LAB 1 – LOQUI

Product Description

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1. Introduction

Autism Spectrum Disorder is a neurological and developmental disorder that begins early in childhood and lasts throughout a person’s life (Data and Statistics on Autism Spectrum Disorder, 2019). It affects communication skills and learning ability, as well as how a person acts in social situations. ASD can manifest differently in every person it affects, which is one reason it is said to be a spectrum. Each person with ASD is unique in where they stand on the spectrum and in how high, or low, they can function. Some people have extreme trouble communicating, requiring specific devices or apps to communicate their thoughts. Others have trouble detecting or expressing emotions which can lead to awkwardness in social situations.

In 2018, the CDC determined that approximately 1 in 59 children were diagnosed with ASD (Data and Statistics on Autism Spectrum Disorder, 2019). In 2000, the CDC reported 1 in 150 were diagnosed (Data and Statistics on Autism Spectrum Disorder, 2019). Autism is occurring more frequently year by year. ASD tends to be related to certain genetic or chromosomal conditions from the parents. ASD can be detected in children as early as 2 years old with the average detection at around 3 years 10 months old. Autism can be very costly to treat, with the
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The total cost being estimated to be between 11.5 – 60.9 billion dollars in the US alone (Data and Statistics on Autism Spectrum Disorder, 2019). In 2005 it was found that medical costs of a child with autism were $10,709 per child on average, with another possible $40,000 – $60,000 in intensive behavioral interventions per child (Data and Statistics on Autism Spectrum Disorder, 2019). Currently there is no cure for autism, only treatments to minimize the effects of the disorder that can go on for a lifetime.

Our solution to this problem is to create an app named LoQui that can be used as another tool in the toolkit in coping with and treating ASD. We recognize that autism cannot be cured, and the treatments that are available right now cannot be replaced entirely. Our solution is supplemental and intends to help the parents of children with autism by saving them in treatment costs, as well as aiding in helping to correct social behaviors and mannerisms of their child.

### 2. **LoQui Product Description**

LoQui will feature a realistic child avatar that will interact with the child and teach correct social behavior, specifically in the categories of recognizing different emotions in others, maintaining eye contact, and correct word pronunciation.

The app will work by presenting a series of games to the child in the categories of emotion and word pronunciation, as well as tracking the eye contact of the child during the games. All games will have a score associated with them. Scores will be saved and can be compared over time to see how the child is progressing, as well as be used as a tool to further improve their abilities by seeing where the child’s weaknesses may lie.
2.1 Key Product Features and Capabilities

LoQui will feature games in 2 main categories. The first category will be related to the ability to detect emotion in others. The game will consist of the avatar showing certain faces and emotions to the child, and the child will be given options as to what the emotion being shown is. The child must then choose the correct emotion. The amount guessed correctly and incorrectly will be tracked for later use in progress tracking and development.

The second category will focus on speech ability and being able to say words correctly. The game will present objects to the child, such as different animals or food. The avatar will then say what the object is and ask if the child can say the word as well. The child’s answer will be analyzed using Google voice recognition APIs and compared to see if it is the correct answer. If the app could not understand what the child said, it
will gently ask the child to repeat what they said again. The child’s responses will be scored and tracked like the first game and used later for progress tracking.

Our app will track the progress of the child and how they are scoring in certain categories over time. Parents will be able to customize the app in which games are recommended based on where the child’s strengths and weaknesses lie. Parents will also be able to set rewards for hitting certain progress goals which are also set by the parent. Rewards are completely customized and created by the parents so that they are catered specifically to their child. The parent can record which rewards worked better than others within the app.

Over the entire time of game activity, the child’s eye contact with the avatar will also be monitored. We will only monitor eye contact during active play time. When the child breaks eye contact with the avatar, the timer will be stopped, and restarted again when eye contact is resumed. The total amount of eye contact will be divided by the amount of time spent playing the game to come up with a percentage of time spent looking at the avatar. This will be used to help encourage maintaining eye contact during conversation; a good skill to have in real life when talking to others.

2.2 Major Components (Hardware/Software)

LoQui will require a mobile device such as a tablet or smartphone running either Android or iOS. We will also use such devices in development for testing and ensuring the product is working correctly on the intended devices.

For software development, we will be using Java within Android Studio for Android development, and Swift within XCode for iOS development. We’ll be using Gradle for Android build management and the Swift Package Manager for iOS build
management. For Version control, we will be using a form of Git for both Android and iOS. Our issue tracking will be done through GitHub. Testing software will consist of JUnit for Java, and XCode for Swift.

