



ExpoSocial

ECE 1778 – Creative Applications for Mobile Devices

Final Report

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1. Introduction

Social Anxiety Disorder (SAD) is a debilitating and pervasive lifelong disorder that represents a major health concern worldwide, with prevalence rates ranging from 8-13% [1] [2]. It is characterized by the subjective fear of a variety of social or performance situations where an individual is exposed to possible scrutiny from unfamiliar people [3]. The individual fears that they may act in a way or display anxiety symptoms that will be humiliating or embarrassing.

Studies show that people with SAD experience significant barriers when it comes to seeking treatment, including shame and stigma, as well as the fear of judgment by others [4]. Once in treatment, remission rates can remain low if clients do not engage in their psychotherapy homework, perpetuating the need for pharmacological treatment, which still leaves 30-40% of this population unresponsive to treatment [5]. Its debilitating course, early age of onset, and high comorbidity often result in mis/underdiagnosis and inappropriate treatment [6] [7]. This leads to a cascade of negative consequences for the sufferer, including low self-esteem, significant educational and occupational impairment, frequent use of medical services, and social isolation [7].

Research shows that cognitive-behavioral therapy and in particular, Exposure Therapy, is a commonly used and effective treatment intervention for SAD [8]. Exposure Therapy involves gradually exposing the individual to their feared stimulus repeatedly until the stimulus is no longer anxiety provoking. Exposures are deemed effective insofar as they elicit a manageable level of anxiety and progressively challenge the client with more distressing exposures as they climb their fear hierarchy or “exposure ladder”. Clients are instructed to complete exposure exercises for homework between in-person sessions but homework compliance tends to be low for this population. It is not intuitive for an anxious person to remain in anxious distress for a prolonged period of time (e.g. 30 minutes) without adopting strategies (safety behaviours) to minimize their anxiety, i.e. by avoidance or distraction. These safety behaviors reinforce the notion that the person cannot tolerate the anxiety, hence why many individuals feel that the exposures are ineffective and thus not worth completing.

Since homework compliance is directly correlated with posttreatment outcome [9], we sought to develop an app that facilitates the exposure homework process by making use of various Android sensors to help keep users accountable and improve therapy outcomes. By making use of phone sensors including GPS and microphone, ExpoSocial monitors the quality of the exposure. The use of push notifications and

reminders, as well as a feature to email progress reports to a therapist will also help ensure that the user is completing their exposure homework correctly and regularly.

