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ECE1778 - Creative Applications for Mobile Devices

Project Proposal	*Roam Game* – Android Application to facilitate data collection in relation to one's Intolerance of Uncertainty.
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1.0 Introduction: "What and Why?"

The purpose of our project is to develop an android application that can be used as a tool to diagnose and help with the mental characteristic "Intolerance of Uncertainty" (IU). IU is an indication of an individual's mental state reflecting their tolerance in regards to the probability of future events and may be able to predict or diagnose various forms of social anxiety and depression. An individual with a high level of IU may experience negative behavioral implications in the form of stress or worry and has been associated with other symptoms such as anxiety or lack of sleep. Being able to monitor or detect high levels of IU may help Psychiatrists more accurately diagnose and prevent the escalation of symptoms.

IU tolerance is currently collected and diagnosed through a survey: (https://adobe99u.files.wordpress.com/2014/12/ius.pdf). This survey has a few shortcomings. This survey can be inaccurate, as users may not be able to self-assess themselves correctly. Another issue is that the survey process itself may not be able to capture sufficient data. Users are asked to fill out survey questions, but these questions do not capture any real time or behavioral data that Psychiatrists may find useful.

Our Project idea is to build an application that will act as a tool to facilitate IU data collection from users. Our key focus is to build a game with IU gameplay elements, where user behavior and input can be monitored and collected. Our game would aim to provide Psychiatrists with more IU data from users, while implementing a reward system to encourage users to take more risk. In addition to our User's in game IU data, our application would also need to be able to collect the regular survey data and user profile information to see if a correlation with IU actually exists.

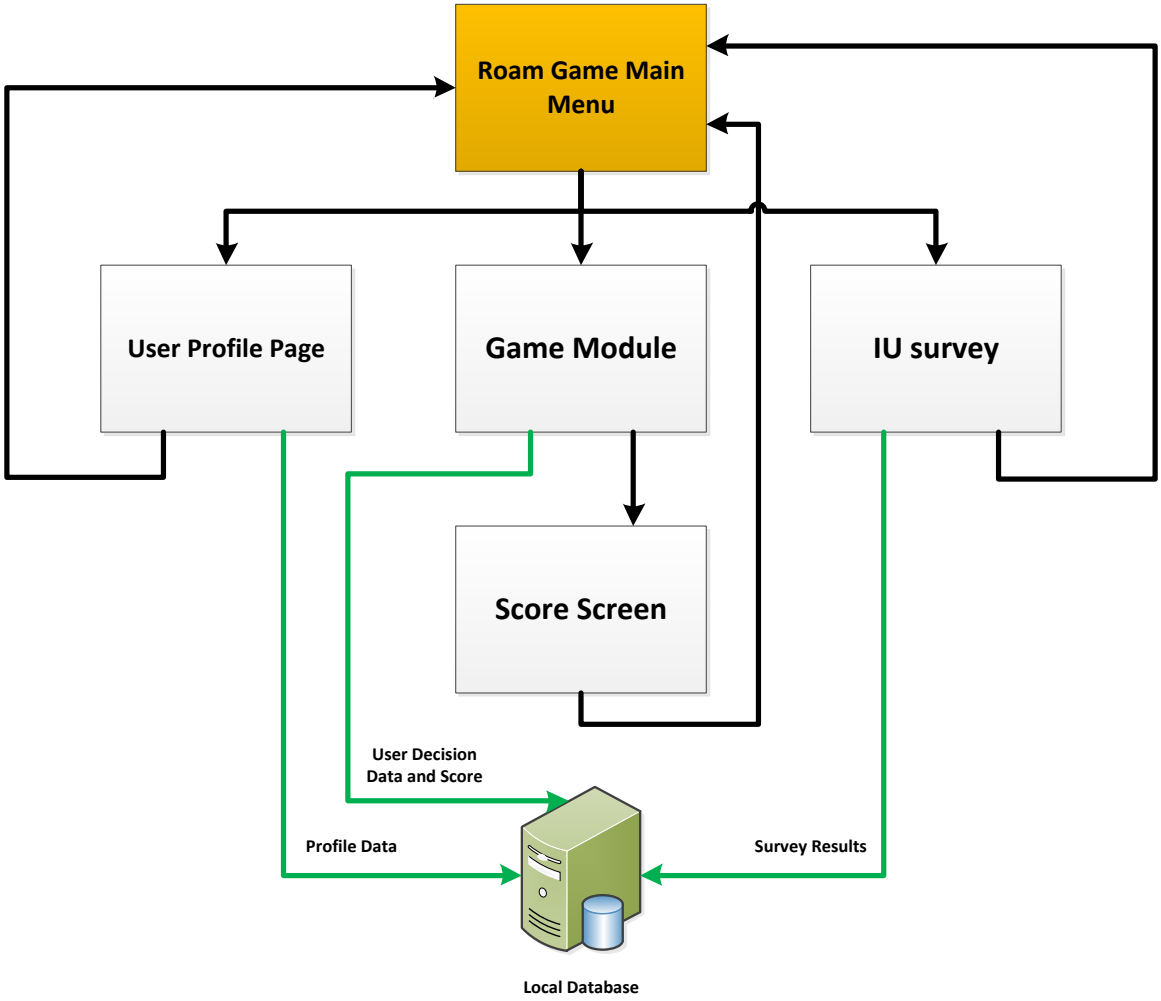
1.1 Specialist Context (External Specialist)

