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# eXperience

Experience Sampling for Android

## Final report

## 1. Introduction

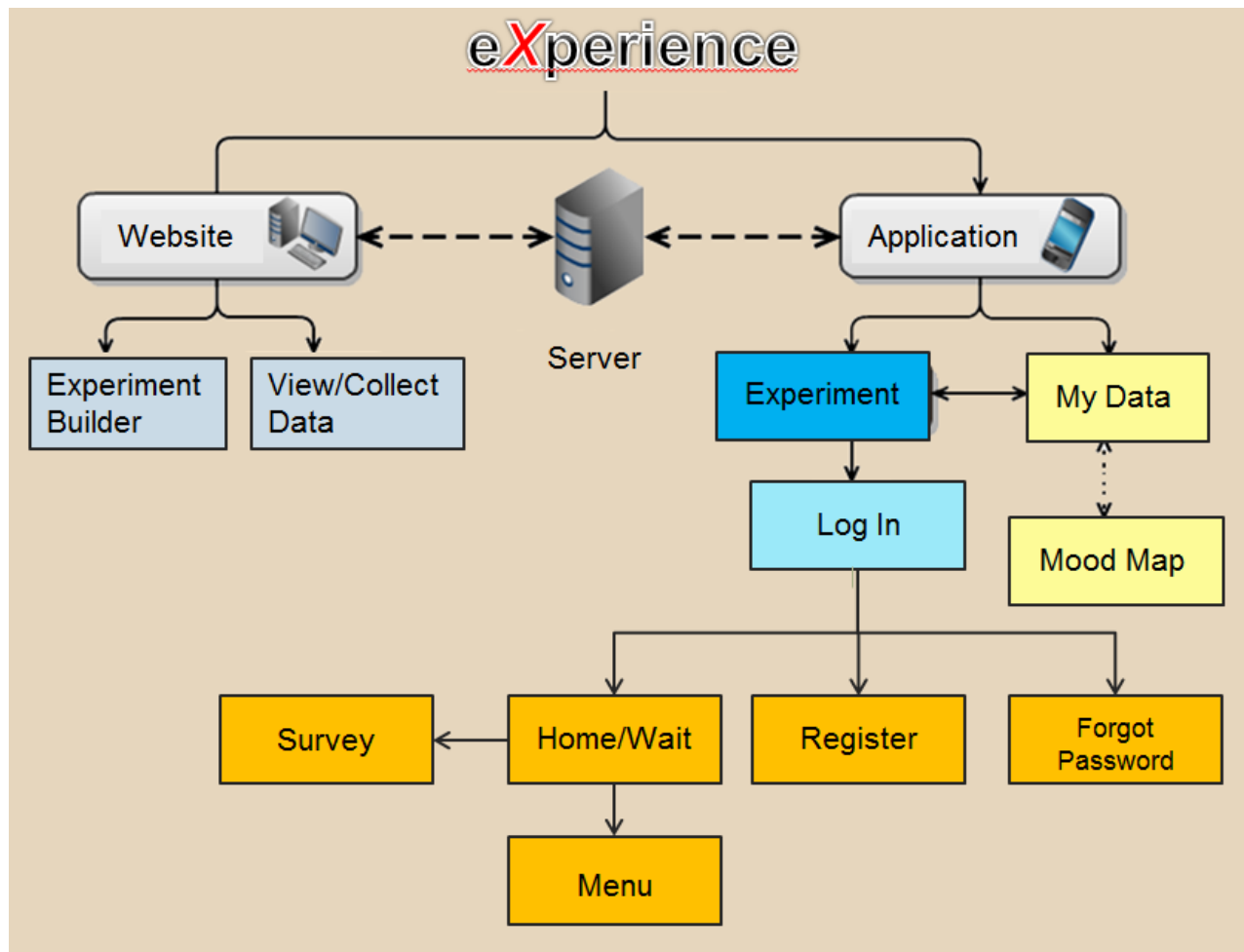
In order to study subjective experience, psychologists rely on self-report data. Most of these measures, however, are collected retrospectively and may suffer from recall biases. Researchers have long been aware of the fact that people are unreliable and often unable to provide accurate retrospective information about their daily behaviour and experience (Larson & Csikszentmihalyi, 1983). For example, how you remember feeling yesterday after lunch might be quite different from how you actually felt at that moment. This is because thinking about a particular experience retrospectively outside of the context of the situation allows distortions and rationalizations to play a role in how we reconstruct a particular experience. Thus, data collected retrospectively will suffer from the same shortcomings. In the 1970's, psychologists realized that a more ecologically valid method of studying subjective experience would be to collect such data at the exact moment an event takes place. Researchers took advantage of the emerging "beeper" technologies of the time for use in this type of research. Signalling devices were carried by participants who were instructed to make notes of their current subjective experience upon the triggering of the device's alarm at random points in time. This research methodology became known as the Experience-Sampling Method (ESM). The general purpose of this technique is to study the subjective experience of people as they interact in their natural environment, in a way to ensures ecological validity. The goal of this work is to identify and analyze how patterns in people's subjective experience relate to wider conditions of their lives such as mental health and well-being (Hektner et al., 2006).