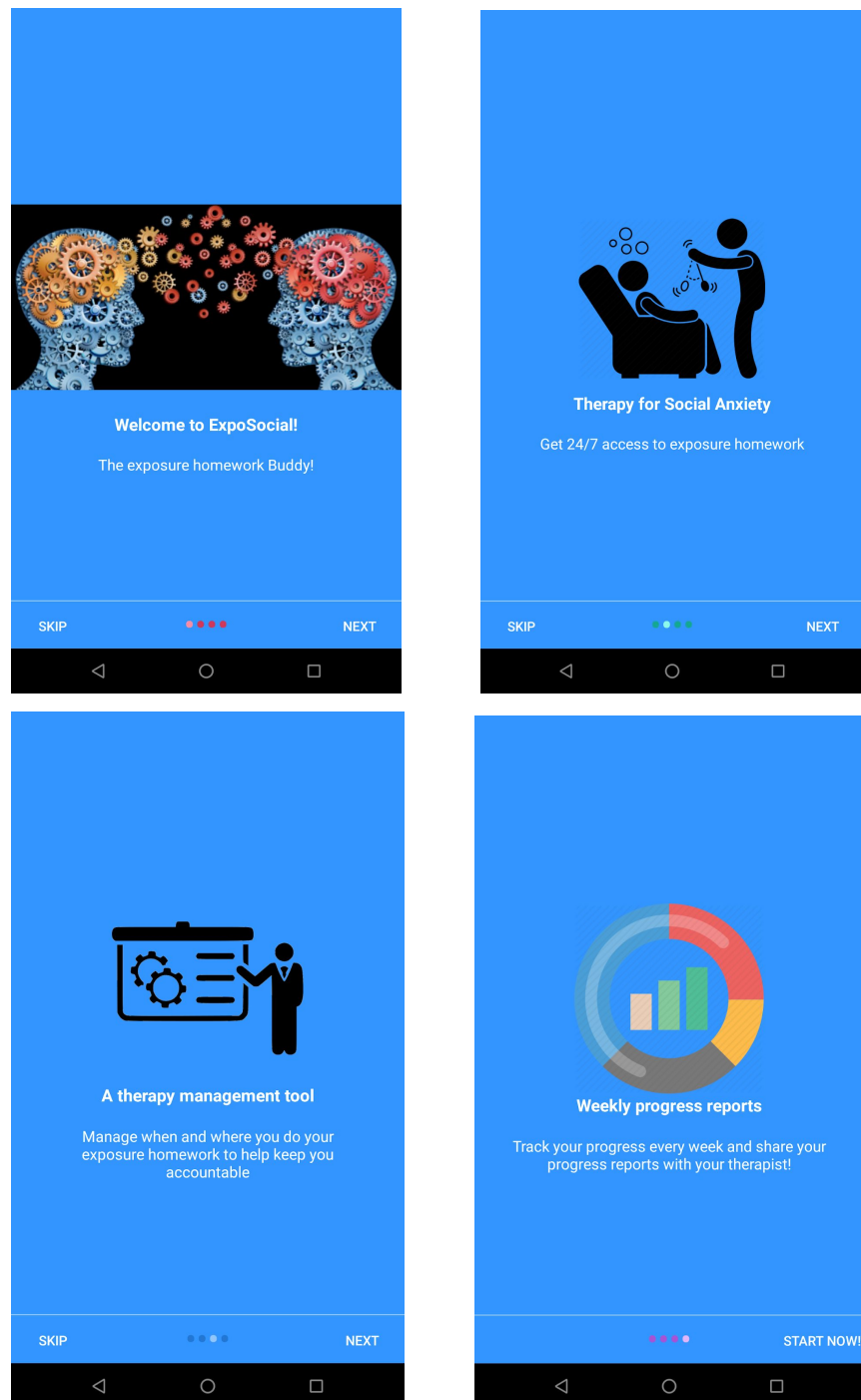


Figure 1: Welcome Screens

2. Statement of Functionality

ExpoSocial leverages Exposure Therapy as the major approach, which is a widely used and proven-effective intervention for SAD treatment in the field of clinical psychology [8]. The main functional workflow of this app will be as follows: Firstly, users' anxiety severity will be assessed by using the Liebowitz Social Anxiety Scale (LSAS), a 24-item self-report scale where users are required to rate their level of fear and avoidance about various social concerns on a Likert scale from 0 = None/Never, to 3 = Severe/Usually. Users will be prompted to complete the LSAS weekly and scores will be saved on the user's profile page. At present, ExpoSocial displays only the first five LSAS questions. Figure 2 is a depiction of how LSAS items are presented to the user.

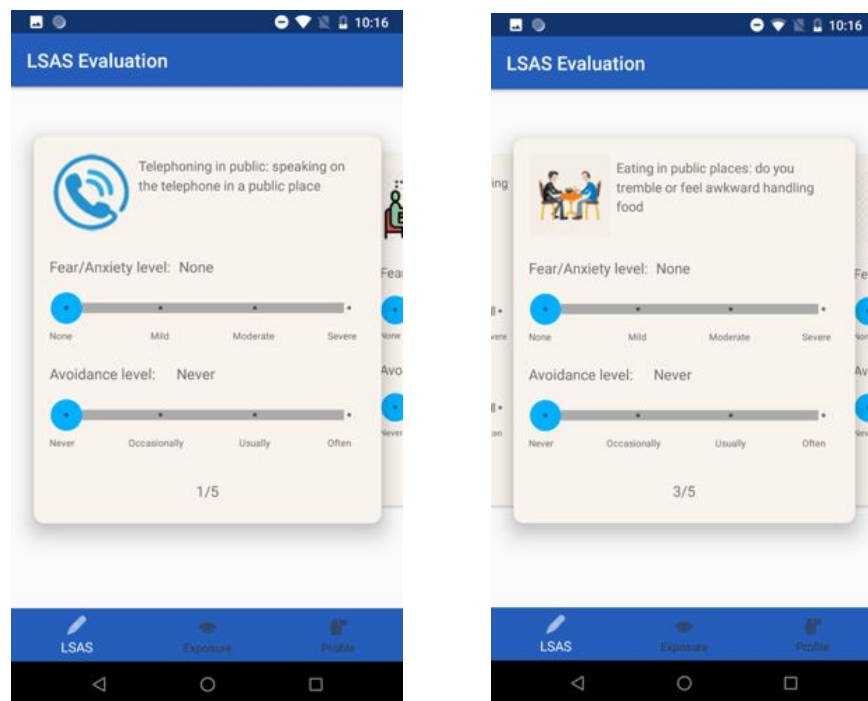


Figure 2: Sample of LSAS Questions inExpoSocial

Completion of the LSAS serves as the basis for generating an 'Exposure Ladder' or fear hierarchy based on a rank order of least to most distressing social concerns, which are user-specific. ExpoSocial generates the ladder where higher-ranking items will only be operable once the user has completed five homework exposures with the lower ranking fear before it. Figure 3 is an example of a user's Exposure Ladder. In this example, *eating in public places* is the lowest-ranking fear since the user rated this item as the least distressing and least avoided social situation on the LSAS. ExpoSocial highlights this item in blue to demonstrate that the user must start here with the least distressing

fear. Once the user completes five of these exposures, only then will the next feared item on the ladder be unlocked.