Our Specialist Dr. Martin A. Katzman is a Professor of Psychiatry at the University of Toronto specializing in Brain and Therapeutics. Dr. Katzman is also a professional Psychiatrist at the S.T.A.R.T (Stress Trauma Anxiety Rehabilitation Treatment) clinic in downtown Toronto. Recently, a major part of his research has been related to IU and its link with other mental health issues.

2.0 Overall Design: Block Diagram

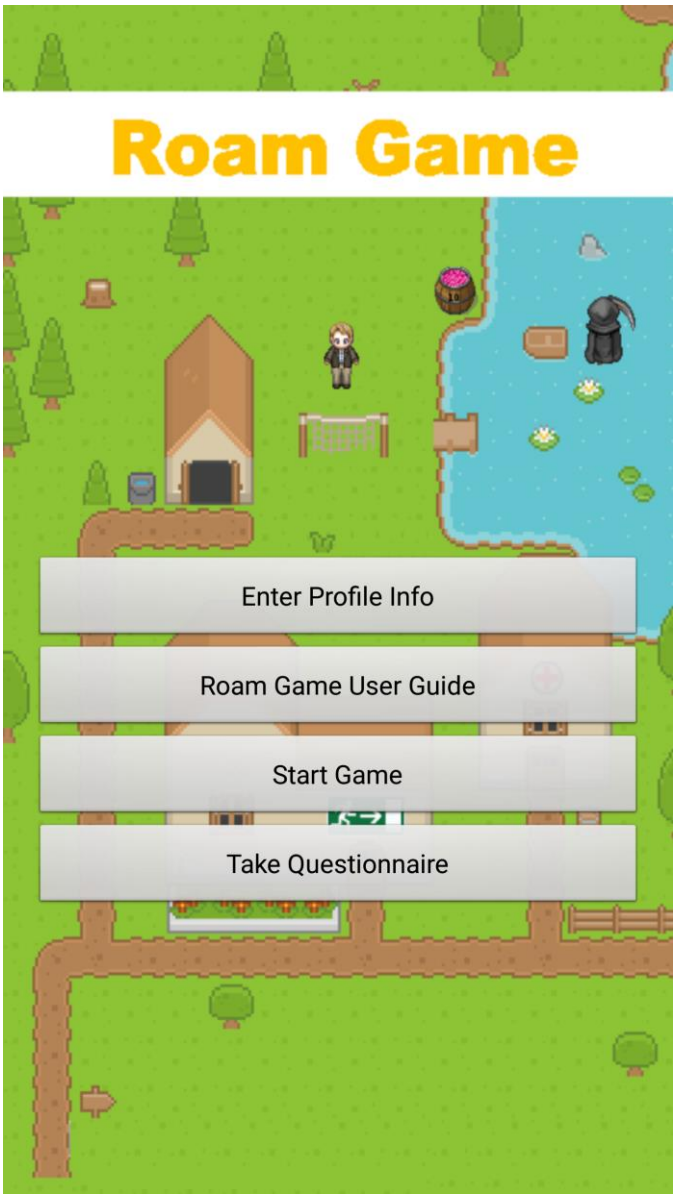
The app will consist largely of the game itself but because of its purpose as a potential diagnostic tool, we will be taking user information and also presenting the IU diagnosis survey after the user plays the game.

