



Boston University
Electrical & Computer Engineering
EC463 Capstone Senior Design Project

Problem Definition and Requirements Review

SITA

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SITA

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Customer Sign-Off _____
Speech Interactive Therapy Application

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Project Summary

Our team is determined to make a speech interactive therapy game application to help young nonverbal children with autism spectrum disorder. Our game will be tailored to every child's needs. The game will begin with a speech pathologist pronouncing basic sounds. As the child's skills progress, the game will open more complex and advanced levels. Everytime the child gets a pronunciation correct, he or she will receive a large amount of stars as a reward. Even if the child pronounces the word correctly once, and then returns to pronouncing the word incorrectly, the child will receive a smaller reward. Our goal is to provide as much encouragement, practice and positivity as possible to the child through the user interface that we will be developing, and through our reward system. This application will be iOS and android compatible in order to provide SITA to a wider audience.

1 Need for this Project

In 2018, there was a study done that shows that Autism Spectrum Disorder (ASD for short) affects about 1 in 59 children in the USA. Furthermore, it is said that as many of 40% of children with ASD are nonverbal. This number has been rising every year, and therefore there is more desire from families across the USA for services such as SITA. This app is tailored to help children with this disorder. SITA will systematically encourage these children to make steps towards becoming verbal. Video lessons will start at the phoneme level and provide the patience and expertise of a speech pathologist. Furthermore, this app is a good alternative for families that simply cannot afford the fees of a speech pathologist, and supplement those families that can afford it.

Additionally, this is meant to improve the quality of life for both the child and the family. Even a small improvement in their speech could vastly change the dynamic of the families. We are encouraging the kids to make any progress no matter how small it may be. Autistic children are especially prone to outside distractors and sudden change. A reliable, simple, and specialized app for these nonverbal, autistic children will provide better at-home therapy in comparison to apps where autism therapy is one of many, if any, uses

2 Problem Statement and Deliverables

Problem Statement:

The aim of this project is to develop a speech therapy game in Unity 3D for nonverbal children with autism. The app is designed to train the children anywhere at anytime and provide therapy comparable to that of a speech language pathologist.

Goal:

The game is mainly supposed to record the model words spoken by the speech or language pathologist and repeat it to the child for practice. Once the child repeats the word, the app will calculate the accuracy of the phonemes uttered by the child and reward the child visually for positive reinforcement.

The Final Deliverable Product:



A Unity 3D app that is compatible with iOS and Android.

Detailed deliverables in the app are:

1. Kids gaming UI

Since the expected users of the app are kids below 8-10 years, the user interface will be made appealing to them with colourful and attractive pages and videos related to the words being reinforced for visual understanding.

2. Access Control

Two different access for the parents and kids will be rendered in the app. One for the parents to set up a training session for the kid and the other for the kids with no access to change any settings except for playing the game till the end.

3. Customized practice session

Based on the child's improvement and progress in speech the parents will be able to set different practice sessions for their kids.

4. Therapist recorded words database

A list of words recorded from the speech or language pathologist will be provided by the client which we will be integrating in our app for the model words to echo it to the kids.

5. Voice recognition algorithm

The client has agreed to provide the algorithm for recognizing the child's vocalizations. This algorithm is to be integrated in the app to identify the phonemes uttered by the kid.

6. Model word similarity analysis algorithm

A BME senior design team is working to build an algorithm for finding the accuracy of the child's vocalization by matching it with the model word from the therapist recorded words database. This algorithm is to be integrated in the app to score the child in the game eventually.

3 Visualization

Our project is exclusively software. Because of this our focus on visualization is on how the app looks. An important thing to note is that this app is being created for young children with autism, primarily between the ages of 2-4 so we have to bring that into consideration when designing our application. The first thing that we noted was the need for our application to be colorful and

visually appealing to children with autism. It will be simple and easy to understand, which a portion in which the parents have control over certain things.

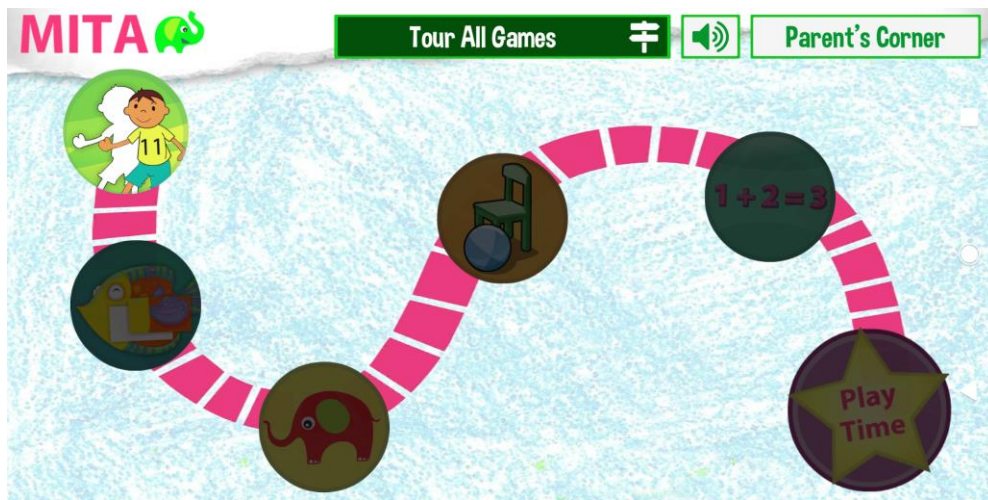


Figure 1.1

The company that we are creating this app for, ImagiRation, currently has multiple applications out for kids with autism. Above is a screenshot of their app, MITA (Mental Imagery Therapy for Autism). It is colorful and simple, with an easy to follow map. We plan to make our app similar to this both in the colorful and fun sense, but also to have it more familiar for the children using these applications.