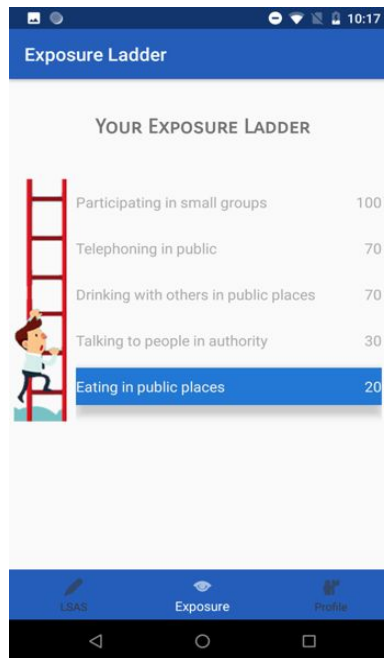


Figure 2: Exposure Ladder generated

Upon selecting the highlighted fear from the Exposure Ladder, ExpoSocial educates the user about what is exposure therapy with a series of swipeable screens before they learn more about the particular exposure they are about to engage in for homework. Users can choose to start the exposure now or reschedule it for a later date and time by selecting the 'Start Later' button, as can be seen from Figure 3.

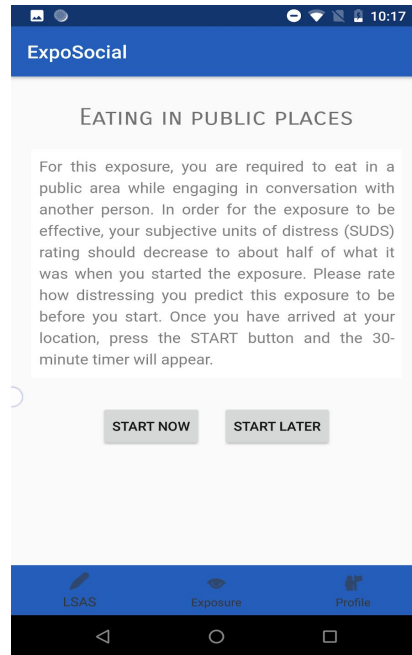


Figure 3: Start/Rescheduling Screen

Should the user choose 'Start Later', they are asked to select a date and time to complete this exposure (Figure 4). The user will then receive a reminder notification to complete the exposure on the scheduled date and time.

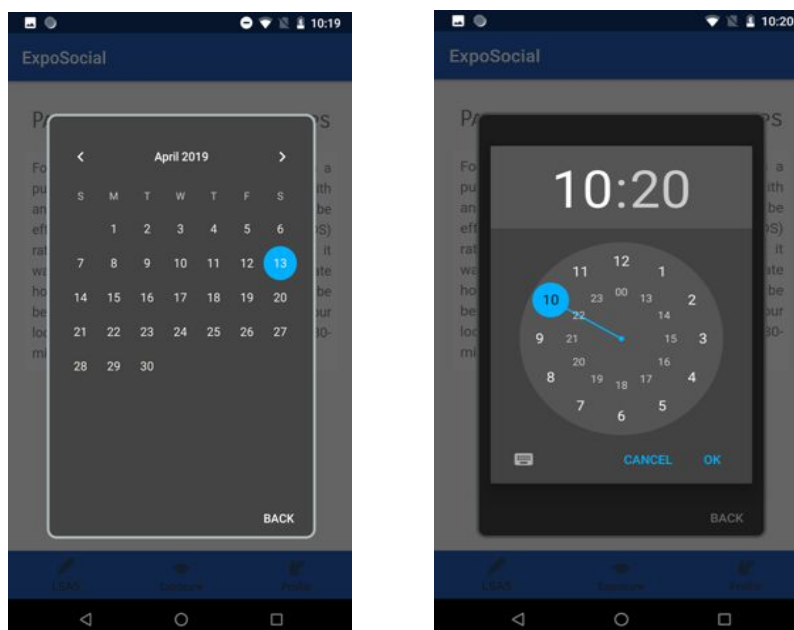


Figure 4: Selecting Date and Time

Should the user select 'Start Now', ExpoSocial will first ask the user to choose a location where they will complete the exposure. The user then is shown a map where they can either enter the location they choose, select from a list of public places near their current location, or by directly selecting a location on the map (Figure 5).