Since the 1980's this methodology has been modified and improved as allowed by the available technology. For example, in the 1990's as PDA's became available researchers developed compatible ESM software. In the early 2000's, as smartphones began to emerge, researchers developed software compatible with Windows Mobile. Surprisingly, however, despite the explosion in smartphone use and development, no significant updates have been made to this methodology, and to date there are no dedicated applications available for either Android or iPhone.

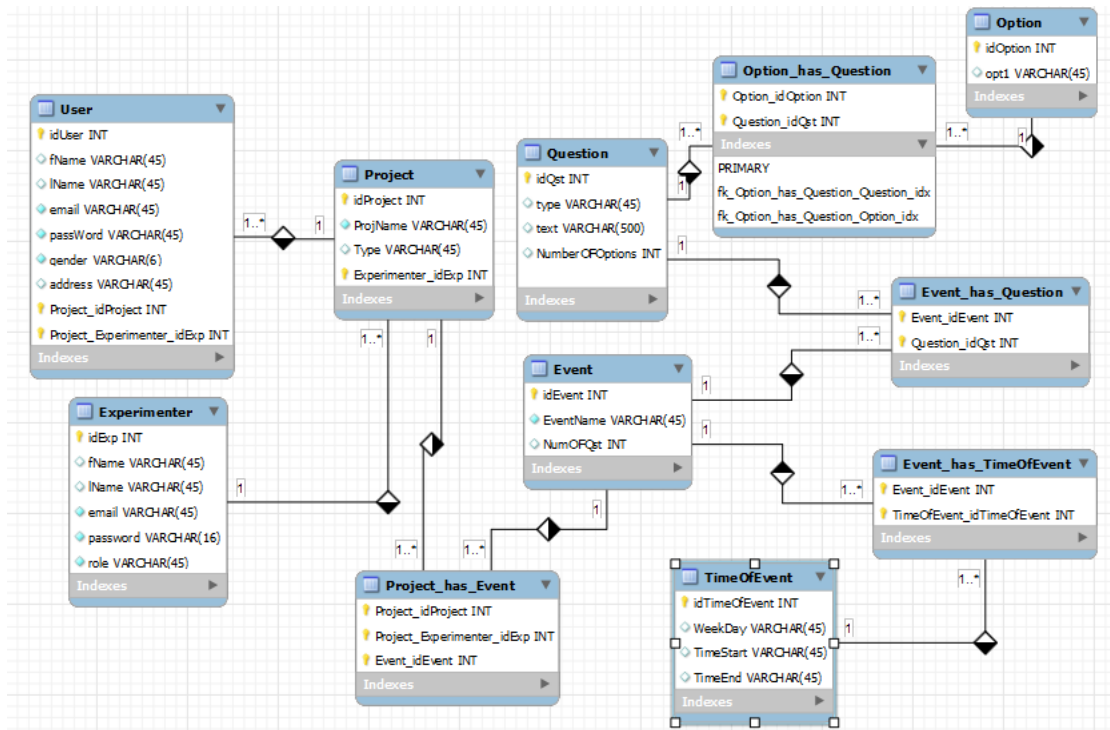
The current project takes advantage of some of the technologies available in today's devices and makes significant improvements over previous experience sampling methods. Our goal was to develop an application that would be ready for use by psychology researchers to study subjective experience.

## 2. Overall Design

Our app required that we developed two modules as shown in the block design below. The first module consists of a **Website** used by researchers to create experiments through **Experiment Builder** and retrieving participants' data (**View/Collect Data**). The second module is the actual Android **application** for the device, where the user is prompted at a certain time to complete a survey (**Experiment**). In addition, the app allows the user to browse and visualize their data via **My Data**. Critically, the experimenter's website and the user's Android app communicate in such a way that experiment questions and settings are downloaded to the device wirelessly, and data entered by the user is uploaded to the server for access by the experimenter. All data is stored in a SQL database in the server.



