Project Deliverable 3: Draft
Jocelyn Kavanagh

Overview of Project

An auditory display system would encourage effective dance training techniques by helping student dancers advance their proprioception, awareness of their body related to muscle memory. The system will support ballet students while training fundamental skills and while running combinations. In ballet, it can be difficult to understand proper form and technique relying on visuals alone which leads to bad habits resulting in injury. Through the sonification of muscle contraction, weight distribution, and body position data, dancers will better understand the details of and reinforce the structure of discrete fundamental movements, and dancers will be able to maintain awareness of their body and their execution of technique during more complex combinations. Dancers will not only be able to feel the correct technique, but they will be able to hear it, allowing for easier replication. This will allow for injury prevention and more effective training both inside of and outside of the studio.

User Persona

Amanda is an intermediate ballet student studying to become a ballerina for her future career. She has been dancing for most of her life, attending classes for about 8 years, and she hopes to dance for the rest of her life. She is 18 years old and is beginning to study ballet in college. Because she has danced from a young age, she understands the basics of ballet and is working to reinforce good technique and break bad habits. Amanda struggles with ankle injuries related to her past training that cause her to periodically take breaks from training. This frustrates her because she cannot pinpoint why her ankle issues keep resurfacing, though her instructors believe it has to do with improper form.

Amanda wants to become a better dancer while staying injury free. She fears that she may not be able to sustain a lifelong career if her ankle injuries persist or worsen. Amanda wants to improve her form to become a better dancer and to relieve her injuries. During class, Amanda adapts her form according to her instructors' critiques and reminders, however, she has a hard time remembering or preserving the correction over time. She especially struggles whenever she is training on her own, without an instructor. She tries to video record herself or work with a mirror, but both lead to issues. When using a mirror, she can't always see herself and it causes her to break alignment when trying to look in the mirror. When video recording herself, she can't make dynamic, in the moment changes. And with both techniques, her corrections never seem to stick.

User Scenarios

1. Amanda is warming up at the barre during ballet class. The class is working through a plie combination. Her instructor informs Amanda that her alignment is off and that she is not pushing through the floor. Amanda's instructor moves her body into proper position and moves to the next student. Once her instructor leaves, Amanda is afraid that she will break alignment again, and she wasn't confident in what her instructor meant by pushing through the floor. She doesn't think fully understood the correct movement and is worried about replicating it.

With the auditory display system, Amanda will hear the contraction of her muscles and weight distribution and will be given alignment cues. When her instructor adjusts Amanda's form, she will hear what a proper plie sounds like, helping her solidify what it feels like. Once her instructor leaves, Amanda will continue hearing the sounds of her muscles and weight distribution. She will try to match the sounds she heard while her instructor was guiding her to help her use and reinforce proper form. The system will also remind Amanda to check her

alignment, and if it becomes extremely incorrect, audio cues will be given to guide her back to proper alignment.

This is an example of the system's use in repetitive training of plies within a studio. Once the proper form sonification is recognizable, this could also be used outside of the studio. Here, the user chooses to hear a continuous sonification to understand how their muscles are working, and the user may choose to target specific muscle groups.

2. Amanda is working at center on her jumps. While she is rehearsing the jump series, her ankle occasionally hurts when landing. It is not bad enough to stop practicing, but Amanda knows it will hurt her tomorrow. Amanda cannot see herself in the mirror while running the series, and her instructor hasn't given her any specific form critiques regarding her landing.

With the auditory display system, Amanda will hear the sonification of her jumps in real-time. Specifically, she will hear a sonification that will help her understand the distribution of weight on her feet during the jump and the contraction of her leg muscles that absorb the shock of landing. If Amanda's muscle contraction (or lack thereof) becomes dangerous, the system will alert Amanda of the muscle group that may be causing injury. From this sonification, Amanda will understand the mechanics of her jump that led to the pain in her ankle. She will continue jumping and listening to the sonification to make adjustments to her form.

This is an example of the system's use of repetitive training of jumps in more discrete way to track targeted issues in or out of the studio. Here, the user will be able to understand how their muscles are working and set the system to alert for injury causing behavior.

