DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
THE UNIVERSITY OF TEXAS AT ARLINGTON

SYSTEM REQUIREMENTS SPECIFICATIONS
CSE 4316: SENIOR DESIGN I
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WORKING IN PROGRESS
THEREMELO

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Revision History

Revision	Date	Author(s)	Description
0.1	09.18.2023	RN	document creation
0.2	10.09.2023	RN, SF, CM	revision, more writing
0.3	10.13.2023	RN, SF, CM, SI	revision, writing
1.0	10.16.2023	RN, SF, CM, SI	Final V1

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1 Product Concept :

The Theremin is a product that utilizes the Leap Motion Controller 2 to read the user's hands to translate them into sound. Users of the ThereMelo will be able to play the instrument in a sandbox environment and learn how to play the Theremin. We want the Theremelo to allow for anyone of any age to play with.

1.1 Purpose and Use

Our product will be a simulation of the instrument called the Theremin. Our product will read the user's hand inputs and translate it to sound. Only one user may be able to use the product, as our camera will not handle more than two hands at once.

1.2 Intended Audience

Our product will be made available for the public to download and use. Our intended audience would be primarily people who are generally interested in music, younger audiences who may pursue a career in Computer Science, or for casual entertainment.

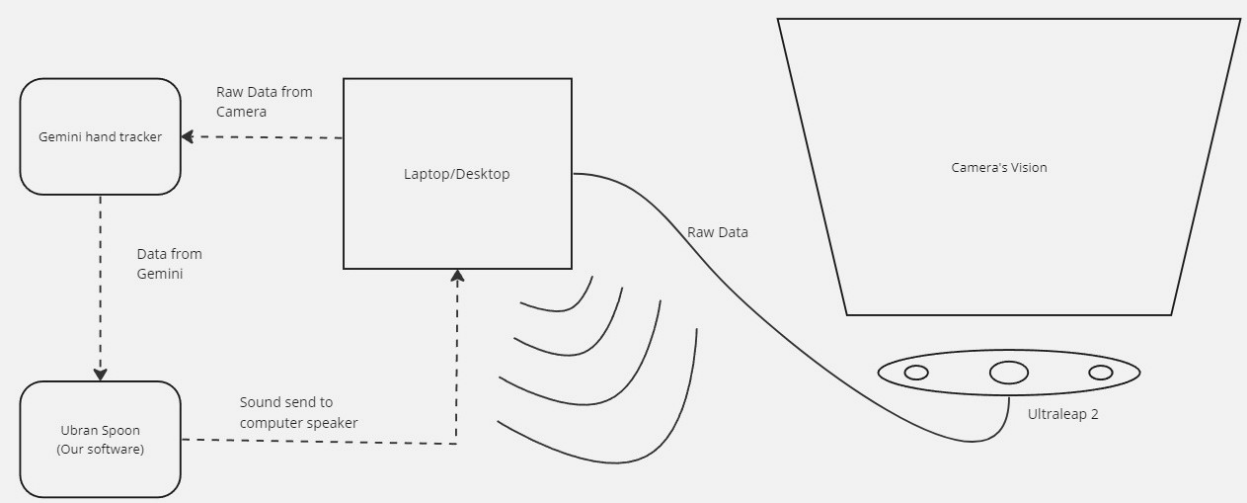

Figure 1: Data motion conceptual drawing

2 Product Description :

The way our product works is once the Leap Motion Controller 2 is connected, it will be able to track the user's hands for them to use the application. If the device is not found, the application will still run but will not function as intended. The user will have to download Ultraleap's Hand Tracker, named Gemini. At this point, the user can use the application, whether it's playing in sandbox mode or lessons. In sandbox mode, the user can start playing the instrument, without many restrictions. Their hands must be near the sensors for our application to produce sound. In lessons mode, the user is given a set of interactive tutorials to learn how to utilize the sensor and play the instrument. This will include the basics, such as the gestures and how to play some songs.

2.1 Features & Functions

Our product will be using the Leap Motion Controller 2 to read our user's hands. Referenced in Figure **1**, the controller will be on the desk with the cable pointing towards the screen. Our main function would be trying to translate the user's names into sound. By simulating the camera as the antenna, the user can move their dominant hand for pitch while the height of their non-dominant hand can control the volume.