For our database we will be using Google’s Firebase. Firebase has an API that works well with Java for interacting with the database within the app's code, as well as authentication for signing-in to the app and creating a profile.

3. Identification of a Case Study

Our app will be used primarily by children that have been diagnosed with ASD, and the parents of those children. Children will be able to play the games on the app while improving their abilities in various social behaviors. Parents will customize the app so that it is catered specifically to their child. Children will progress over time beating their own scores, and when enough progress has been made, obtain a reward that was set by the parent.

4. Product Prototype Description

a. Proof of Concept

i. Parents

1. Create User Account and Profile

2. Set user preferences

3. Track game progress
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4. Watch the tutorial
5. Choose an Avatar
6. Choose music to play
7. Choose Rewards
8. Set progress goals

ii. Children

1. Play emotion training games
2. Eye contact tracked during play
3. Earn Rewards through improved progress

b. Risk Mitigation

i. Application will contain a tutorial for both the parent and child
ii. Offer a variety of Avatars
iii. Parent can modify settings in the app to suit their child’s needs
iv. Customizable Rewards System adjusted by the parent
v. All data will be encrypted
vi. App will be 100% in compliance with HIPAA standards

c. Customer Feedback

i. Professors/Instructors

ii. Students

**4.1 Prototype Architecture (Hardware/Software/Algorithms)**

a. Hardware Utilized

   i. Android Smartphone

b. Software Utilized
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i. Android Studio
   1. Application feature libraries

ii. GitHub

iii. Firebase API

iv. Google Identity Platform
   1. Account creation and management
   2. Authentication

v. OpenCV 4.1.2
   1. Java library for real-time computer vision

c. Primary Languages
   i. Java

d. Target Deployment Platforms
   i. Android Mobile Devices

4.2 Prototype Features and Capabilities

a. Demonstrate ease of use
   i. Allows user to test interface
   ii. Allows user to explore functionality
   iii. Displays a how to use and play tutorial

b. Demonstrates user account creation and verification
   i. Allows user to register for a LoQui profile
   ii. Allows user to sign-in upon each use

c. Demonstrates user profile customization
   i. Allows user to customize profile settings
ii. Allows user to choose an avatar

d. Demonstrate emotion training game
   i. Displays an avatar showing a certain emotion
   ii. Displays different choices regarding the avatar’s emotion
   iii. Allows child to choose an emotion from the given choices

e. Demonstrate real-time feedback
   i. Displays correct emotion after each round
      ii. Allows child to see updated total score upon each round

f. Demonstrate real-time eye movement tracking throughout game
   i. Allows user’s eye movement to be tracked throughout game play
   ii. Allows the user’s eye movement tracking to be pause when game play is not detected

g. Demonstrate progress tracking
   i. scores from emotion training and eye contact are generated and stored

e. Demonstrate a reward system
   i. Displays animated rewards upon reaching each set goal

4.3 Prototype Development Challenges

a. Requirements volatility
   i. LoQui is complex, and keeping requirements complete and consistent is going to be a challenge

b. We will not have iOS representation as part of the Prototype

c. Usability
   i. Designing LoQui to be easily used by children with ASD
c. Implementing eye-movement tracking functionality within the app

d. Lack of knowledge of Autism from a professional standpoint

i. Autism is a complex mental disorder

e. Security

   i. Protecting user’s personal data

5. Glossary

All terms are in the context of LoQui.

**Android** - A mobile operating system that is based on a modified Linux Kernel, used mainly on touch screen mobile devices such as smartphones or tablets.

**Autism Spectrum Disorder (ASD)** - Autism spectrum disorder is a neurological and developmental disorder that begins early in childhood and lasts throughout a person’s life. It affects how a person acts and interacts with others, communicates, and learns. It includes what used to be known as Asperger syndrome and pervasive developmental disorders.

**Avatar** - An electronic image on a computer that represents a person that can be interacted with by a user.

**Google Firebase** - A NoSQL Cloud Hosted Database that offers live synchronization and supports offline use.

**iOS** - A mobile operating system that was developed by Apple specifically for use in their own mobile devices, such as the iPhone or iPad.

**Java** - A Class based object oriented programming language that was invented in 1995.
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**User** - Any user of the account. This could indicate a child user interacting with the app, or a parent user modifying settings or checking progress within the app.

### 6. References


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