stop using mobile health apps [5]. Secondly, an incentive for consumers to use mobile health apps is for them to be provided with personalised data they wouldn't otherwise have access to. However, this data can only be useful if presented in a logical and easy to understand format. Whilst data is often presented using graphs, it must be considered what graph form the data is best presented in, or whether a graph is even the best way to convey data to the user. For example, there is a health app (Gyroscope) which conveys the number of calories burned in a workout in equivalence to the number of calories in a doughnut. Finally, as an app that aims to reduce stress detection and records the emotions of the user throughout the day there is a challenge in creating a calming user experience, so that the application does not negatively affect the users emotions. A poor user interface can cause frustration and ultimately bias the data presented to the user and the recommendations provided to them.

III. RESEARCH

There has been plenty of research and work done in the field of user interface development. This section goes into details about particular research done and how it can be best applied to this project.

Ben Shneiderman outlines the importance of guidelines and design principles [9] and their ability to help solve design challenges at hand such as the ones detailed in section II. Guidelines provide a shared language to help promote consistency across applications on a platform in terms of terminology, appearance and action sequences. An example of a set of guidelines that will be followed in this project are Apples iOS Human Interface Guidelines [1]. Across the wide range of mobile platforms available to consumers, each one has its own unique design language. The iOS human interface guidelines help developers and designers to identify areas of an application that can help it look and feel part of the iOS platform to ensure that users do not have to adjust to starkly different aesthetics or interactions across their applications. In their guidelines, Apple highlights three key themes that differentiates iOSs design language: Clarity, Deference and Depth [1]. Their exact meaning will be better conveyed later on in Implementation section as they are applied to particular aspects of the app design.

Whilst guidelines are focussed and are targeted at specific elements of UI design, principles tend to be more widely applicable and can be seen as values for what should be considered when designing the interface. Shneiderman goes on to devise eight design principles that will also be considered in the implementation of Hotei's User Interface.

1) Consistency
2) Universal Usability
3) Informative Feedback
4) Dialogs to yield closure
5) Prevent Errors
6) Easy reversal of actions
7) Make users initiators of action
8) Reduce short term memory load

As with the iOS guidelines, each of these design principles will be elaborated on in the implementation section in reference to actual elements of the Hotei design.

There has been considerable research done to understand the relationship between aesthetics and usability in a design. Don Norman states that attractive things work better [6]. He performs an affective analysis to determine that whilst no discernible value can be derived from attractive designs, they do influence a users emotions and affections. He goes on to state that affect can influence the process of cognition and gives the example as made in section II that stress can make people less able or less flexible. In terms of a design, poor aesthetics can invoke negative affect which makes a user less tolerable to seemingly minor problems in the design. As a result, whilst aesthetics does not guarantee that a design is usable, it influences the users perception of its usability. A similar conclusion surrounding the importance of aesthetics is put forward by Wang et. al [10] where aesthetic appeal on web services had an impact on the sample participants perceived quality of the service.

Numerous efforts have been made to understand the importance of colour and its role in design. Imagining everything around us makes us realise the importance of colour for how it can convey meaning and invoke a range of emotions. In the field of colour psychology several researchers state that colours do have psychological affect on humans. Faber Birren gives an example where blue invokes a feeling of calm and pleasant ideation, whereas a colour like red invokes arousal, passion and excitement [2]. In reference to the example given by Birren, it should be noted that additional researchers suggest that colours have both positive negative connotations. At the same time, the influence of colours is different for every person. The effect of colour can even be influenced by culture, psychology, gender and social trends. The condition of gender has been expanded on by Leatrice Eiseman [3], who states that women are more emotionally effected by colour than men.

Whilst colour can seemingly be taken for granted, it is important to make its use inclusive to those with colour blindness. Colour blindness relates to deficiencies in registering levels or red and/or green. As a result colours tend to be skewed towards appearing in hues of yellow, blue and grey, compared to the full spectrum most people can see [8]. Even Apple and Google both make their user interfaces accessible by either deliberately using colour combinations that can be easily distinguished (as shown in figure 1), or making available screen colour modes that can adjust colour spectrums to suit those with different forms of colour blindness.