2.2 External Inputs & Outputs

Input	**Description**
Leap Motion Controller 2	Tracks User's hands, Sends Data to Program
Output	**Description**
Speakers	Plays audio data from our program.
Screen	Allows user to see visual given from our program.

2.3 Product Interfaces: TODO

We have a simple UI below and it will show up once you flip your non dominant hand. It will be set to your left hand at the start, and if you need to change hit the hand icon. We will have a switch between sandbox and lessons. Below it will be the volume so that the user can lower or raise it. Finally we have a question mark to start a tutorial so that anyone can learn fast. The figure 2 shows a mock up of what the UI would look like.

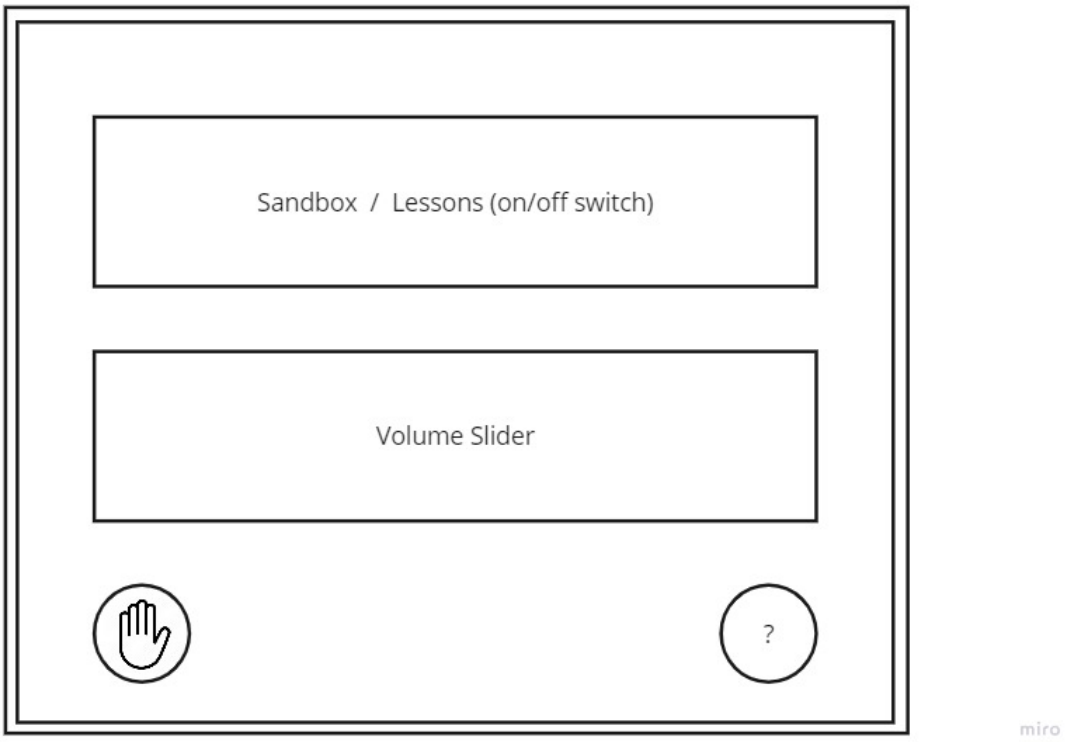

Figure 2: Data motion conceptual drawing

3 Customer Requirements : Review

Customer requirements are our product wants to act like a theremin. The end user should expect that our product will allow the end-user to learn how to play the theremin and be able to transfer the skills from ThereMelo to a real theremin. Our product will not be exactly like a theremin, but we will try to get as close as we can. We want our look and feel to be welcoming to learn for any age. With this, we will have lessons to teach the user.

3.1 Theremin like controls

3.1.1 Description

The controls will be like a theremin and to ensure that our product is like that we will be using a real theremin to test the difference between the two. We want to minimize the difference so that the skills of a user of either or will be transferable.

3.1.2 Source

Our sponsor and our team had agreed on this requirement.

3.1.3 Constraints

We will have to deal with learning a real theremin and having someone know how to play a theremin.

3.1.4 Standards

There are no applicable standards.

