# EYEdentify: Final Report

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## Introduction

Our goal was to create a game-based app that helps children with Autism Spectrum Disorder (ASD) learn four key human emotions: happy, sad, frustrated, and confused. The Android app is a simple matching game where players match the cued emotion to the three possibilities presented on the screen. Theoretically, playing this game will increase a child's transferable skill of emotion recognition so that they can identify people's emotions - from simple to more complex representations. Since children with ASD have a problem with facial feature recognition, this game focuses on facial characteristics rather than situational-based examples of emotion expression.

We would position our app at a point of intersection between the fields of technology, psychology and play; here lies enormous potential to support learning. The game is grounded in research on ASD and technology development to support the disorder. Principles of learning were integrated into our app to create an engaging experience that has the possibility to help children with ASD increase their emotion recognition skills. We chose to integrate three types of images into the game: cartoon robots designed to represent the most basic level of emotion understanding; a hybrid robot – which is made up of photos of humans faces overlaid with a robotic shell – as an intermediary level; and photos of humans faces for the most challenging level in the gameplay. Children with ASD benefit from continuous reinforcement and support for learning since they are able to focus intently on activities they are engaged in. Gameplay is divided up into five levels and once all are achieved, an infinite loop of gameplay is initiated. The entire game is customizable and parents can tailor gameplay to the child's needs. Although this is a marketable aspect, we are primarily interested in conducting research to find out if the app confirms our hypothesis that children with ASD can increase their emotion recognition skills and transfer these into their everyday life if they play this game.

Learning is no longer something that happens within the confines of a classroom. Parents are constantly looking for ways to support their child's learning

journey and educational app development has only started to scratch the surface of the potential that mobile technology has in learning. This app is one of few where design and content are deeply rooted in educational theory and we are highly motivated to see if future research validates our creation.