Fig. 1. iOS Activity App (Original vs Colour Blind)

IV. DESIGN AND IMPLEMENTATION

Before a design can be implemented, it is important to consider the types of interactions that the user will perform or be required to perform. A summary of which are shown as follows:

- Login and/or Register Account
- Select Activity Preferences
- When stress detected, user is presented with activity recommendation
- User prompted to enter emotion level at regular time intervals.
- User can input how they are feeling (positive, negative, neutral) throughout the day with associated activities
- User is asked at the end of the day to provide feedback on activity recommendations
- User can view at anytime, graphical representation of their emotional score across the week/month/year.

Having outlined the challenges associated with the design of this UI component and conducted suitable research of existing efforts in this field, this section will detail the resulting design for the app and describe what techniques will be used to execute the design. The consideration of interactions for the user means that guidelines and principles outlined previously can be better applied in context to how the app will be used.

A. Views

To maintain simplicity and clarity for the user, the app will be based on 3 core views shown in figure 2 accommodating the 3 most important actions for that a user will perform. The activity view presents the most recent activity recommendation as well as past activities which the user may not have registered an emotion for. The data view allows the user to better understand how their emotions change over a given time period. The data view will ideally provide this data in a single screen view without the need to scroll. More detail about the data visualisation can be found in section. Finally, the emotion entry view allows the user to quickly enter their emotion score along with a corresponding activity. This will be displayed, not as a discrete page, but will overlay on top of either the activity or data views, making use of depth to convey visual hierarchy to the user. To avoid distraction from the underlying view, a gaussian blur will be applied to help the user focus on the emotion entry. The use of three discrete views helps form dialogs (guideline 4) where a sequence of actions that a user will perform are limited to the view they are in. For example, entry of an activity does not require the user to go to any other view after the emotion entry view. The limited set of views also helps in achieving guideline 8 where the user does not have to remember too many pages in the app.

There are three secondary views that will be accessible by the user: login, activity preferences and settings. The login page will only be required upon first use or if the user chooses to log out of the app. This page will make use of guidline 5 where suggestions will be provided the case that login information is entered incorrectly. The activity preferences will be displayed by default immediately after first login, however will be accessible through the settings view where users can additionally adjust time intervals of emotion entry notifications and the colour scheme. The ability to go back and adjust activity preferences meets guideline 6.

B. Data Visualization

As stated in challenges, it is important to present data to the user in a clear and logical format to help them understand what it means and ultimately for the data to be of value. The data view will display a time series of their emotion inputs as well as the corresponding heart rate of the user over time along with location data. Whilst the heart rate is a continuous signal and therefore should be displayed using a line graph format, the challenge was how best to convey the users emotion score. The aim of the data view is to allow the user to see the relationships between their emotions and their corresponding heart rate and location. However, the frequency of heart rate sampling is much greater than emotion sampling. As a result, displaying the emotion as a continuous line may misrepresent or exaggerate emotional fluctuations. Instead it is decided that emotions are best represented in a bar graph form. To increase the

users awareness about activities or events that typically invoke a positive or negative emotion, icons associated to the respective activities will appear along with each bar entry. Neutral entries are not considered to be important for the users awareness and so will not be displayed. Additionally, underneath the graph will be a section detailing the locations where the user spends most of their time, along with an icon representing the average emotion they feel there.

C. Interactions

There are two types of interaction possible with this app: user-initiated, and non-user initiated. An example of a user-initiated interaction is where they voluntarily open the app to view their emotion data or wish to manually enter an emotion entry and activity of their own accord. Non-user initiated interactions primarily occur when the user is required to enter their emotion according to a pre determined time interval, or when the user is being recommended an activity if stress has been detected. As stated in requirements, it is essential that non-user initiated interactions are fast and lightweight to reduce any inconvenience it may cause. To achieve this, the app will make use of three forms of interaction available on the iOS platform: actionable notifications, the apple watch and 3D-Touch.

Actionable notifications (termed rich notifications in iOS) enable users to perform simple tasks with an app without having to explicitly open it, making use fast and convenient. When a users stress is detected they can receive a notification with the activity recommendation clearly visible. In the case of requiring emotion entries, the user will be prompted with another notification which can be expanded and the user can quickly enter their emotion and assign a commonly used activity to it. Due to limitations in iOS, if the user wishes to enter an activity not displayed in the pre-generated suggestions, they will be directed to the app where it can be manually entered. Another aspect of the user experience related to notifications is their frequency. After surveying a sample of student at Imperial College London, 16 out of the 20 participants stated that they would be put off by regular notifications. When asked for an ideal interval to be notified for emotion entries a two-three hour interval was deemed the smallest interval tolerable. From this it has been decided that the default notification interval will be between 2 to 3 hours, with an exact figure confirmed through the user testing phase of development.