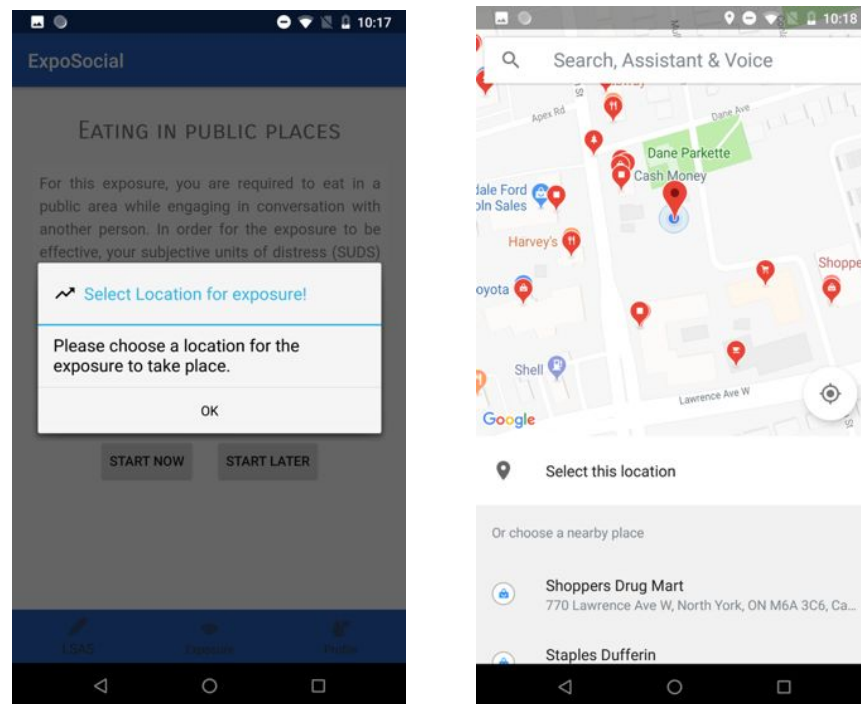


Figure 5: Select Location

The user is then asked to confirm the location they selected. ExpoSocial uses the location compliance module running in the background to track the user's location and evaluate whether or not the user is at the specified location. If the user is not at the correct location, ExpoSocial will present the shortest path from their current location to the specified location and prevents them from beginning the exposure until they have reached the specified location (Figure 6). Because location tracking using GPS is not always accurate, ExpoSocial allow the user to begin the exposure even if they are not at the desired location. If after a few minutes, ExpoSocial still reads a different location, then the exposure is terminated and the user is not allowed to proceed.

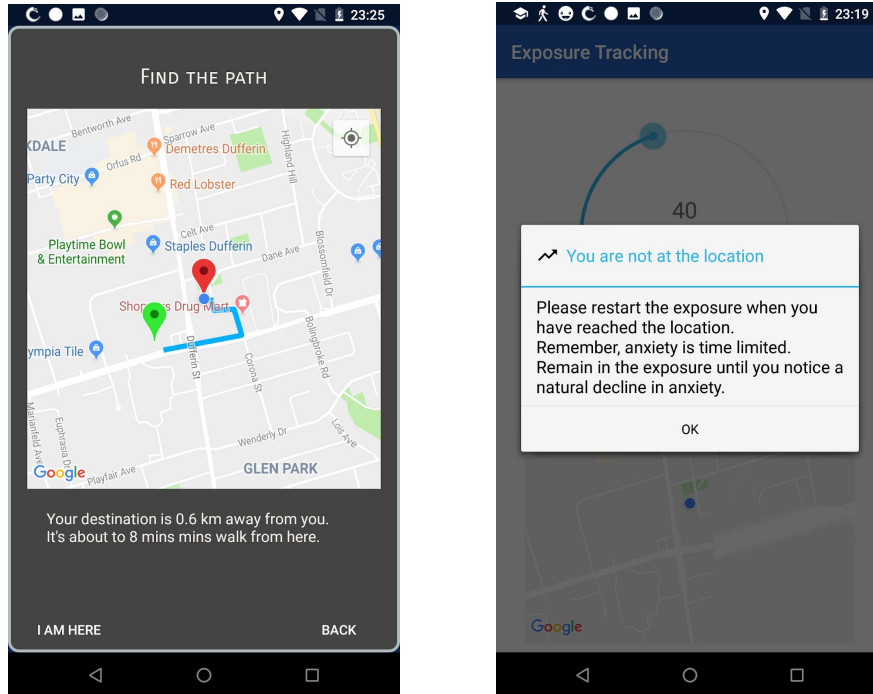


Figure 6: Location Compliance

Once the user is at the appropriate location, they are then asked to predict how distressing they think this exposure will be on a scale out of 100. This score is understood to be a representation of how anxious the user is and is measured as a *subjective units of distress* or SUDS score (Figure 7).