The main screen of the app will consist of a menu with several options: 1) Filling in Profile, 2) Playing Game and 3) Taking the survey. We intend that the patient perform these tasks in that order.



The team will create a simple SQL database that will be hold the text data associated with the user profile, game decisions and score, as well as the survey results. The game decision data includes the raw components of the IU score which includes the relative location of the user, the frequency of motion, current health and the time elapsed. Currently this database is local, but because there is only text data involved, but even with a large pool of users setting up an online database, which may be necessary if this app is distributed to multiple devices, would remain small and require only a small fee to run. Statistical analysis will be run on the server outside of the app to determine correlation with survey results.

The main menu in the actual application (entry point as indicated in orange on block diagram):



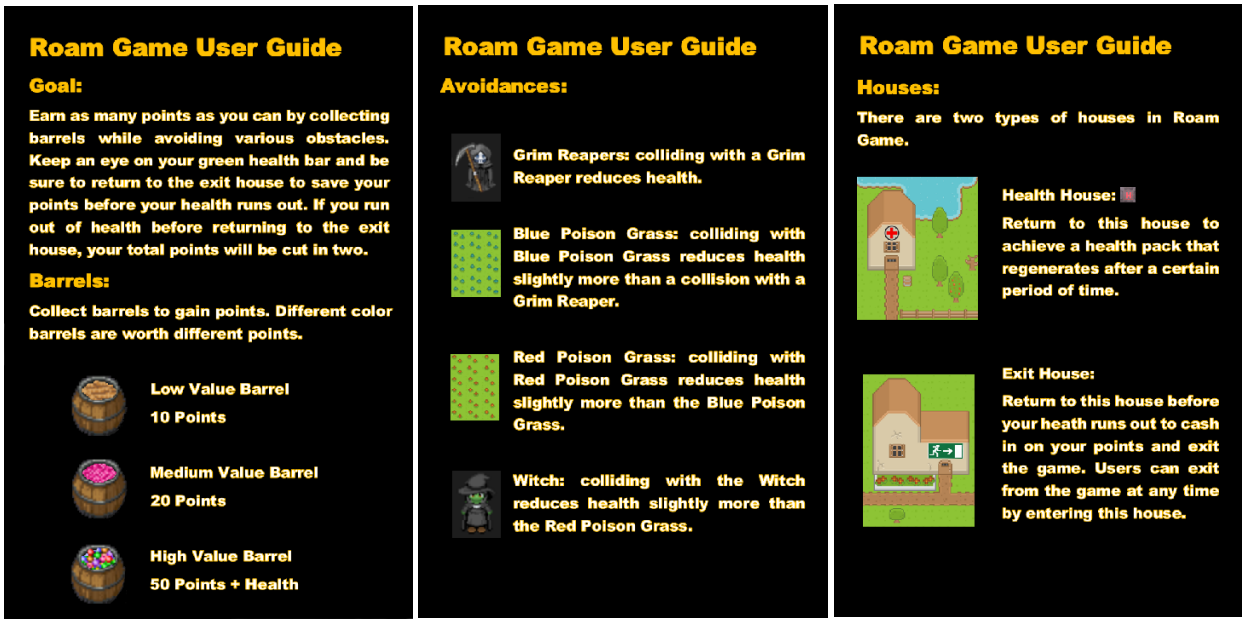
3.0 Statement of Functionality

As our goals state, our application is designed to facilitate a User's IU data collection. We have three main sources of input from User's: user profile information, game data and survey information. In terms of Application flow, we would first like user's to input some

basic profile information about themselves, then play the game and then fill out the surveys and questionnaires. This sequence is important as it ensures the user's gameplay will not be biased based on the survey questions.