## Overall Design

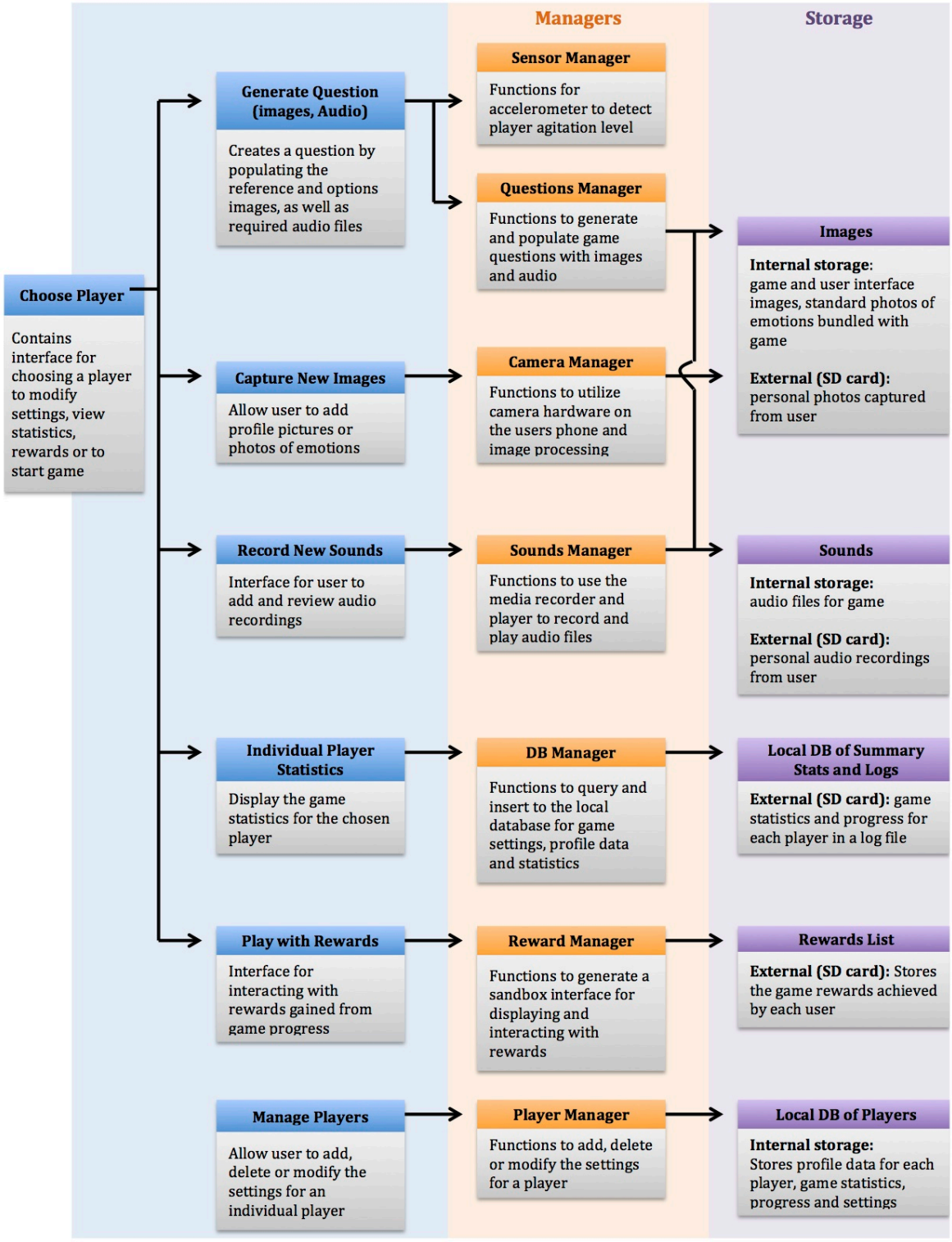


**Figure 1: Block diagram of *EYEdentify***

Functionality and Screen Shots

The penultimate version of our app if fully functional - it offers continuous gameplay and customizable sound and visual features. Below are the details of its functionality and the corresponding screenshots:

**Table 1: Functionality and description of *EYEdentify***

| Figure | Function | Description |
|---|---|---|
| **2** | Player Management | This allows for up to three users to play the game on the same phone. The progress of each child is stored so that the game picks up where the child stopped playing previously. |
| **3** | Individual Player Statistics | This tracks individual player summary data including: number of correct and incorrect emotion identifications, time played, and response time. It also logs the stats from each question. |
| **4** | Reward Prompt | This screen is initiated when the user gets five consecutive questions correct. They are awarded robotic part that can be re-assembled in a sandbox mode. A similar prompt appears when they complete a level. |
| **5** | Cool down Screen | This event is triggered when the accelerometer detects shake, which can be an indication of the user becoming frustrated. The volume of the music playing increases and the user is prompted to cool down by counting to 10 and then resuming the game. |
| **6** | Gameplay | The main gameplay screen is populated with randomized images that correlate to the question being generated. |
| **7** | Customizable Sounds | The microphone and speaker are used to record and playback new feedback phrases. These sounds are stored on the SD card and are integrated into gameplay. |
| **8 & 9** | Customizable Images | The front or back cameras can be used to take a photo. Once the photo is taken, two new images are created (human and hybrid), stored on the SD card, and integrated into gameplay. |