3. Amanda is rehearsing a combination she learned in class at home. In class, she remembers getting the correction that she was breaking alignment and was carrying too much tension in her arms and neck. She does not have a mirror at home, and she is having a hard time noticing if she is falling into those bad habits while she is dancing. She can watch a video of herself afterwards, but, even though she can see her tension in the video, she can't translate the correction while rehearsing. When she focuses too much on her tension and alignment, she messes up the choreography. As she practices more and more, her alignment, tension, and energy levels get worse and worse, so she cannot correct the issue.

With the auditory display system, Amanda will hear audio cues to correct her tension and alignment while she is rehearsing the combination. The system will alert Amanda when she has too much tension in her body and will specify where the tension is being carried. The system will also remind Amanda to check her alignment if it becomes too far out of line. Amanda will be able to adapt in real-time to the sonification of her performance to correct her performance mistakes, similar to how an instructor would make corrections in person. She will better understand where her bad habits appear while being able to focus on the choreography.

This is an example of the system's use in a less obtrusive way, where continuous sonification of the entire body is not necessary, only specific reminders. Here, the user will be able to choose which areas to focus on sonifying.

Event Description

For learning the simulator, the muscular and weight distribution information can be inputted by the user through a drop-down selection for muscle type, slider for contraction level, and an xy grid for weight distribution. Under normal circumstances, all events will come from Json files.

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Events:

- Muscular Information of 9 muscle groups
    - Type: Calf, inner leg, outer leg, glutes, core, hands, arms, shoulders, neck
    - Contraction level (float from 0-1)
    - Flag: good, bad, dangerous (string)
    - Priority (1-3, 1 is highest)
    - Timestamp (milliseconds)
- Alignment/Posture Accuracy
    - Percentage "correct" (float)
    - Flag: good, bad, dangerous (string)
    - Priority (1-3, 1 is highest)
    - Timestamp (milliseconds)
- Weight Distribution data
    - Position from center in x direction (float from -1 to 1)
    - Position from center in y direction (float from -1 to 1)
    - Force downward in z direction (float from 0 to 1)
    - Priority (1-3, 1 is highest)
    - Timestamp (milliseconds)

Example Events

- Muscle
    - Type: Calf
    - Contraction: 0.3
    - Flag: "good"
    - Priority: 2
    - Timestamp: 1000
- Alignment
    - Percentage: 0.5
    - Flag: "bad"
    - Priority: 2
    - Timestamp: 1200
- WeightDist
    - xPos: -0.8
    - yPos: 0
    - zPos: 1
    - Priority: 3
    - Timestamp: 1500
- Muscle
    - Type: Neck
    - Contraction: 0.9
    - Flag: "Dangerous"
    - Priority: 1
    - Timestamp: 2000

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User Experience

The simulator will have three contexts: training for plies, training for jumps, and minimum intervention. The user will be able to select these modes via a radio group. The user will also be able to toggle on and off injury prevention cues. Each mode will sonify the data slightly differently.

Plie training mode will emulate scenario 1, improving plie motion. In training mode, the sonification stream will be continuous with the muscular data being the primary sound source. The muscle groups will be represented by sine and saw waves. Each muscle group will have its own pitch, and the contraction level will be represented by the amount of sine vs saw present. If the muscle is contracted 100%, a saw wave will be heard, whereas if the muscle is not contracted, a sine wave will be heard. The weight distribution data will then manipulate these continuous sine/saw streams. The horizontal position will be represented by panning, and vertical (forward/backward) position will be represented by the rate of amplitude modulation. When the simulated dancer shifts forward, the rate will increase, and when the dancer shifts backward the rate will decrease. In training mode, alignment data will be given as alerts with varying loudness and attack envelopes depending on severity and priority.

Jump training mode will emulate scenario 2, finding injury in jumps. The sonification map will be similar to training mode, however, the sound stream will be discrete. The z position of weight distribution will be used to control the envelope of the waveforms, when the dancer is in the air no sound will be produced. With the injury prevention toggle, the user will hear the estimated injury causing issue with a text-to-speech alert.