With notifications forming a key component of interaction with this app, it has been considered that forcing the user to take out their phone from their pockets can also be an aspect of inconvenience. As a result, it was decided to make use of the apple watch device, used to detect stress, as a portal to receive notifications. Users can simply glance at their wrist, requiring far less effort to receive information. Actionable notifications are also available on watchOS, and therefore users will not be required to learn any new actions. Instead of keyboard-based text input for activities, a user will have the option to dictate the activity they are doing along with selecting their emotion.

Finally, as a means to ensure fast manual data entry, the new 3D touch interaction introduced by Apple on their two most recent iPhones (6S and 7) will be implemented enabling users to quickly enter emotions and activities by applying pressure to the app icon on the home screen. As with actionable notifications, a similar interface will appear alleviating the need to explicitly open the app and making the task of manual emotion entry faster.

D. Design Language

1) Visual Elements: As shown in the figure 2, the app will be based on a cards layout, taking inspiration from the iOS 10 design language. This results in an interface where content fills the screen, yet creates distinct boundaries between different pieces of content, helping users focus. In development, considerations were made regarding the use of iconography versus imagery. Keeping in mind the guideline to make the app universally usable (guideline 2), it is important that visual elements convey clear meaning. It was considered that the use of imagery was impactful for the activity view, contributing vivid colour and clear meaning. However, it was decided to make use of icons instead, resulting in a more consistent (guideline 1) and visually focussed aesthetic to the entire app. The benefit of icons versus imagery is most evident in the emotion entry view where the positive, negative and neutral emotion icons could be replaced with equivalent emojis. The resulting design was deemed distracting and not in keeping with the overall design language. In addition, it was determined that providing visual feedback (guideline 3) was harder to achieve with emoji images versus icons which could be made to change colour to convey the registration of a touch event to the user.

2) Colour: The importance of colour was outlined in section IV-D.2. The research implied that blue was generally the most pleasant colour to invoke calm emotion in a user. Whilst this was experimented with, it was determined that the app design may appear boring very quickly. Instead, an idea considered was to make the colour scheme dynamic to invoke a subtle sense of vitality to the application. By categorising the types of activity recommendations, a colour could be assigned to that category and the app colour scheme would be based on the current activity recommendation. For example, if running was assigned blue then a subtle hint of blue would be visible amongst the white cards layout throughout the application. A conscious effort was made to ensure that the diverse use of colour would not become distracting or overbearing. To achieve this, the use of colour was deliberately applied in gaps between the primarily white cards interface, in addition to icons and buttons. The intention was for a calming emotion to be invoked through the majority use of white. Whilst it was considered to make the colour palette accessible to those with colour blindness, it was determined that limiting the use of colours compromised the experience for users with normal colour vision. Given that the colour blind spectrum can range between yellow and blue, and pink and blue depending on the exact condition, a set of colour scheme adjustments will be provided in the settings section allowing colour blind users to still experience a dynamic colour scheme. Finally, light gradients are applied to colours across the app in keeping with the iOS design language.

3) Animation: Animation has the potential to build a visual sense of connection between the user and content on screen. However, when not used sparingly, it can become a distraction and can even confuse the user. To keep with the theme of deference in the iOS interface guidelines, and keeping the goal of achieving a calming experience, the app will make use of a very limited set of animations. Primarily, there will be fading slide transitions between the activity views and data views. As stated previously, the emotion