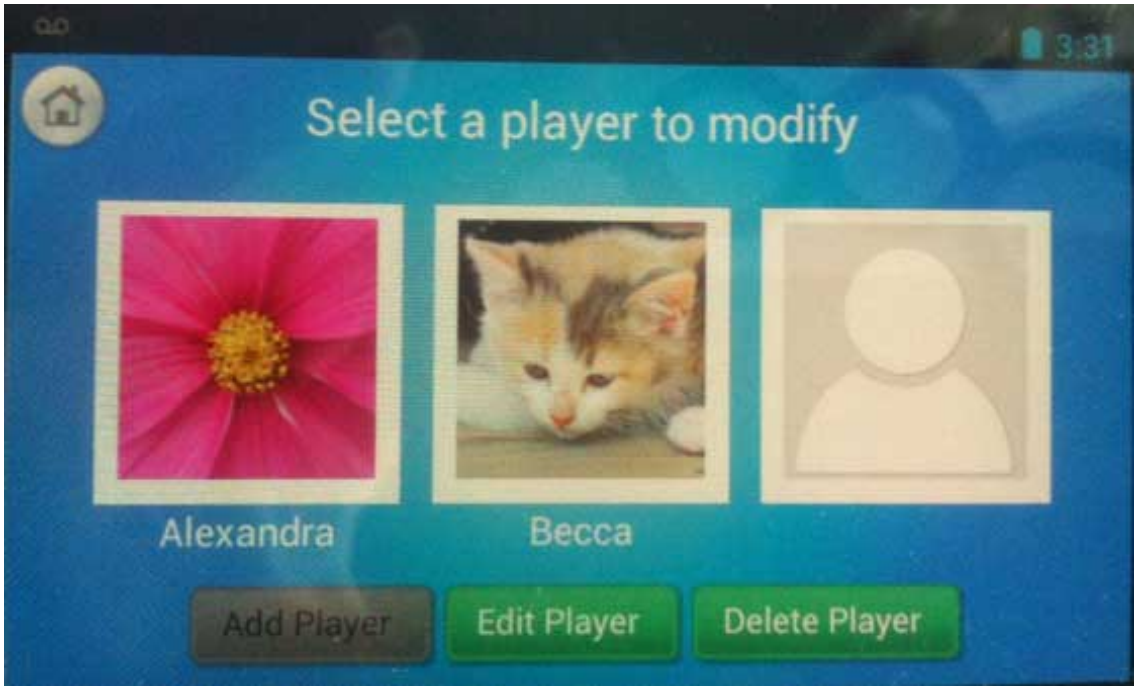


Figure 2: Player management screen

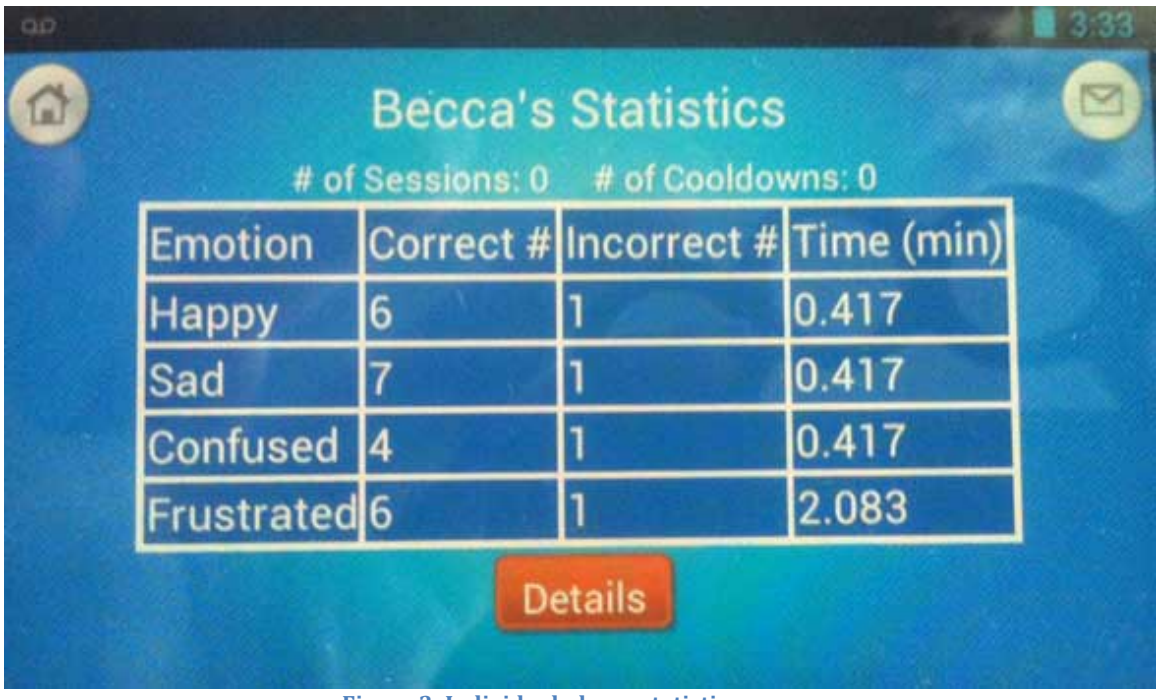


Figure 3: Individual player statistics screen

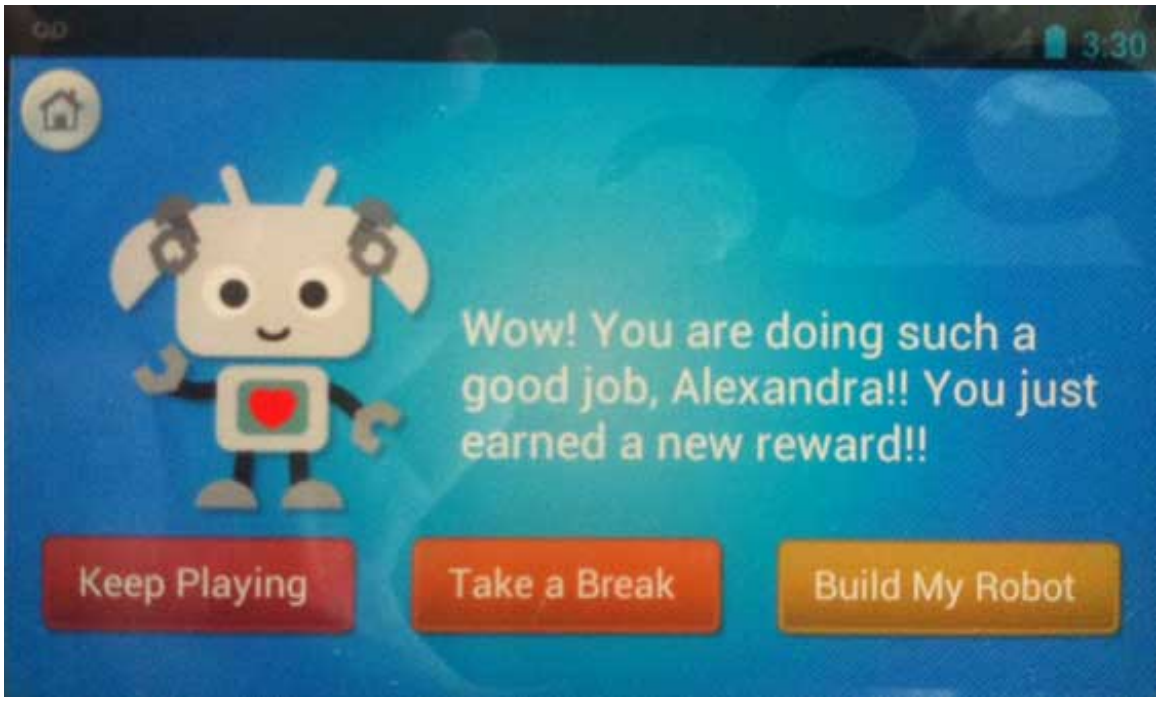


Figure 4: Reward prompt screen

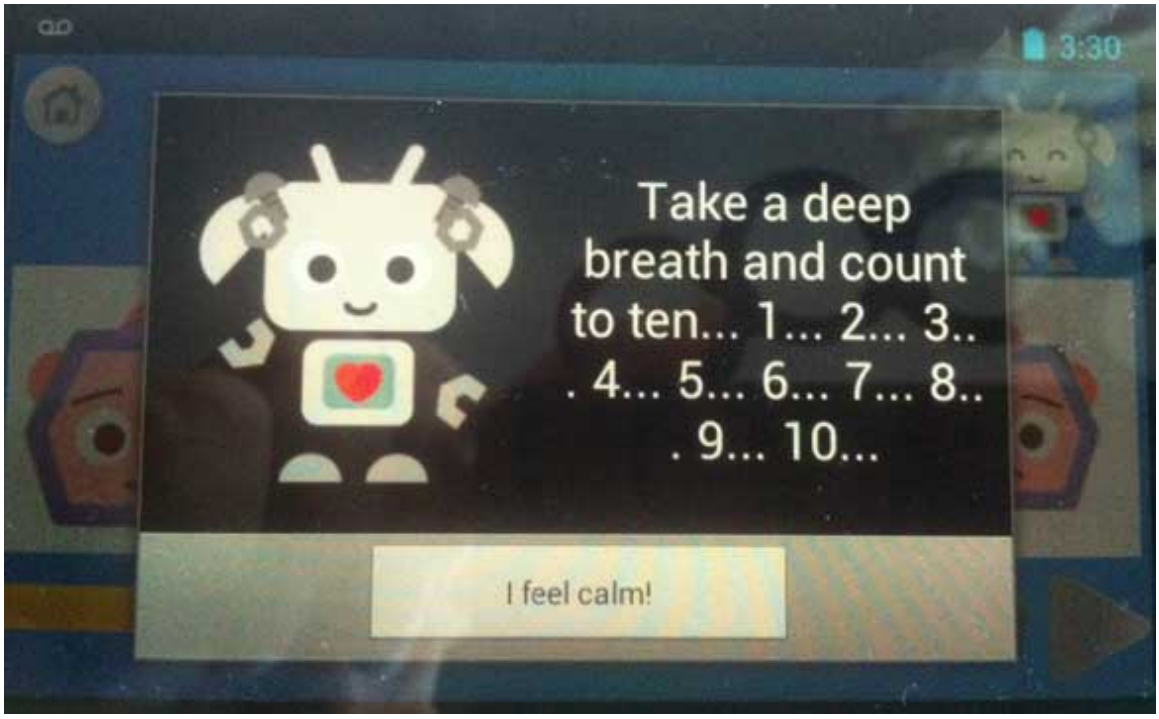


Figure 5: Cool down screen

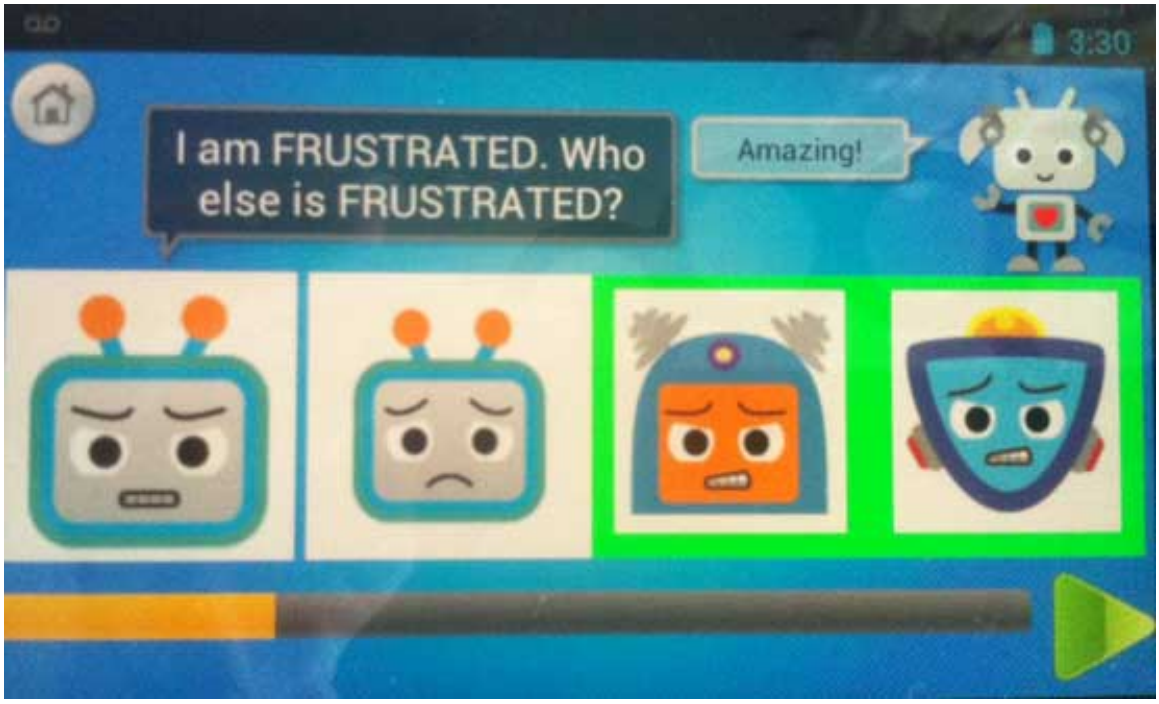


Figure 6: Gameplay screen, correct answers displayed

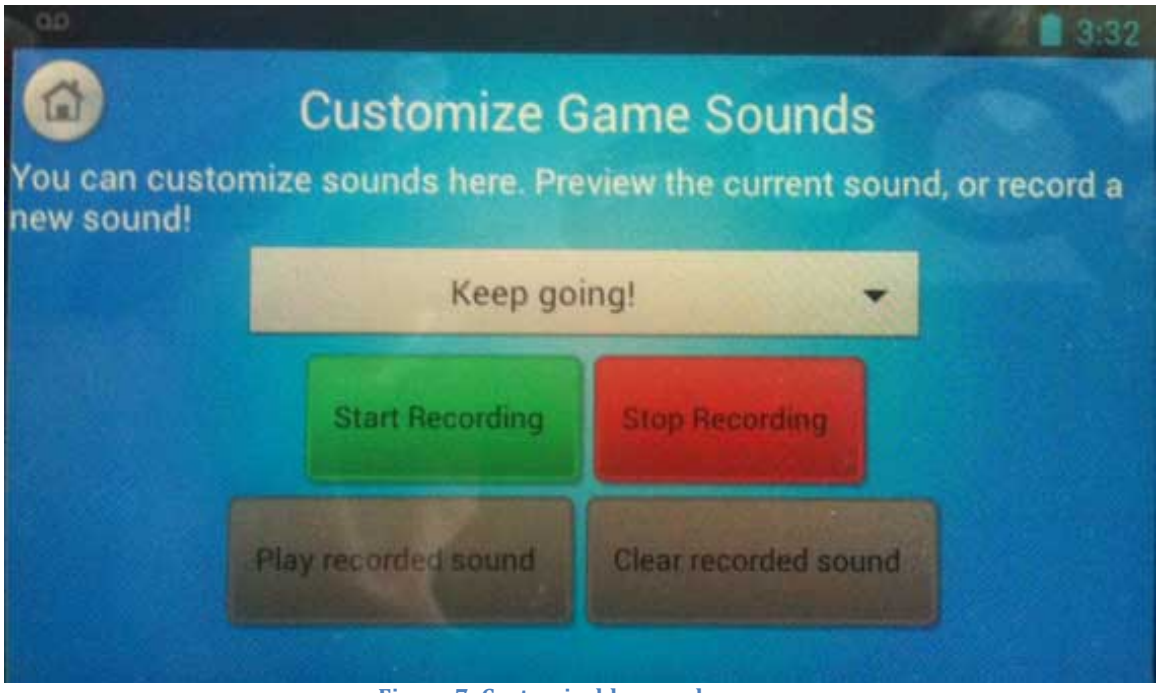


Figure 7: Customizable sound screen


Figure 8: Camera capture screen


Figure 9: Custom images screen

## Learning Process

In hindsight there are three areas we would have liked to rework during the initial construction of the app: the choice of mobile device; usability testing; and, the extendibility of the code.

From the onset we decided to design a smartphone app. Although the tablet market is expanding, we were not familiar with iOS development, so we chose to program our app for Android phones. Looking back we would have developed our app for the iPad because our display screen real