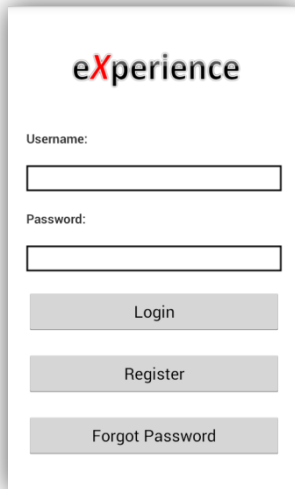
Block Design



**Database schema**

The chart above is a schematic representation of the SQL database where all information is stored and organized in different tables. One table for “users” or participants’ information, another for experimenters’ information. Other tables (Project, questions, event, options) keep all the parameters for the experimenter. Finally, other tables store all the data collected from users (Project\_has\_event).

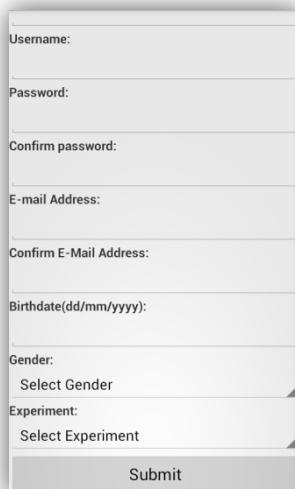
### 3. Functionality & Screenshots



The screenshot shows the eXperience login interface. At the top is the eXperience logo. Below it are two input fields: 'Username:' and 'Password:'. Under the password field are three buttons: 'Login', 'Register', and 'Forgot Password'.

#### Log In

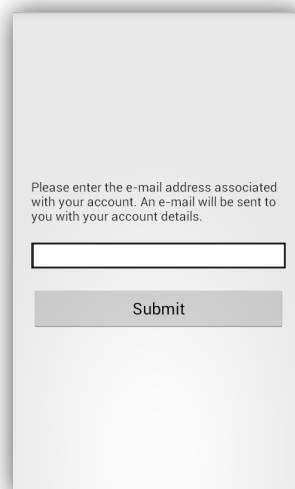
From this screen a user is able to sign in ("Log in"), create an account ("Register"), or recover their password ("Forgot Password"). The account information is validated by checking the 'person' table in the database.



The screenshot shows the eXperience registration form. It contains several input fields: 'Username:', 'Password:', 'Confirm password:', 'E-mail Address:', 'Confirm E-Mail Address:', 'Birthdate(dd/mm/yyyy):', 'Gender:' (with a dropdown menu labeled 'Select Gender'), and 'Experiment:' (with a dropdown menu labeled 'Select Experiment'). At the bottom is a 'Submit' button.

#### Register

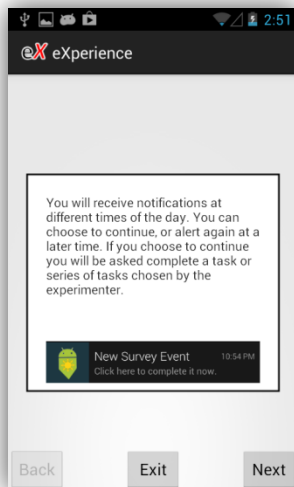
The user must fill out the form with personal and experiment information. Once the user submits a filled form, two things will occur. An account is created with the specified details, and the account user will be sent a confirmation email acknowledging the account creation.



The screenshot shows the eXperience forgot password page. It features a text prompt: 'Please enter the e-mail address associated with your account. An e-mail will be sent to you with your account details.' Below this is an input field for the email address and a 'Submit' button.