Minimum intervention mode will emulate scenario 3, occasional form checks while performing a combination. Here, the simulator will not include weight distribution data and will simplify the delivery of muscular information. If muscle groups reach a tension threshold, text-to-speech will play, relaying the appropriate muscle group, with varying loudness depending on the degree of tension. The alignment sonification will remain the same.

As discussed above, the user will be able to directly interact with the simulator through UI to understand how the muscular sonification works. Additionally, the simulator may display a video reference for the training modes in order to better understand what's being sonified.

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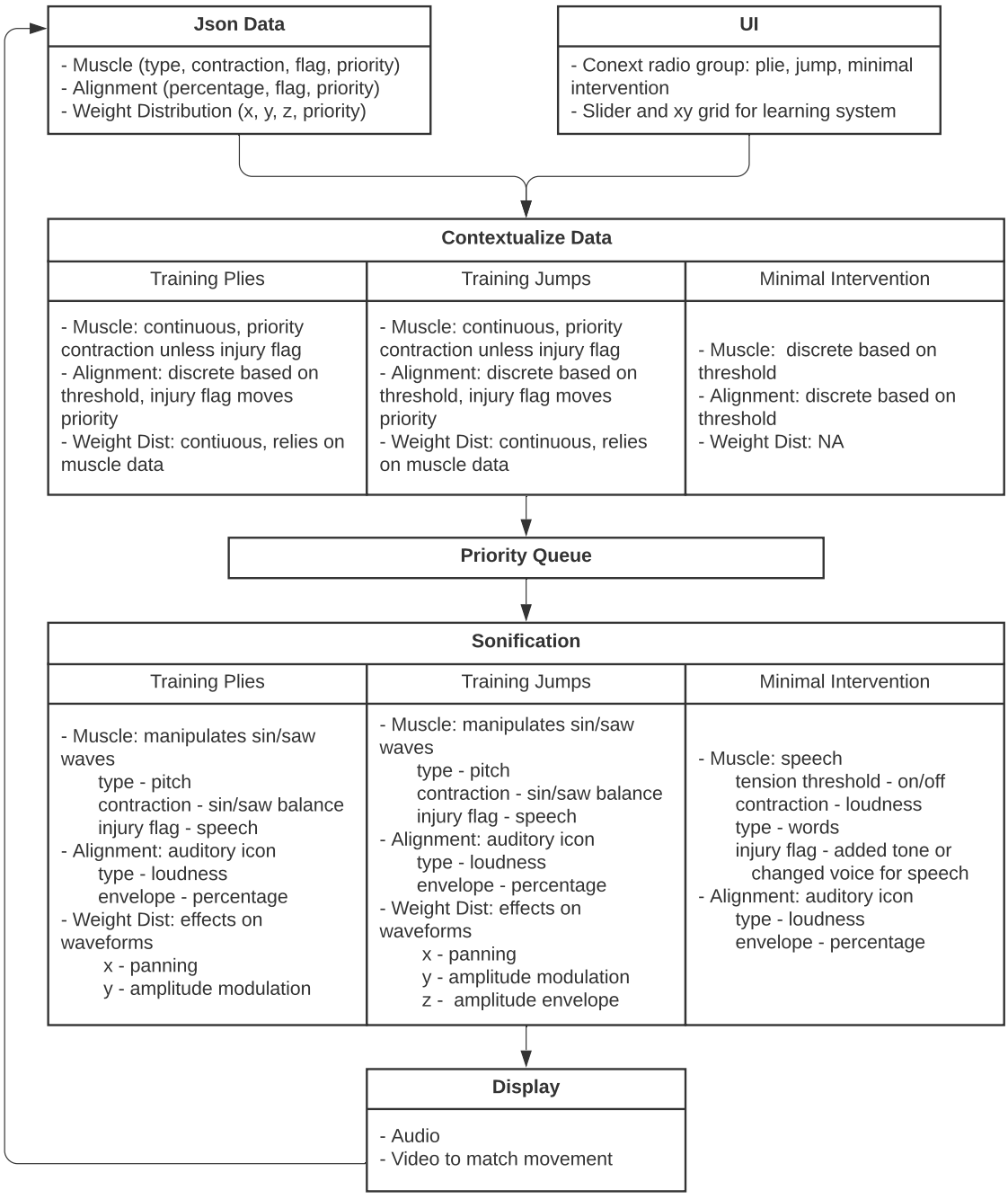
Design Diagram