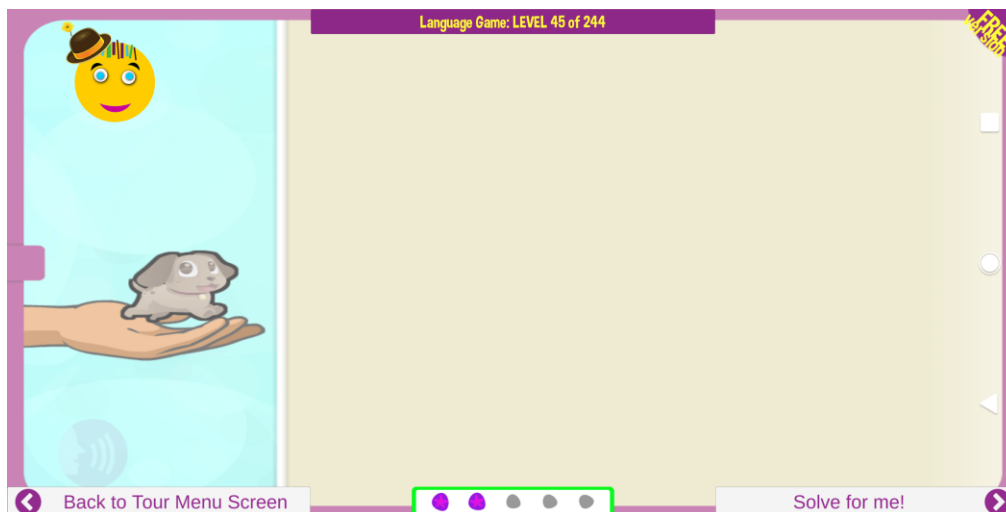


Figure 1.2

Above is another screenshot of the MITA application. This is what a page on the game looks like. For our application, there will be a video that can be played for the child to listen to the speech pathologist speaking. They will be praised for the response on the left hand side of the screen.

4 Competing Technologies

The dynamic, accessible learning environment of therapy apps appeals to companies and health organizations. *Comprehension TherAppy*, *Speech Sounds Visualized*, and *LetMeTalk* are just three out of many apps that share similar requirements with *SITA*, yet none directly compete with *SITA*'s "pivotal response treatment" (early treatment for nonverbal Autism Spectrum Disorder [ASD]).

Comprehension TherAppy by Tactus Therapy is from a line of apps for adults with acquired communication disorders (e.g. aphasia from stroke). Because of its target audience, this app assumes that users were once verbal. Furthermore, there lacks a game-like user interface that motivates younger children. Nonetheless, *Comprehension TherAppy* attracts speech-language pathologists (SLPs) with its minimalistic design and word-level exercises. To further the app's lifecycle, *Comprehension TherAppy* also allows users (in the case of children with ASD, the SLP) to add new words with matching images.

Similar to Tactus Therapy's app, Pullman Regional Hospital's *Speech Sounds Visualized* (SSV) focuses on sound and word-level language for verbal adults and children. It helps users pronounce specific sounds in the English language. The key feature of SSV is its X-ray display of

the user's mouth and upper throat as well as suggestions for mouth movements. While *SITA* does not take any video, this emphasis on real time user feedback appears as part of its UI through speech-triggered rewards (e.g. fireworks, balloons, etc.).

Lastly, *LetMeTalk* by Appnotize UG is an app that nonverbal users use independently. The app forms sentences in over 15 languages from images chosen by the user (like a keyboard made of pictures) in a process called "Augmentative and Alternative Communication" (AAC). While more accommodating to nonverbal users, *LetMeTalk* does not encourage the user to make sounds themselves. *LetMeTalk* caters those who are unable to become verbal or those currently in the process of becoming verbal.

SITA combines aspects of similar therapy apps to solve the current lack of self-contained (no SLP required) therapy apps for nonverbal, autistic children. While in its learning mode, the child has full control and receives responses comparable to those of an SLP. In this respect, *SITA* shares a required level of independence with *LetMeTalk*. Furthermore, *SITA* allows parents or caretakers to add video lessons, similar to *Comprehension TherAppy*'s upload features. All throughout the learning process, *SITA* provides continual encouragement and dynamic responses that alleviate focus-hindering ASD symptoms.

5 Engineering Requirements

Functions:

1. The main function of *SITA* is to offer children continued practice in an exciting way, so that the child does not see it as practice, but rather as a game. The app will do this in an interactive way while offering enthusiastic support and encouragement specialized towards the child's specific needs.

Objectives:

1. *SITA* must be able to run on both iOS and Android, as well as accommodate varying levels of mobile processing power.
2. The app must work offline and avoid any cloud interaction in order to abide by privacy laws and the client's instructions.
3. There must be a section dedicated to parental controls. The app may also be accessed by the parent via an unlock slide screen at any time. These controls will also be able to allow parents to specialize and customize this app specifically for their children. This screen must be tamper-proof and last 3 to 5 seconds when triggered.
4. All responses must show positive reinforcement and constant rewarding. High rewards should be given for more progress and lower rewards for staying at the same level or going backwards.

5. It must be a colorful and interactive app with saturation levels above 50% and a high dynamic range. This is to ensure that the child's focus is maintained on the game.

Constraints:

1. No specific constraints, other than to ensure that the app consumes as minimal battery power as possible, on whichever device the child is using it on. This is to ensure that the child can use the app for as long as possible in one sitting.

6 Appendix A

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