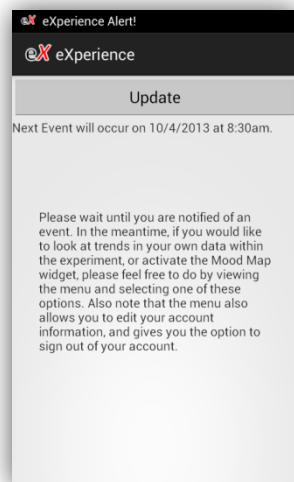
#### Forgot Password

In order to retrieve account username and password, the user must provide his email address. An automatically generated email will be sent to the email address with the account username and password



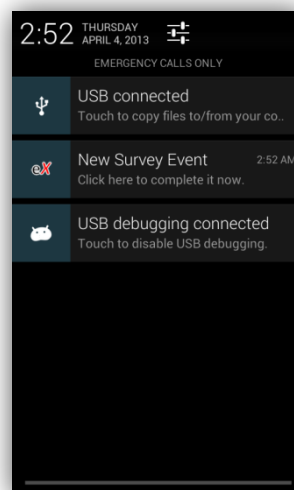
## Instructions

Once a user logs in, they will be presented with instructions on how to use the application. The user can click the exit button at any time to move to the home screen.



## Home/Wait Screen

In the background of this screen, the application loads a schedule of surveys and sets up the alarm notifications. If the event shown has already passed, the user can tap the update button to get the next closest future event to appear. Using the menu, the user can also access the 'My Data', 'Mood Map', and 'Account Info' screens.



## Notification

When a survey event occurs a notification appears in their notifications bar. The user will have to click on the eXperience notification which sends them to the questions screen.

## Questions Screens

The questions screen loads the survey questions by dynamically populating the pre-defined question type layouts. There are currently three types of questions that the user can be asked: a slider-type question, a checkbox type question, and a textbox type question. In order to move from question to question, the user will need to tap the 'Next' button. A list of questions and their respective answers are stored to a results table, along with the date, the time, and the GPS location of where the survey was completed.

Please fill out the survey below.

Q6: Please comment on your current emotional state

Submit

Q. Type 1

Please fill out the survey below.

Q3: Which of the following emotions are you experiencing?

- ☐ Happiness
- ☐ Sadness
- ☐ Fear
- ☐ Anger
- ☒ Other

Next

Q. Type 2

Please fill out the survey below.

Q2: Please rate how are you feeling right now (mood)?

Negative Positive

Next

Q. Type 3

## My Data

This function displays the history of survey results from the user's account. Using the menu, the user has the ability to view their data from the results table in three ways:

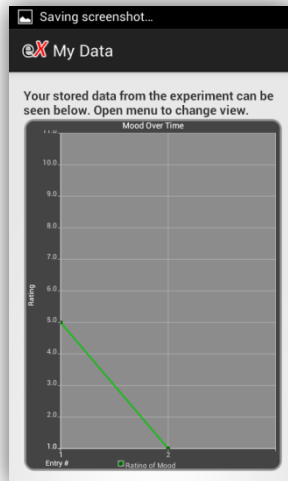
- Table view displays all of the survey questions and results as well as the time and date they occurred
- Graph view displays the user's mood over time
- Pie view displays the user's distribution of moods

**@X My Data**

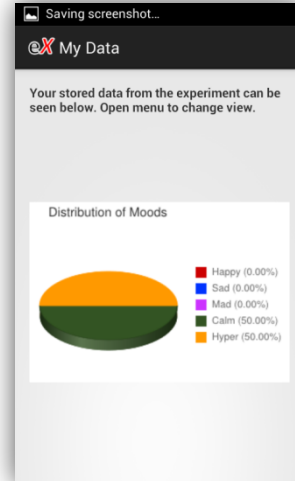
Your stored data from the experiment can be seen below. Open menu to change view.

Entry #	Date/Time	Q1: Please select the word that best describes your current mood.	Q2: Please rate how are you feeling right now (mood)?	Q3: Which of the following emotions are you experiencing?	Q4: Please rate the intensity of this emotion.	Q5: What are you doing right now?	Q6: Please comment on your current emotional state
Entry 1	04/04/2013 - 02:45 am	Calm	5	Happiness	5	Watching TV	
Entry 2	04/04/2013 - 02:45 am	Hyper					

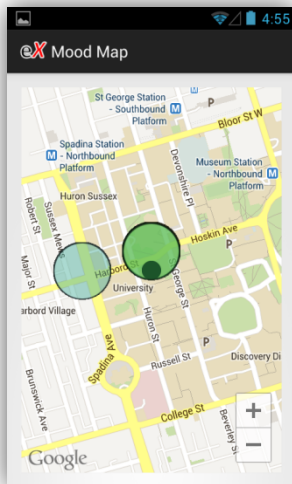
Table View



Line Graph (Mood vs Time)



Pie Chart



## Mood Map

Places moods on a localized map by their GPS locations. Once the map is loaded, the user has the ability to filter what is marked on the map based on specific moods by using the menu

Your current account information can be seen below. Note that you cannot change your Username, Gender, or Experiment.