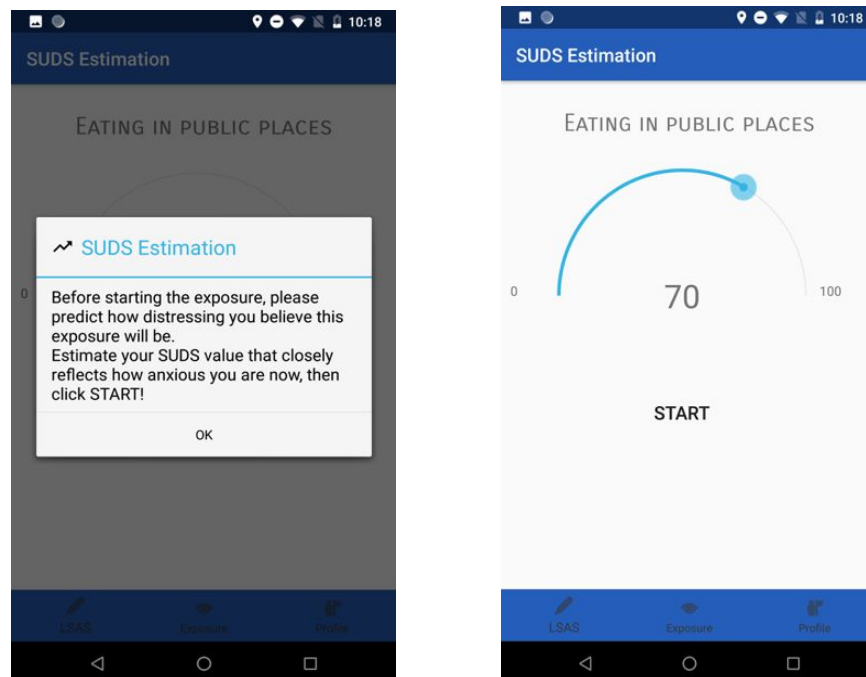


Figure 7: SUDS Estimation

Once the user has begun the exposure, ExpoSocial utilizes various sensors such as GPS and microphone, in order to monitor the quality of the exposure (i.e. is the user terminating the exercise before their anxiety reduces; are they choosing under-populated locations in order to avoid social scrutiny), as intended by both the user and the therapist. While GPS monitors the user's location during the exposure, audio recorded using the microphone will be used both as a compliance tool but also to provide feedback to the user. Audio feedback can be interpreted as the percentage of time spent (denote as p) engaging in conversation throughout the exposure, which is

calculated by following equation: $p = \frac{\sum t_i}{T} \times 100$, where t_i is the duration (in seconds) of the i^{th} conversation in one exposure, T is the duration (in seconds) of the exposure. Consistent with traditional exposure therapy, ExpoSocial notifies the user to update their SUDS/anxiety level every 2 minutes to keep an active record of the user's anxiety over time in the exposure. An exposure is complete when the user's anxiety has reduced to half of their initial estimation, or after 30 minutes has passed. ExpoSocial also ensures that the user is engaged in the exposure for at least one minute before the SUDS can be reduced. Upon completion of the exposure, users are presented with a series of questions to help reinforce the learning from the exercise (Figure 8).