3.1.5 Priority

Critical

3.2 Suitable for All Ages

3.2.1 Description

We want our look to be able for any age to try our the theremin. We want our program to be able to give lessons so that the end user can learn with some help. In the end, anyone should be able to play around and have fun.

3.2.2 Source

Our sponsor and our team had agreed on this requirement.

3.2.3 Constraints

We will need music that will be applicable to all generations and that is in the public domain.

3.2.4 Standards

There are no applicable standards.

3.2.5 Priority

High

4 PACKAGING REQUIREMENTS :

The packaging components of the ThereMelo will be composed of 2 main parts. We will consider both the hardware and software packaging requirements of this project. The project should be a simple plug-and-play for the end-user. Once the hardware component and the software is installed. The two components should integrate with no additional steps from the user. The Hardware components will be made up of:

Device	Dimensions	Weight
Leap Motion Controller 2	84 mm x 20 mm x 12 mm	29 g

The Software components will be made up of the project files in the form of a separate executable application. This project will developed in the Unity Engine (Editor Version 2022.3.10f1). However, will not require the installation of Unity on the user end. The project will be delivered to the sponsor via an executable application

Software	Description	Size
ThereMelo	This is the project itself in its entirety	(TBD)

4.1 LEAP MOTION 2

4.1.1 DESCRIPTION

The Leap Motion Controller is a small USB peripheral device which is designed to be placed on a physical desktop, facing upward. It can also be mounted onto a virtual reality headset. The device observes a roughly hemispherical area, to a distance of about 1 meter.

4.1.2 SOURCE

Our sponsor and our team had agreed on this requirement.

4.1.3 CONSTRAINTS

Windows®10+, 64-bit, Intel®i7 processor**, 5th Gen (supports AVX instructions) macOS version 11.0+, supported processors: Intel®i7 processor, Apple m1, m2. As per the developer specifications. The device also requires a USB type C connector to be readily available.

4.1.4 STANDARDS

There are no applicable standards.

4.1.5 PRIORITY

Critical

4.2 THEREMELO

4.2.1 DESCRIPTION

This is the executable application that will read the input and process that data from the Leap Motion 2 controller.

4.2.2 SOURCE

Our sponsor and our team had agreed on this requirement.

4.2.3 CONSTRAINTS

Windows®10+, 64-bit, Intel®i7 processor**, 5th Gen (supports AVX instructions) macOS version 11.0+, supported processors: Intel®i7 processor, Apple m1, m2. As per the developer specifications.

4.2.4 STANDARDS

There are no applicable standards.

4.2.5 PRIORITY

Critical

5 Performance Requirements :

ThereMelo is only an application, that requires additional components to function properly. We only require a functional computer for our user launch on for usage. The following sections will provide what is needed for a flawless experience with the application.

5.1 System Performance

5.1.1 Description

A machine to be able to run our program, an executable. Our application is not intensive. Computer Specifications are listed on Packaging Requirements and the section **Other Requirements**.

5.1.2 Source

Our Team

5.1.3 Constraints

Machine with a USB-C port or a USB 2.0/3.0. Equipped with a speaker or able to provide sound in anyway. Machine must meet minimal requirements for Unity, Editor Version 2022.3.10f1.

5.1.4 Standards

There are no applicable standards.

5.1.5 Priority

Critical

5.2 Setup Time

5.2.1 Description

Extra applications are needed for the Leap Motion Controller to function property. This will require the user to head to the controller's main website to download the tracking software.

5.2.2 Source

Team Assumption

5.2.3 Constraints

Download and installation should take a minimum of 10 minutes. Operational time is limited to the system's battery if not charging.

5.2.4 Standards

There are no applicable standards.

5.2.5 Priority

Critical

6 Safety Requirements :

ThereMelo enables immersive and natural hand tracking and interaction in virtual environments. Ensuring the safety of users and operators when working with this technology is paramount. This document outlines specific safety requirements tailored to the use of ThereMelo to prevent potential hazards and ensure safe operation.

6.1 Laboratory equipment lockout/tagout (LOTO) procedures

6.1.1 Description

Any fabrication equipment provided used in the development of the project shall be used in accordance with OSHA standard LOTO procedures. Locks and tags are installed on all equipment items that present use hazards, and ONLY the course instructor or designated teaching assistants may remove a lock. All locks will be immediately replaced once the equipment is no longer in use.