First Name:  
ece1778

Last Name:  
student

Password:  
.....

Confirm password:  
.....

E-mail Address:  
ece1778student@utoronto.ca

Confirm E-Mail Address:  
ece1778student@utoronto.ca

Birthdate(dd/mm/yyyy):  
11/11/1985

Save Changes

## Account Info

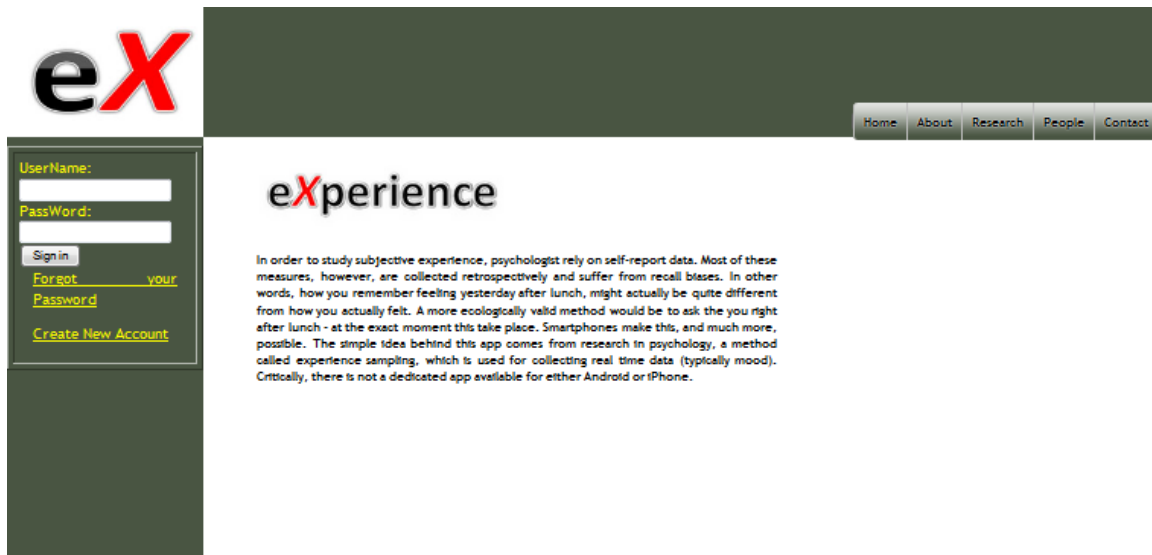
The user has the ability to view and edit his account details, but will not be able to edit their gender, experiment, or username for stability purposes