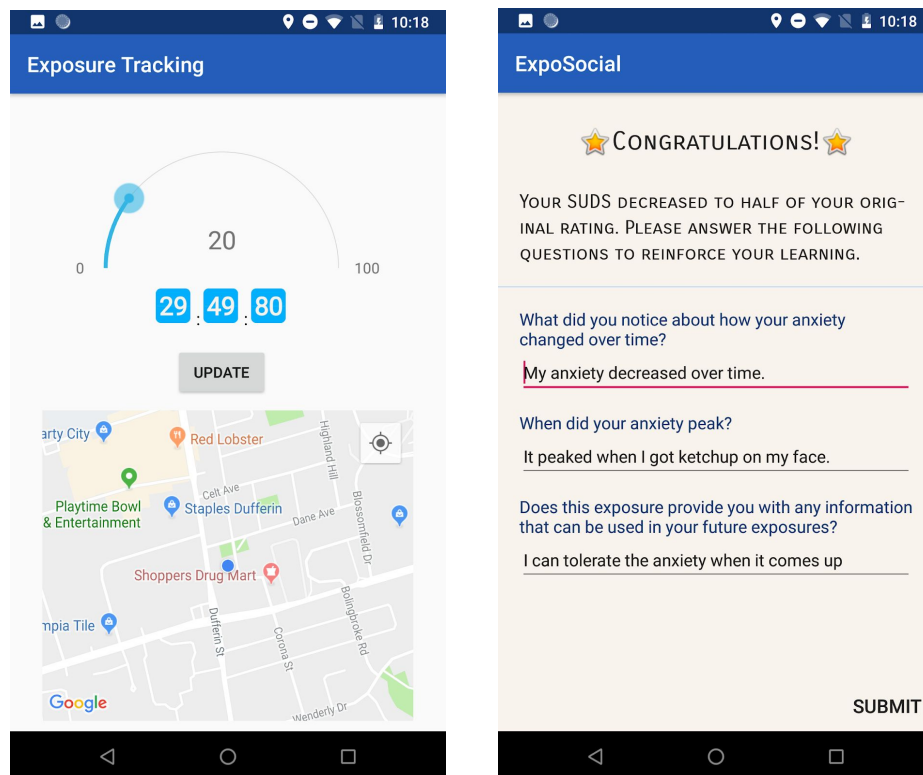


Figure 8: Exposure Tracking and Once it is completed

After pressing 'Submit', ExpoSocial takes the user to their Profile Page where they are displayed with a graphic depiction of their progress throughout the course of the week. Users are shown their (1) LSAS score, followed by (2) a graph of their anxiety (SUDS) during each completed exposure exercise, (3) a list of locations in which each exposure was conducted, (4) a graph outlining the percentage of speech detected during each of the completed exposures, and (5) any rescheduled exposures for later in the week. ExpoSocial also provides the user with the option to share the analytics/progress report as a PDF to be sent via email for both the user's and their therapist's reference.

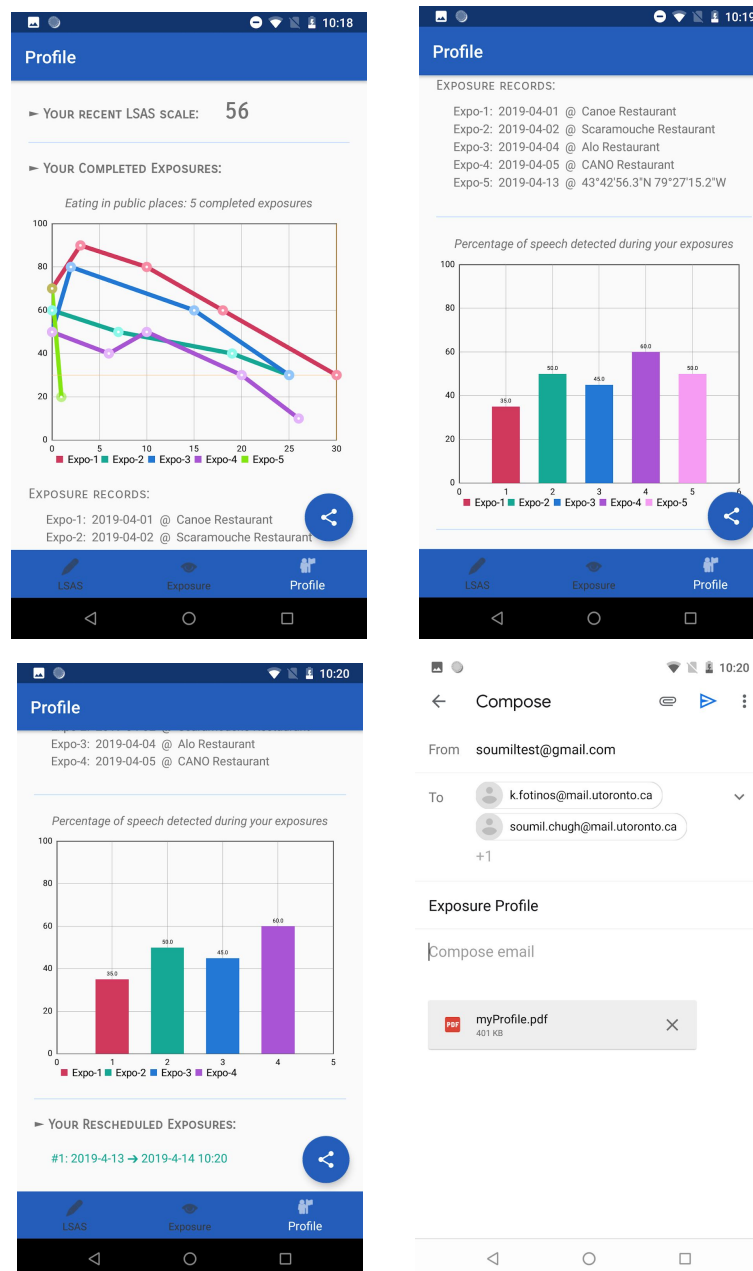


Figure 9: Profile Page

Once 5 of the same exposure is completed in the course of a week, only then will the subsequent exposure on the Exposure Ladder become unlocked (Figure 10).

