

Virtual Instruments

'What' Document

By Tim Barron, Jessi Beck, Troy Dietz, Grace Kendall

Background

Virtual Instruments is a unique project that gives children with ASD a stimulating environment that aims to improve social interaction through cooperative play. Virtual Instruments is a large indoor play structure suitable for large homes, indoor play areas, schools, and children's science museums. The project is based around a textile wall with many different patterns sewn in. A few bars of an instrument will play when a pattern is touched. Longer and more complex the sound clips will play if two or three patterns are touched simultaneously.

Minimal Viable Product

The minimal viable product consists of a textile wall with uniquely textured sections that, when touched, play music. The textile wall will have sections of different textures representing instruments. When a specific section is touched, the Kinect will register this and the appropriate sound clip will begin to play.

The next level of this product will be to incorporate partner instruments that light up when one instrument is touched. When the partner instruments are touched, the sound clip will play longer and include more instruments. The product should aim to encourage collaborative play. The textile wall will also incorporate tunnels for the children.

Requirements

Architecture

A textile wall with tunnels and textures

The wall will be used as a medium for Ara to touch, while the specific textures will be the triggers to start the music. This wall must be sturdy enough to withstand pressure from young students, and the textures must be interesting enough to engage the users and create a unique tactile experience. The tunnel's purpose is to provide an enclosed experience but it must not be too claustrophobic.

Hardware

Microsoft Kinect

The Microsoft Kinect is used to sense changes in the distance between the wall and the Kinect. We will use this data to start the appropriate music. The Kinect must be able to detect small changes in the depth. The Kinect must also be able to sense multiple touch inputs.

Projector

The projector is used to display highlighting and animations. The projector must be able to display multiple animations at once. Animations must have instantaneous starting and

stopping as dictated by the user and the software.

Audio System

The audio system will be used to play the appropriate music when the user touches an instrument. The audio system must be able to stop and start music instantaneously. The audio system must also be able to play multiple track at once.

Software

Our Code

Our code will be used to run the Virtual Instruments project. It must control the Kinect and read the change in depth data. It must also control the audio system and play music at the appropriate time. The code must also control the projector and play the correct highlighting and animations. The code must also handle the calibration with the Kinect and projector. The code must respond quickly to user input and respond appropriately. Lastly, the code must not crash during use.