estate is our most valuable asset. While our app will run on an Android tablet, the UI will not display at an optimum resolution without some additional work. At the moment, gameplay is not affected, but larger pictures will definitely enhance the experience. We do not think this will negatively influence our data collection (once we start conducting research), but we are aware that the photos chosen to integrate into gameplay need to be clear and effectively represent the emotion.

Secondly, we would have liked to conduct usability trials with children early in the development process. This would have allowed us to tweak the UI, gameplay and reward schedules – each of which are important to the user's engagement with the game. So far, we have only conducted informal usability trials with adults. This is not representative of our target demographic.

Lastly, we would have made our code more extendable so that we could expand gameplay to include more emotions than the four we have chosen to study. Adding more emotions to the current app would involve including more parameters into the database tables and UI components. As versatility in integrating emotions is preferred, we will concentrate on extendibility of the code as we develop the tablet version of the app.

## Contributions

### *Rebecca*

I wrote the skeleton code, and added: a database with two tables (player information and statistics); helper functions that abstracted database calls; and a reusable class for choosing the current player. I created a gameplay activity to

display a randomized question with the following features: music, visual and audio question representation, shake detection, visual and audio feedback, and data collection. I added a leveling system. I added an activity to view and export statistics. I added an activity for changing sounds and game options (which later became the profile activity) and integrated those preferences into gameplay. I added an activity for recording personalized audio messages and integrated it into the gameplay. I collected all human images from Google and manually generated the hybrid images. I integrated the user-created images from the camera class into the gameplay. I added a feature where players earned rewards (robot parts) at different gameplay milestones, and I created a sandbox where they could drag around their rewards. I created the UI for all activities that I had code and was very active in testing and bug-fixes.

*Cindy*

With the block diagram and the wireframes that were created early in the design process, I refined our ideas into UI mockup designs using Adobe Illustrator. As we were designing the game for children, the team had some ideas of what the style of art and colour scheme should be, and I incorporated those concepts into the user interface design. I also created some original characters to be used as scouts for the children. I generated all of the robotic faces and image overlays used throughout the levels, placeholders, menu buttons, backgrounds, titular images, elements for the rewards screen, as well as UI components including the 9-patch buttons and the scalable text bubbles.