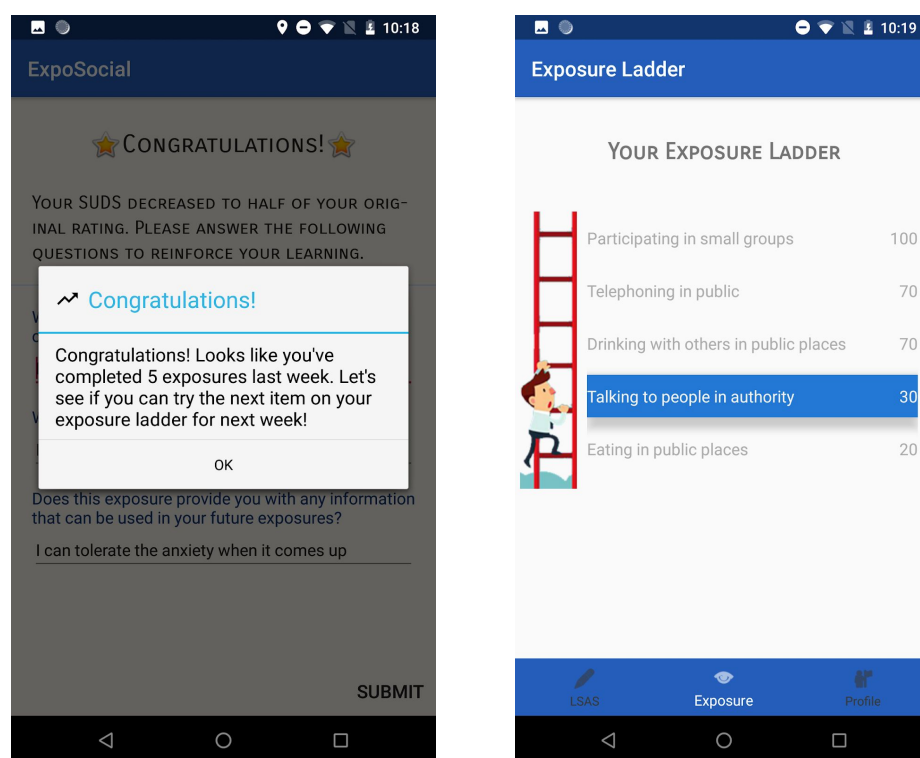


Fig 10: Next Fear is Unlocked

3. Overall Design

The functional block diagram of ExpoSocial is illustrated in Figure 11. Along with the progress of exposure therapy, functional modules can be grouped into three phases, i.e., pre-therapy, in-therapy, and post-therapy. In the pre-therapy phase, the anxiety evaluation module is responsible for generating the fear hierarchy according to the clinical standard (LSAS evaluation). The therapy admin module is responsible for educating the person about the exposure they are about to engage in, selecting a location where the exposure will be completed, asking the user about their initial SUDS level, rescheduling the exposure at a different time, ensuring that user is at the specified location and ensuring that the user is completing their exposures by providing reminders.

During the in-therapy phase, therapy evaluator makes sure that a user updates their SUDS level every 2 minutes, consistent with what is done in clinic. In order to evaluate a user's engagement in the exposure therapy, using the Android's SpeechRecognizer API, a conversation using audio recorded from the microphone is detected and the

amount of time speech is detected during the exposure is measured. Using the `isSpeechDetected` callback from the `speechRecognizer` API, ExpoSocial keeps track of the time a person has spoken during the exposure.

In addition, therapy evaluation module keeps track of the current location using the Google Places API by querying the device location every 10 seconds. Finally, in the post-therapy stage, the progress analysis module generates the visualized progress review/report as well as the follow-up questions to the user. On completing 5 exposures, ExpoSocial unlocks the next exposure.