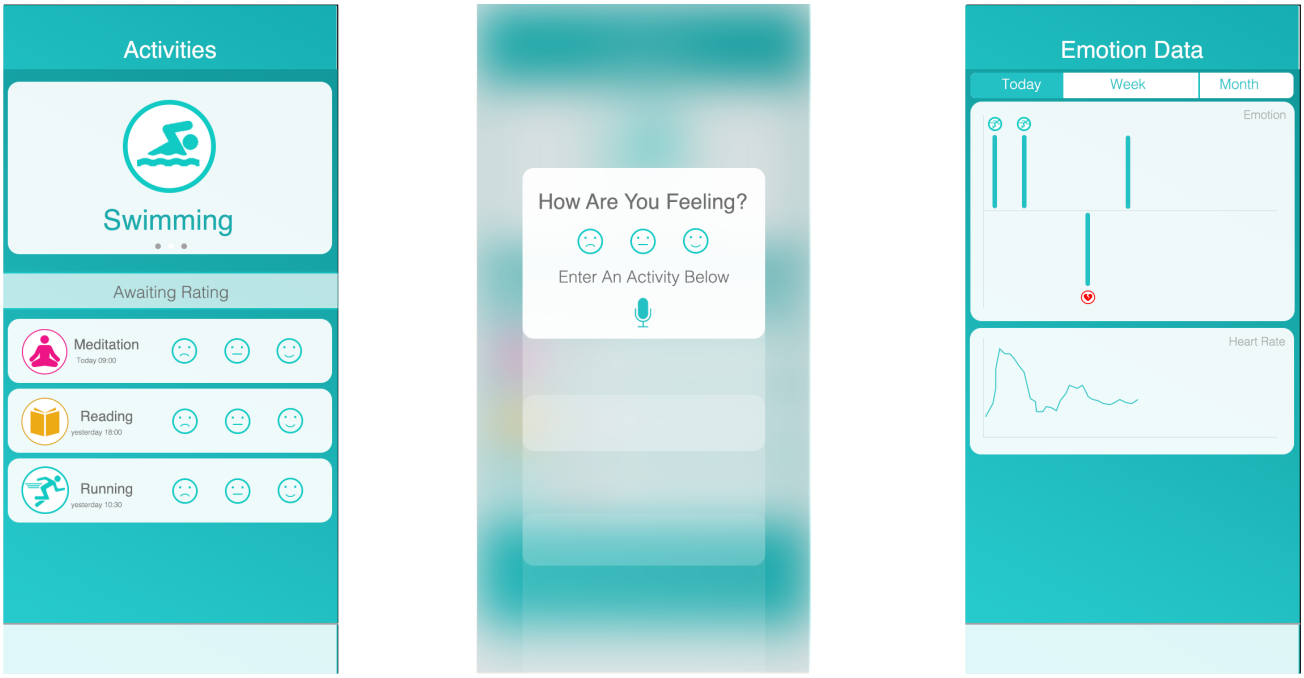

Fig. 2. Mockup Views of Hotei

entry will not be a distinct page and will instead layer on top of the two aforementioned views. The emotion entry panel will fade in and float up from the bottom of the screen, similar to animation used for Apple Watch notifications. To dismiss the panel, the user can either tap outside of the panel area, or even swipe the panel off the screen in any direction. In either case, the panel will playfully fly off the screen according to the momentum of the users swipe and the content behind will fade back into view. An attempt to visualise this is presented in the centre view in figure 2. This use of animation is intended to make the app feel fluid and vital, yet its smoothness ensures that the user remains calm.

E. Execution

As an iOS application the user interface will be designed primarily using the Swift coding language as well as xCode storyboards. Custom imagery such as the icons will be designed through Adobe Photoshop and imported to the project.

Two aspects of the app which will present technical challenges are the graph generation as well as the animations. Given time constraints, an open source library called 'ios-charts' [4] will be incorporated into the project, making aesthetically pleasing graphs easier to implement. The library supports animation allowing for the possibility of animating the bars rising from the x-axis. With regards to animations, the UIKit framework provides several API's to perform simple animations. For the most part, simple animations are contained in transitions between views. The animation assigned for the pop up card allowing users to register their emotion may require a more advance framework. It is essential that animations feel realistic to the user. Given this, Apple's SpriteKit framework will be incorporated to deliver realistic animation. The frameworks physics engine makes it possible for the user to flick the card off the screen when they have finshed their entry, and for the visual feedback to be convincing.

V. CONCLUSION

This report details the development of the user interface component of the Hotei app - an application to help student reduce their levels of stress. As a result of identifying the challenges with such a task and performing research into prior efforts to develop user interfaces a design has been created which meets a set of established principles in the field of UI design as well as the design guidelines for the iOS platform. From this point, further development will be done to refine the interface layout and the interface will be implemented through the use of Swift and other frameworks.

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