Apart from generating images, I was responsible for coding the functions relating to image capture and processing. This included setting up the camera hardware and storing the images. During the first spiral I had originally coded an edge tracer to create robot-like images from the faces, but the results were not entirely satisfactory, and hence our Apper decided we could utilize a more effective method of pasting faces onto inanimate robot-like objects. I then created a function to dynamically crop user photos and fit a robot image as an overlay. These functions were incorporated into an interface that allowed users to take their photos of

different emotions using their front or back cameras. Later on this interface was also adapted for the user to take profile photos. I created a gallery for the user to view and delete their existing photos on their SD card, or to select a generic picture for their profile. Aside from the image-related functions, I was involved in reorganizing some of the setup sections into a more concise interface, reworking some of the UI design and functions with usability in mind, and testing and debugging of the app.

*Alexandra*

For this project, I concentrated on the design of the UI, the game structure, and acted as the content expert. I was preoccupied with designing a game that was grounded in theories of learning and the literature on ASD. I mocked up the screens for our app and would provide Rebecca and Cindy with the background info on the design and gameplay issues we came across. I took on the responsibility of writing the bulk of our reports and creating the presentation slides so that Rebecca and Cindy had time to work on programming the app. Ultimately, my goal was to bring to life what I saw in my mind as an app that has the potential to develop emotion recognition skills in children who are completely lacking or have not fully developed this skill.

Apper Context

My motivating factor coming into this course was the potential to create an app that I can conduct future research on. In the field of education, there has been a long-standing tension between technology and learning that is only now starting to dissipate. With the ubiquity of smartphones and tablets, learning doesn't just happen inside the classroom; it can be fully supported by parents outside of school hours. The potential for educational apps has not gone unnoticed; however, in my personal exploration of the highest rated educational apps on the market, these apps have limited grounding in theory, which I find rather disturbing. Some of the apps I explored in the earlier assignments of this course had no theoretical basis. As preparation for my foray into app design, I chose to take two independent reading courses that focused on the role of technology in learning for adults and children. I

also became part of a research group at OISE that looks at the relationship between technology, psychology and play. For me, developing an app grounded in evidence-based research was paramount. In terms of the design of the game there is great potential for future research on the transferability of skills through game-based learning.

The issue of supporting disabilities through mobile technology is a recent advancement in the area and there is a lot of potential for future work as the use of mobile technology has made support for disabilities more accessible to the masses. Funding for the accurate assessment and support of disabilities in the education system has continued to decrease. If researchers can design and advance tools for parents to support their child's development without the need for therapists and additional specialists, then major headway can be made in this area. Apps can be designed to target specific dominant characteristics of particular disorders that require skill development through constant reinforcement. The model of game-based learning is ideal in that it increases user engagement, which is critical when trying to support constant reinforcement of ideas, concepts or principles addressed in the game. In bringing the research on ASD and game-based learning together, I have created an opportunity for our group to understand the potential that intelligent app design has on children's skill development. I have made a point to ground all major game-play decisions of our app in educational theory and research on ASD in order to minimize the variables that could affect data collection in our future research. Once we determine the apps ability to help children gain transferrable skills in emotion recognition, we will have marked a point in the body of literature of technology, psychology and play that opens up new possibilities for researchers.

## Future Work

After this course, we will continue to develop this app. We are interested in developing a version for the iPad to utilize current research being done in ASD and communication. In a research setting that relies heavily on apps created for the iPad, it would be more favorable in terms of data collection for this project to be

continued as a tablet format. We believe that the user experience will be more engaging as it will be easier for the users to examine the pictures during gameplay. This version will also allow us to expand gameplay by adding more levels and incorporate more emotions into the gameplay rotation.

Simultaneous to developing a tablet version, we shall write a help section on how to use the app – this is important for user setup – which will allow parents to maximize their child's learning experience. In addition to the help section, an info button will be added to the statistics page that will give parents insight regarding the skill development of their child that is being tracked by the game. We are interested in providing parents with a comprehensive set of tools that will allow them to further support their child's learning. As a complement to the info section in the statistics page, we are going to be adding comprehensive data visualizations. Together, the written info and visuals will allow parents to easily understand how their child is progressing in emotion recognition over sessional gameplay.

## Business Plan

We are interested in having this taken up by the Rotman Business School class because our app has been designed to target such a specific population that we want to be able to maximize its impact from a commercial perspective. Sufficient funding would also enable more content to be generated, allow comprehensive usability testing, as well as open up new markets for further dissemination of our work.