3.1 Game Module

Our game module is our biggest and most complex module, and most of our effort and time went into making our game provide an environment of uncertainty. Users can first view a user guide, which will tell them the objective of the game, as well as how to play and what avoidances to look out for. This is implemented via a View Pager as shown below.



The objective of the game is to collect barrels that are worth various points, while avoiding obstacles. Users should try to score as many points as possible without their health reaching zero, and return to the exit house to cash in on their points. User movement is controlled via touching a directional keypad in the bottom right hand corner of the game screen.

3.2 Uncertainty Elements and Zones

The key element to our game revolves around making an environment that is uncertain for users. Our primary method of creating this environment is through avoidances and game Zones. There are 3 main Zones in Roam Game that we have created, each with a different level of uncertainty.

The inner zone is the safest zone in the map, and the only avoidance in this region are the Grim Reapers. The uncertainty revolving the Grim Reapers are that they spawn at random locations on the map and change directions every few seconds. They also have a 50% chance to speed up when they change direction. This region also contains the exit House which players can use to exit the game any time, as well as the health house. The caveat is that while users are safer in this zone, only the low value barrels spawn here, so users will not be able to score a lot of points if they only remain in this zone.

The middle zone is just outside the inner zone and provides a higher level of uncertainty. In this zone, in addition to the Grim Reapers, there is Blue Poison Grass. Collision with this grass reduces health slightly more than colliding with the Grim Reapers. The benefit here is that the middle value barrels spawn in this zone. If users are able to withstand the added uncertainty of the Blue Poison Grass, they can potentially score more points as the barrels here have higher value. The Blue Poison Grass spawns at random locations in this zone and disappears after some time.

The outer zone is the most perilous. In this zone in addition to the Grim Reapers, there is also Red Poison Grass. Colliding with the Red Poison grass reduces health slightly more than colliding with the Blue Poison Grass. The Red Poison Grass is spawned in much the same way as the Blue Poison Grass, however, in the outer zone the paths are narrower and some paths lead to dead ends. Therefore users who risk coming to this zone may have no alternative than to walk into Red Poison Grass. The benefit here is that the high value barrels spawn in this zone, which has the maximum points of any barrel while also

returning health to the user. This additional health can help users play the game for a longer time and collect even more points.

The final mini zone is the health house. In this house there is a health pack that regenerates after a few minutes time and returns a decent amount of health to the user. The caveat is that there is a Witch that spawns in this house and moves and changes directions rapidly. The Witch also has the highest damage to players when collisions occur. This house is just an additional uncertainty we thought of that is very high risk and high reward, similar to the outer zone.

3.3 Questionnaire (IUS + GAD7 surveys)

After completing the game users can take the IUS and GAD7 surveys to complete their data collection. Currently this information is associated with the user profile and can be pulled from the database in the future as inputs for statistical analysis.

3.4 IU Algorithm

Our current IU algorithm is a naïve implementation and is used to show the potential of using game data to predict a user's IU. We display a current IU score as well as a cumulative IU score based on the user's behaviour in the top left hand corner of the screen. The current IU score is calculated based on the user's movement and distance from the exit house in terms of two factors as follows:

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IUFactor1 = 15 + 60f * (1 - (player_speed/180f));
IUFactor2 = 12 + 48f * (1 - (health/max_health))*(1 - ((movement)/distance));
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We tried to model IU score based on the IUS survey score calculations. In the IUS survey, there are questions with values ranging from 1 to 5, separated into two factors with maximum scores 75 and 60 respectively. A high score for Factor 1 represents a mindset that: "Uncertainty has negative behavioural and self-referent implications." A high score for this Factor 2 represents a mindset that: "Uncertainty is unfair and spoils everything."