User Manual

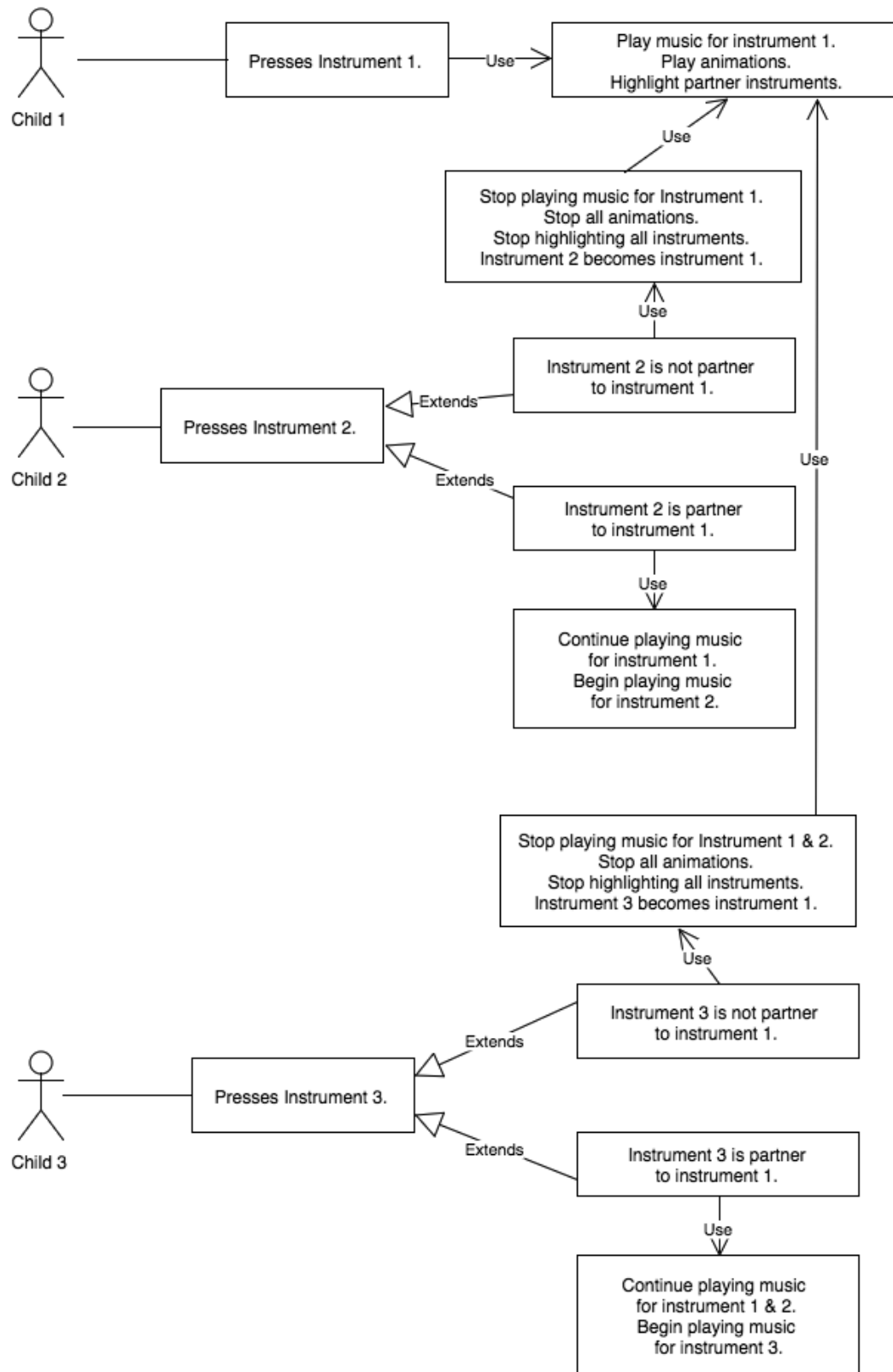
Virtual Instruments requires at least one user, but can accommodate up to three users. When the first user touches or engages an instrument-mapped-texture, a music composition for that instrument will begin playing alongside animations that originate from the point of contact similar to a water ripple. Animations will be largely abstract but might include recognizable silhouettes such as birds. At the same time, two more partner instrument-mapped-textures will illuminate via the projector. This behavior will persist for 5-10 seconds after the instrument mapped-texture is engaged.

While the instrument remains engaged, if the second user touches an illuminated partner instrument, the same composition will continue playing but will now include the second instrument. Animations for the second instrument will occur analogous to the first instrument. The duration of this behavior will continue for an additional 5-10 seconds. See Figure 2.

Similarly, if a third user engages the final illuminated partner instrument while the first and second instruments remain engaged, the composition playing will include the final instrument. Animations for the final instrument will occur analogous to the first and second instrument.

Additionally, there will be a section in the middle of the textile wall with no textures. The projector will project images onto this section. When an image is touched, a brief sample of a song (eg. the chorus) will be play.

UML Use Case Diag



User Persona

This application is intended for general use. However, it will be targeted towards children with ASD. As children along the autism spectrum exhibit a wide variety of behaviors and preferences, development will focus on a single user profile.

Ara

Description

Ara is a five year old girl with Autism Spectrum Disorder. Like most children her age, she is an inexhaustible source of energy. She is very active: running around, climbing on and touching everything near her. Ara has an attraction to different kinds of tactile feedback. During the mindfulness workshop, Ara was engrossed by the different fabrics on the students' clothing and backpacks. She seemed most interested in students' jeans and the mesh one student's backpack in particular.