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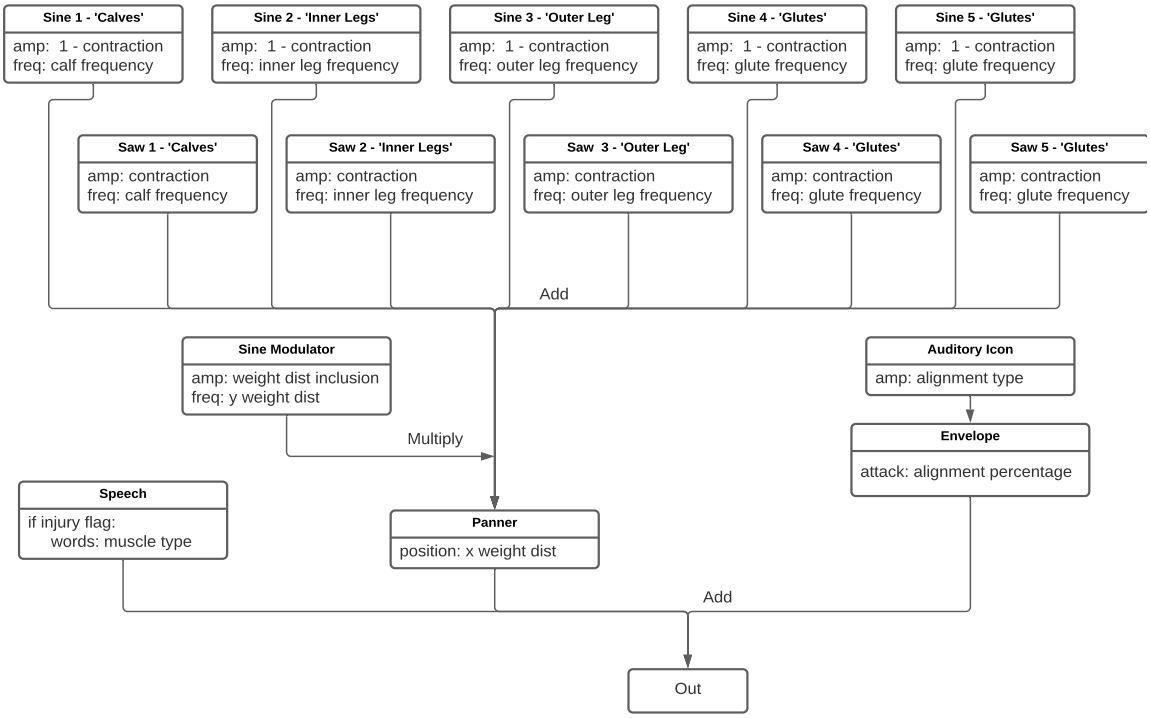
Possible UGen graph for Training Modes:



Timeline

	Goals
Week of Oct 26	• Develop sonification engine by connecting UGens • Mock-up sound design using temporary GUI controlling each Ugen parameter individually (will represent training context)
Week of Nov 2	• Create Json mock data from video reference • Build logic to contextualize the Json data • Add UI to interact with contexts
Week of Nov 9	• Connect contextualization logic and sonification engine • Finalize UI (add visuals) • Create evaluation plan Deliverable #5: Evaluation Plan due Nov 13
Week of Nov 16	• Schedule meeting with evaluation participants • Aim to complete evaluation this week Deliverable #4: Simulator Implementation Due Nov 16
Week of Nov 23	• Complete evaluation early this week if not already finished • Analyze the data from the evaluation • Write evaluation and results deliverable
Week of Nov 30	Deliverable #6: Evaluation Results due Dec 1