All fabrication equipment used in the development of projects involving ThereMelo shall adhere to OSHA standard Lockout/Tagout (LOTO) procedures. Locks and tags must be securely installed on equipment that poses usage hazards, and only authorized personnel, such as the course instructor or designated teaching assistants, are permitted to remove these locks. Locks should be promptly replaced once the equipment is no longer in use to prevent unauthorized access.

6.1.2 Source

CSE Senior Design laboratory policy

6.1.3 Constraints

Equipment usage, due to lock removal policies, will be limited to availability of the course instructor and designed teaching assistants.

6.1.4 Standards

Occupational Safety and Health Standards 1910.147 - The control of hazardous energy (lockout/tagout).

6.1.5 Priority

Critical

6.2 Heat Radiation

6.2.1 Description

The Leap Motion Controller 2 uses infrared stereo cameras as their way of tracking hands. Heat management is required, as the device will eventually overheat if used incorrectly or placed on an insulating material. Please do not attempt to pick up the camera while in use, as it may be hot to handle.

6.2.2 Source

Ultraleap

6.2.3 Constraints

Operating temperature: 0°C to 40°C (32°F to 104°F)

6.2.4 Standards

No applicable standards

6.2.5 Priority

Moderate

6.3 Noise Exposure

6.3.1 Description

Our application will be outputting sound data for the user to process. Usage of our product through an amplifier, headphones, or speakers may produce sound levels that could cause permanent hearing loss.

6.3.2 Source

Our Team

6.3.3 Constraints

User must use application with audio levels under 70 dB.

6.3.4 Standards

Occupational Safety and Health Standards 1910.95 - Occupational noise exposure.

6.3.5 Priority

High

7 Maintenance & Support Requirements :

With our product Theremelo, we would just need to maintain the code. If any new bugs are found they would need to be handled. The end user will be given an executable and our source code so that they will be able to change it. We will be keeping support by creating Doxygen Documentation to allow for easiness to code.

7.1 Source Code

7.1.1 Description

We want the end-user to be able to edit the code and allow for them to make changes. We will provide source code of our project in our repository for the public on GitHub. We will also focus on adding in-line comments on our source code in addition to the documentations. Comments shall explain what each function does and the parameter's purposes.

7.1.2 Source

Our team members

7.1.3 Constraints

Only constraint is our licence of GitHub

7.1.4 Standards

No applicable standards

7.1.5 Priority

Low

7.2 DoxyGen Documentation

7.2.1 Description

For our documentation, our team decided to let DoxyGen generate for information and to allow for ease of editing. This will allow for a better understanding of our written code to the end-user and for us for furture improvements.

7.2.2 Source

Our team

7.2.3 Constraints

No applicable constraints

7.2.4 Standards

No applicable standards

7.2.5 Priority

Low

7.3 User Manual

7.3.1 Description

ThereMelo will try and simulate a real life instrument. Learning a new instrument will take time and practice to be proficient in. Our team will try to provide a user manual of our software to explain how to run the software, every interaction available for the user, and an explanation of each graphical user interface's actions. Our software will also provide an interactive tutorial in-software for any new users.

7.3.2 SOURCE

Our Team Members

7.3.3 CONSTRAINTS

No applicable constraints

7.3.4 STANDARDS

No applicable standards

7.3.5 PRIORITY

Critical

8 Other Requirements :

As stated in previous sections, ThereMelo has requirements that must be met. The section will specify what ThereMelo needs in order to function correctly.

8.1 Unity Version

8.1.1 Description

The user's version of Unity must be at least compatible with the source code's Editor Version 2022.3.10f1. Usage of other Unity versions may not function as intended.

8.1.2 Source

Team Members

8.1.3 Constraints

No applicable constraints.

8.1.4 Standards

No applicable standards

8.1.5 Priority

High

8.2 Operation System

8.2.1 Description

At the moment, we are developing our software within both Windows®and Mac. Linux support may be already supported as our Unity version will run within a Linux Environment.

8.2.2 Source

Team Members

8.2.3 Constraints

Windows®10+ or Mac w/ Intel®or M1/M2

8.2.4 Standards

No applicable standards

8.2.5 Priority

High

References