Small, enclosed areas are especially attractive. Ara may enjoy having room to run around, but she loves small spaces that she can climb through. Ara could spend hours climbing between the front and back seats of her car.

She enjoys listening to music and dancing along, but has difficulty producing music herself. Ara will respond to all kinds of noises, oftentimes with a shriek of excitement.

Ara is nonverbal. However, she can be quite social. Ara spent a lot of time at the mindfulness workshop high-fiving all the students in attendance. She will communicate her emotions through noises and will use physical contact to get other people's attention.

Goals

Listen and dance to music. Ara is active and enjoys dancing. She controls the music that is being played, but without taking an active role in its composition and production.

An area to climb around and play in. There is an area that is enclosed, but also provides enough room for Ara to move around. The small size of the area makes Ara feel comfortable.

Experience various types of tactile feedback. Ara can experience many different style of fabrics. The different textural properties are engaging and improve her emotional mood.

Roles

Music controller. Ara controls what music plays and at what volume.

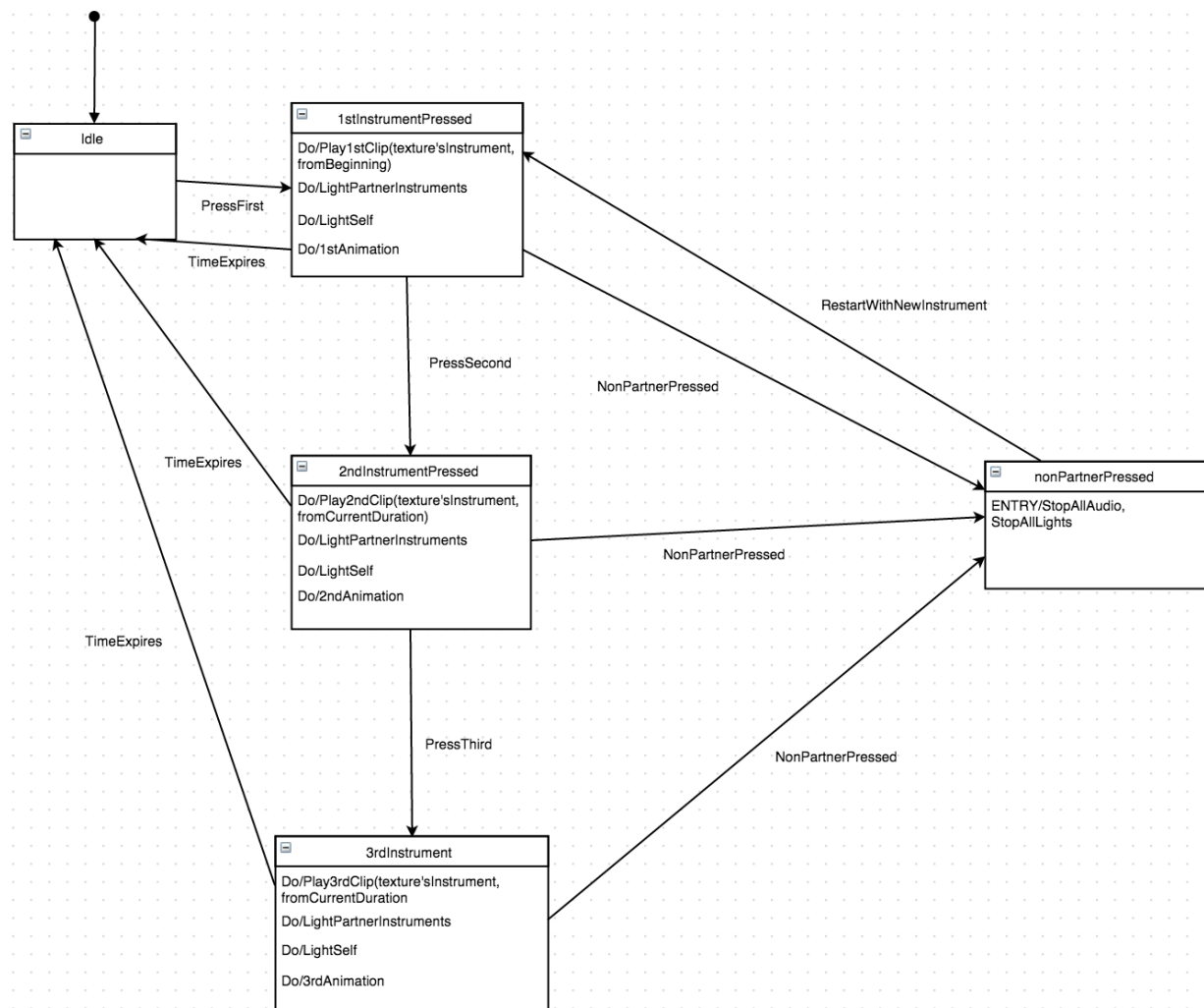
Animation creator. Ara causes animations to appear on the textile wall.