We replicated these ranges of values for our two on screen IU Factors. We also tried to get game data to match the definition of each factor. For instance for Factor 1, which is a reflection of negative behaviour, we modelled the value for this factor based on the users speed and movement, where moving slowly or hesitantly would represent negative behaviour. For Factor 2, where the mindset is that uncertainty is unfair and spoils everything, we tried to model this factor based on the user's distance from the safe house and health level, indicating an unwillingness to venture to regions where the game outcomes are more random or unfair.

3.5 What Worked Well and Didn't

We believe that our game module incorporates effective uncertainty elements that offers real trade-offs. We also feel that our IU score is successful in showcasing that our uncertainty elements in the game are measureable based on the raw data that we collect. The key challenge in our game was to actually have the game data distinguish between players that might have varying levels of IU. We had to ensure that there was a clear benefit for taking more risk, as opposed to playing it safe without having an obvious optimal solution, which all users might end up defaulting to. Overall, we felt that we developed a good platform of getting user behaviour data that will in the future be useful for researchers to use and directly apply to IU diagnosis.

In terms of what didn't go so well, we felt that designing the uncertainty elements should have been done using feedback of the target group. Because we were restricted on time and did not have time to set up trials, we simply had to go on what we felt were elements that would distinguish people with different IU, e.g. the willingness to go into a region of poisonous grass that can randomly spawn around the character.

4.0 Lessons Learned

One aspect of project development that we did well and that was reinforced by this experience was the idea of the spiral approach and more specifically, when embarking upon new technical tasks, starting off simple and building from that knowledge rather than try to be specific about technical goals early on. This was the first game that we developed so we started off with a popular gaming platform and began learning by performing a tutorial and creating a simple 2D game. This allowed us to understand the limits and difficulty of the things that we wanted to implement so that we could quickly shift gears if we needed to, instead of diving deep with a narrow minded vision of our game.

Something we could have improved on was doing earlier brainstorming for the uncertainty aspects. It was not until halfway through game development where we would actually test out the uncertainty elements to see if it would elicit different users to make different decisions. I felt that we should have created a much more simplified sandbox version of our game to implement features and test them out. This was due to our focus on creating a game, but we sometimes strayed from the purpose of creating a tool that could get valuable user data used for predicting IU.

5.0 Contribution by Group Members

Justin's contribution was setting up the main gameplay environment and the user interface for controlling the character. The gameplay environment consisted of finding open license sprites online and converting these into walking animations for the character and various hazards as well as designing the tiled map and implementing obstacles within the map. As for the user touch interface, Justin was involved with designing the touch directional control pad to move the character as well as the information layer, which includes the health bar and score.

Vinu's contribution was implementing the uncertainty hazards in the game, such as the poison grass and the reapers as well as designing the menu, surveys and gameplay instructions. Vinu had to configure where to spawn the poisonous elements and designed an algorithm for how it would form to create a natural environment of uncertainty for the player. He was also responsible for implementing scrollable surveys that were intuitive to use and a succinct user guide.

6.0 Specialist Context

Our specialist Dr. Katzman is an external specialist. We believe this section is not applicable to our group based on the report guidelines since we have no designated specialist as outlined in the requirements for this document.

7.0 Future Work

In terms of data viewing, we could create an online console for Dr. Katzman or any Psychiatrist to view the data collected from Users in terms of game IU behavior, survey data and profile data. This would involve having the local database update to a centralized server.

In terms of data collection, currently we only capture user input based on their status, movement and location in game. We could also capture data such as frequency of touch

input, or force of touch screen input. We could also collect sensor data from the Accelerometer or Gyroscope or even leverage external sensors such as a heart rate monitor or temperature monitor. This would provide further data in our platform for researchers to use.