## Website

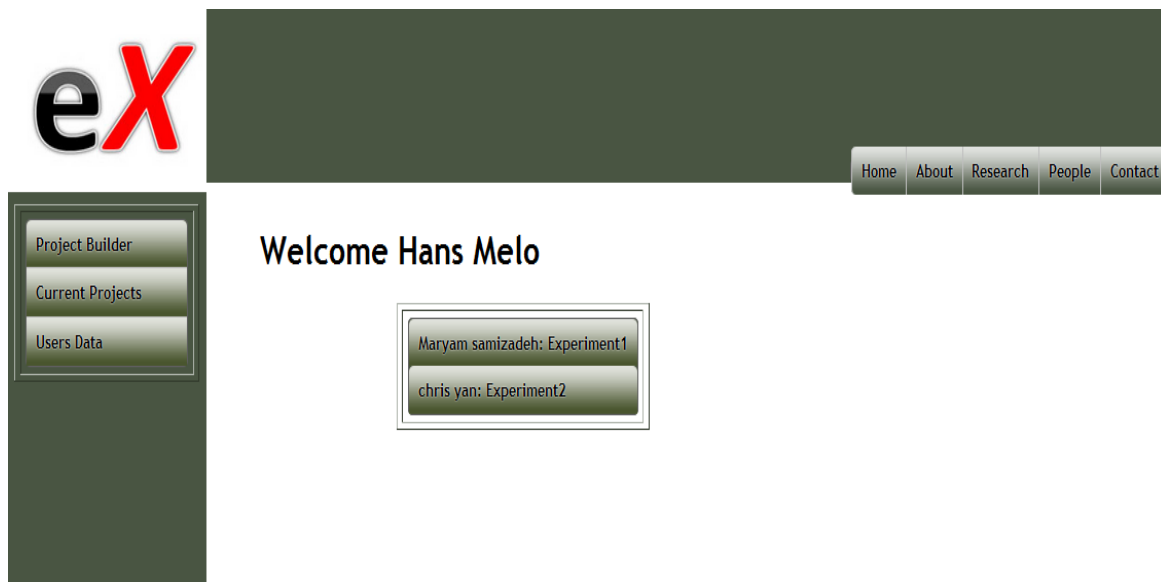
### Log In

Start page where an experimenter can log in, create an account, or recover his/her password. The account information is validated by checking the 'experimenter' with the database.



### Home

Experimenters are presented with their existing projects and the users registered. An experimenter can choose to build a new project, view current projects, or view the users' data. The menu bar is in all the pages and it gives the experimenter options to move to the homepage.



## Current Project

Here, experimenters are able to change the project's details by selecting the specific project in drop down menu. They are able to change name, date and time of the event, questions, and also the status of the project. By clicking the save button, everything will be saved in database and the application on the user's mobile phone retrieve these information from database.

**eX**

**Build Your Project**

Project Name:

Current Events:

New Event:  Number of Events:

Status:  Number of Questions:

Include Questions And Orders:

Questions

Questions

Questions

Questions

Repeat:

☐ Everyday

☐ Monday

☐ Tuesday

☐ Wednesday

☐ Thursday

☐ Friday

☐ Saturday

☐ Sunday

Time:

Start Date:

Start Time:

End Date:

End Time:

## Project Builder

Experimenters are able to create a new project and associate a new user to it. And also, existing events with their questions are presented in this page for the experimenter to reuse it.

Build New Event

Event Name: <input type="text"/>	
Current Events: <input type="text" value="Morning"/>	
Current Questions:	
<div>Please select the word that best describe your current mood! Please select the word that best describe your current mood! Please rate how are you feeling right now(mood)? Which of the following emotions are you experiencing? please rate the intensity of this emotion. What are you doing right now!? Please comment on current emotional status</div>	
Include Questions And Orders:	
Question1 <input type="text"/>	Question4 <input type="text"/>
Question2 <input type="text"/>	Question5 <input type="text"/>
Question3 <input type="text"/>	Question6 <input type="text"/>
Repeat: <input type="checkbox"/> Everyday <input type="checkbox"/> .. <input type="checkbox"/> ..	Time: <input type="text"/>

## What worked ...

For the application, all of the design's planned functions were functioning in an offline version. This means that for all of the screens that a user would see and interact with, as specified in our design, worked when dealing with local databases which were housed on the device running the application.

## What didn't work and why ...

For the online version, there were a few issues with the database implementation. For our implementation we used an SQL server which was housed on a local network. The major issues with it were the long loading times of data from tables, and the inability to write to tables in the database from the application. One explanation for these issues was the implementation that we used to access the database. To do so from the application, we used a Java Database Connectivity (JDBC) connector, which provided

the simplest solution as it allowed for direct access to the databases, but the most problematic as it was fairly difficult to debug. It is because we never got the SQL server to work fully with the application that we were not able to implement a web service to replace the JDBC connector. Normally, in internet-based applications which use SQL databases, tables are accessed through some sort of web service which provides a level of security as it helps to prevent SQL injection, which allows unauthorized people to make malicious changes to the database.

#### **4. What did you learn – what would you do differently?**

In general, we learned how to take an idea of an application, plan it out as in terms of its functionality, and finally to implement these ideas in a working application for Android. For this, programmers learnt basic principles of psychology research including for example how researchers study emotions, and the apper became familiar with the sensors (GPS) and other capabilities of smartphones. All team members learnt of the limitations of current experience sampling methods such as the lack of integration of contextual information (i.e. location) mostly due to device and software limitations. We learned how to implement several open-source and Google APIs for Android application development including Google maps. We also learned how to implement the application as a service so that users would be able to receive notifications at specific times even when the application is running in the background.