Social partner. Ara cooperates with other user(s) to further her other roles.

Tasks

- Touch instrument-mapped textures on the textile wall to play a musical sound clip.
- Touch locations on the textile wall to cause animations to appear.
- Coordinate with other user(s) to touch partnered instrument-mapped textures to play longer sound clips with both instruments.

UML State Chart Diagram



Rapid Contextual Design

1. Contextual Inquiry and Interviewing
 - During the mindfulness workshop, we observed Ara playing in her normal environment.
2. Interpretation Sessions and Work Modeling
 - We have had many meetings regarding the key issues as they relate to Ara.
3. Model Consolidation and Affinity Diagram Building
 - Not applicable. Current application design is centered around a single user, Ara.
4. Developing Personas

- Our primary user is Ara. We have developed a Persona for her above.
5. Storyboarding
 - The flow of the project is described above in the User Manual section. It is also developed in the State Diagram.
 6. Paper Prototypes

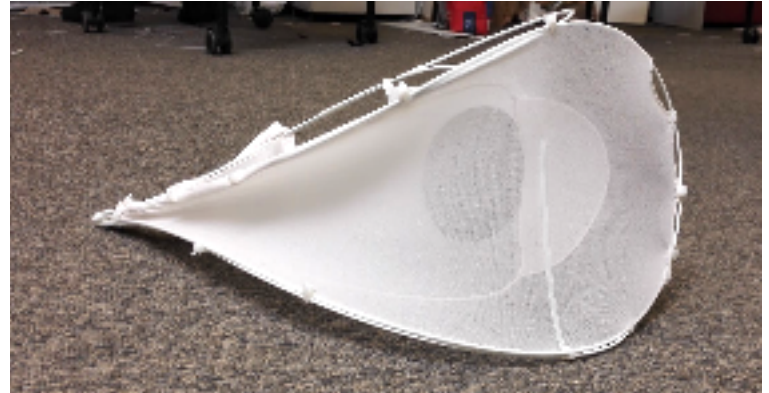


Figure 1: A preliminary prototype of the wall structure, built by the architecture students. In this prototype, there is a flat section at the end of a tunnel where the instruments will reside. There are two tunnels for the children to climb into to get to the textures section.



Figure 2: Dr. David Chesney playing with the Kinect Coloring App, the predecessor of Virtual Instruments. The basics of this project (touch with feedback) will carry into Virtual Instruments.

7. Mock-up Interviews

Will be accomplished once more functionality has been implemented.

Conclusion

Virtual Instruments is a textile wall with differently textured sections that provides a unique tactile experience for Ara. The basic idea of the project is for a user to be able to control the music through touch actions. Once this is achieved, we hope to encourage collaborative play through partner instruments and creating music with peers.