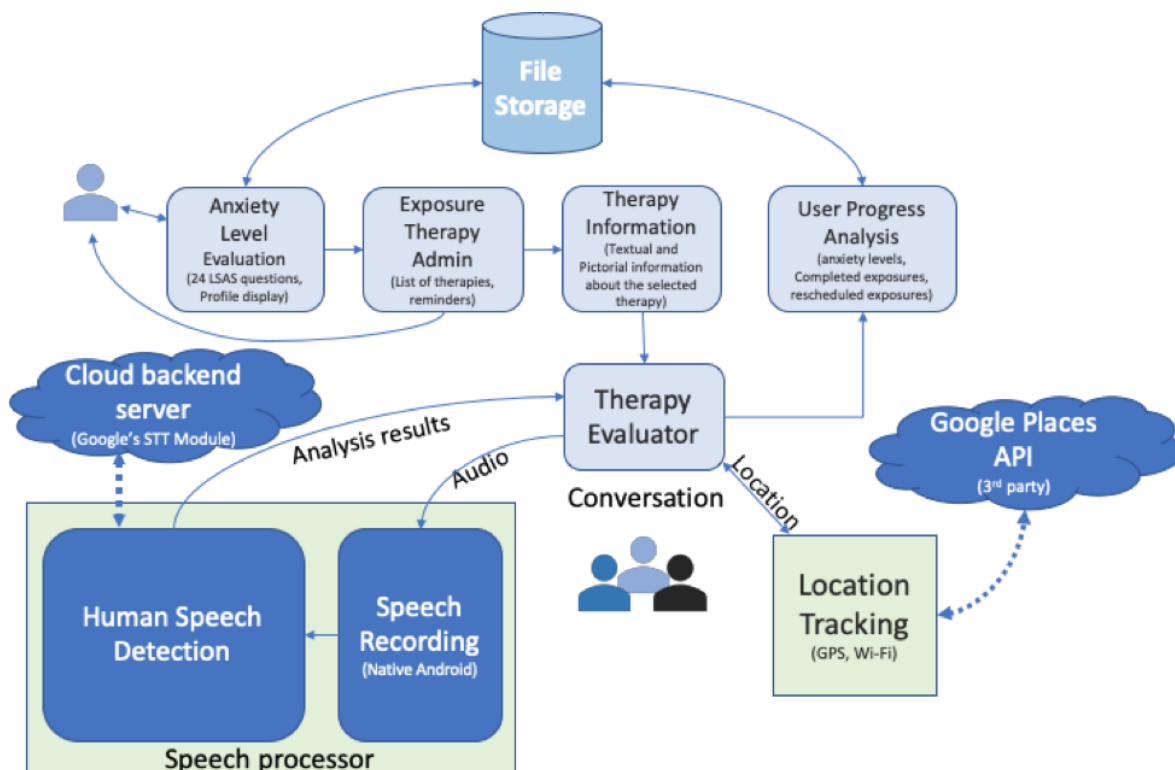


Fig 11: Block Diagram

4. Reflection

Numerous lessons were learned at various stages throughout the collaboration. Firstly, the specialist learned early on that broad ideas do not translate well into functional operations in a mobile application. So much effort is required to conceptualize and create even the most minute operation or UI screen that may be simple in theory but is infinitely more difficult in practice. Furthermore, the group learned to navigate when it was important to be detailed and when it was important to be brief and concise. The

latter was especially true for class presentations where the bulk of the presentation was about the core functionality of the app rather than the background and motivation. The group learned about the benefits of issue tracking using GitHub as the integrated project management platform. Lastly, the group ought to have spent more time considering issues of user-accountability and marketability both from therapeutic and functional standpoints.

5. Contribution of Members

	Spiral 1	Spiral 2	Spiral 3	Spiral 4	Final
Kathryn Fotinos	Research, UI design, Functional Test	UI design, Progress management	Functional testing, Progress management	Functional testing, problems follow-up, future work, and continuous improvement	Functional testing
Soumil Chugh	GPS module, Audio Recording	Therapy admin UI/database implementation (reminder/notification)	Continue to audio recording database implementation, UI/database implementation (Therapy info)	Therapy progress analysis (anxiety level report and related UI/database)	Speech detection and exposure quality metric implementation
Yan (Leo) LI	LSAS page UI/DB design and implementation	Fear ladder, exposure start/reschedule, path finding pages UI and functions implementation	Location compliance, exposure tracking pages UI and functions implementation	Profile page UI and functions implementation	Functional Integration and improvement

6. Specialist Context

Research shows that therapy outcomes are strongly associated with therapy engagement, and this is particularly true for anxiety disorders [10]. Therapy engagement is largely comprised of homework compliance, which includes engaging in behavioural experiments, or exposure exercises, between therapy visits. At present, there is no way of ensuring homework compliance in our clients, with the exception of checking in via phone or email on a daily basis. This is not only impractical but also encourages dependency, which is counterintuitive in the context of psychotherapy. ExpoSocial, the exposure homework compliance app, may solve this problem by holding the user accountable through ecological data sensing, reminders, notifications, and a visual analog of user progress over time. The user/client may feel more in control of their homework practices and more inclined to engage in a homework activity when they are reminded to complete an activity and when they are able to track their progress over the course of a week. The data collected by ExpoSocial will not only help inform subsequent in-person therapy appointments on an individual level, but may provide important information about exposure therapy as a therapeutic intervention in the digital age.

7. Future Work

In terms of future work, the group intends to implement all 24 questions of the scientifically validated social anxiety severity scale (LSAS). This will provide a framework for which to make other social exposures on the Exposure Ladder functional. Adding these features will complete the SAD version of the app, which can serve as the basis for future iterations with different mental disorders where exposure therapy is still a validated therapeutic intervention, i.e. in Obsessive-Compulsive Disorder. The group may consider adding a social networking feature where ExpoSocial users can connect with each other for peer support. Finally, cloud-based storage or a firebase server will be implemented for long-term data collection and storage for longitudinal research purposes in both the mental health and electrical engineering spaces.

8. Group Consent

Video	YES
Report	YES

9. References

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