If we had the opportunity to re-do this project there are a few things that we would do differently. First, we would start by focusing on essential functionality rather than specific features so that we would have all of the basic functions even within a tight deadline. For example, we began by programming specific questions that would appear in the survey, without yet having the architecture to store the data. Second, we would have more frequent and consistent communication between group members to minimize misunderstandings about any of the features or facets of the application. Third, we would implement a faster and more reliable solution for our databases such as a cloud-based service (Amazon EC2 or Google App Engine) minimize issues with retrieving and writing data. This would greatly improve functionality and efficiency of the app from the start and would have helped in meeting our goals for Spirals' deadlines. Finally, if possible we would have an actual experiment already in mind, perhaps through collaboration with a professor in the psychology department, such that the application would be designed, tested, and implemented for a specific project.

## 5. Contribution by Group members

### Christopher Yan

Chris did a majority of the work on the Android application. This includes the design of each of the applications screens and their associated functionalities. Also came up with some of the ideas of how the user will interact with the application in terms of widgets and APIs.

### Maryam Samizadeh

Maryam did all of the website design and online capabilities. This includes the functionalities of the eXperience website as well as the implementation of the SQL server which stored all of the data. Also did extensive troubleshooting in attempting to incorporate interconnectivity between the application and the website.

### Hans Melo

Hans provided the original idea and worked closely with the programmers in all aspects throughout the development of the app and helped them meet the project goals. Hans first introduced the programmers to the main theoretical aspects in the study of subjective experience including explaining how psychologists assess mood and emotion. For example, he communicated that a psychometric scale could be implemented as a sliding bar to indicate degree of intensity, and the open-ended question as an input text box. Hans also introduced the programmers to the body of tools already available for other platforms, and suggested directions for improvement, including new ways for the user to interact with her data such as the Mood Map widget.

## 6. Apper context

The current project makes significant improvements over previous experience sampling tools. First, to my knowledge eXperience is the only experience sampling application available for Android devices. Second, it takes advantage of some of the technologies available in today's devices. In particular, unlike previous methods this app records the location of the user while completing a survey via device's GPS sensor. This new data is especially informative for researchers who are interested in the different aspects that influence our daily experience, and specifically how our environment/location influences our emotional state. Our goal was to develop an application that would be ready for use by psychology researchers to study subjective experience. In general this goal was met. The app is able to prompt participants at

certain times of the day to stop and complete a survey. The website on the other hand, allows researchers to set up an experiment, entering relevant questions, as well as setting up the time of delivery. Another important development is the ability for users to interact with their data. This is important because previous research indicates that participants are significantly more likely to complete an experiment if allowed to interact with their data (REFs). I was therefore interested in developing the app in a way that would ensure user compliance. We accomplished this by creating two widgets: 1) the mood map, and 2) a graph of mood over time. The successful implementation of these widgets will make the app more engaging for the user and potentially increase the rate of user completion. Together these developments represent significant advances over currently available experience sampling technologies and allow researchers to study subjective experience, and emotion in particular, in an ecologically valid manner.

## 7. Future Work

There are many aspects about the current version that could be improved. Here we present the main points.

For the Application:

- Implement more question types, such as audio/video recordings, so that experimenter's would have a larger number of options when creating surveys.
- Faster and more reliable data storage so that the application would not have issues with writing and retrieving necessary data
- Record additional information when recording survey responses, such as weather, so that experimenters would have more data to work with when evaluating survey responses.

For the Website:

- Management options for researchers. This can include editing and deleting user accounts, as well as survey results.
- Conditional type questions such that the answer to one question would determine what is asked next.

## 8. Would you be interested in business school

We would be interested but, as highlighted, there are many elements at this stage of development that must be dealt with before taking it to business.

Open source libraries/resources used in application:

Android Plot (<http://androidplot.com/>) - Used to generate line graphs based on data stored in SQL tables

Java Mail (<https://code.google.com/p/javamail-android/>) - Used to generate automatic background e-mails

Google Maps API (<https://developers.google.com/maps/documentation/android/>) - Used to generate a MapView widget which we could then localize to device's location as well as place custom markers

Google Chart Tools (<https://developers.google.com/chart/>) - Used to generate Pie charts based on pre-calculated data

Website resources used:

Stack Overflow (<http://stackoverflow.com/questions/tagged/android>) - Used very frequently when it came to debugging issues and trying new things

References:

Larson, R., & Csikszentmihalyi, M. (1983). "The experience sampling method". *New Directions for Methodology of Social and Behavioral Science*, 15, 41-56.

Hektner, J.M., Schmidt, J.A., Csikszentmihalyi, M. (Eds.). (2006). *Experience Sampling Method: Measuring the Quality of Everyday Life*. Sage Publications, Inc