

Project Deliverable 4

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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.

Using the Simulator

The simulator has three main modes: Training, Normal Event, and Minimal Intervention. Training mode is individual and unrelated to the other modes and should be used for learning the sonification scheme. The Normal Event modes allow the sonification of pre-loaded JSON files of dance data. Minimal Intervention mode modifies both the event playback mode and the training mode by simplifying the sonification.

To access training mode, press the training mode button. This allows you to “Wizard of Oz” through the features at the base of the GUI. To exit training mode, press the training mode button again. Event buttons should not be pressed while in training mode. Upon activating training mode, you will hear the sonification of all muscle groups, and deactivating training mode will silence the sonification.

To access event mode, press any of the plie or sauté buttons. This will call the pre-loaded JSON event file corresponding to that button. There are 5 example events for both plies and sautés. The topmost “perfect plie” and “perfect saute” buttons will play the sound of a properly executed plie and saute, respectively. This is an important feature of the system because it provides the user with a baseline and a goal for the sound of a plie and saute. The other 8 buttons are variations of plies and sautes with various errors. Below is a list of the variations:

Test Plie 1	Plie with poor balance
Test Plie 2	Plie with muscle tension
Test Plie 3	Plie with poor alignment and balance
Test Plie 4	Plie with complex issues – many problems
Test Saute 1	Saute with poor landing and poor balance
Test Saute 2	Saute with poor alignment
Test Saute 3	Saute with tension in extraneous muscles
Test Saute 4	Saute with complex issues – many problems

In a real-world setting, it is more likely that case 4 occurs, however, simplifications and isolations were made to better evaluate and test the system. Entering an event also prompts a

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video to appear corresponding to the given dance technique. The plie and saute videos are constant for their event types and should be used merely as a visual aid while learning and evaluating the system.

To access Minimal Intervention mode, press the minimal intervention button. This limits the sonification to only play discrete, alerting sounds in hopes to be less busy or distracting to the dancer. This mode modifies both the event modes and training mode. To exit Minimal Intervention mode, press the minimal intervention button again.

Sonification Explanation

The sonification system is comprised of 8 wave players and some alerting sounds like an earcon and text-to-speech.

Muscle Contraction

The muscle groups “calf”, “hamstring”, “outer leg”, and “glutes” are represented by pitched sine and saw wave with pitches corresponding to an Fmaj7 chord. Muscle contraction is represented by the presence of the saw wave in the additive synthesis mix. For example, if a muscle is contracted 60%, it will be sonified with a sine gain of 0.4 and a saw gain of .6. Each muscle group has its own set frequency and varying contraction level. In minimal intervention mode, these sounds are silenced.

Additionally, if the muscle contraction levels are very poor or dangerous according to the event files, a text-to-speech alert will play corresponding to the at-risk muscle group. This extends beyond the initial “calf”, “hamstring”, “outer leg”, and “glutes” to include “neck”, “shoulders”, “hands”, or any other muscle written into the a JSON event with a “bad” flag.

In training mode, you can manipulate the contraction levels of the “calf”, “hamstring”, “outer leg”, and “glutes” via the 4 left vertical sliders. To isolate a muscle group, press the button with the muscle’s name. To go back to hearing all the muscle groups, press the all button. To hear the sound of text-to-speech alerts for the selected muscle, press the injury button.

Alignment

The body position and alignment of the dancer is represented by a musical earcon. The percentage “out-of-line”, or percentage incorrect, is mapped to the volume of the earcon playback. In training mode, you can manipulate the alignment sonification via the alignment button and the vertical slider above it. Press the alignment button to hear the earcon and adjust the slider to change its playback volume.

Weight Distribution

Weight distribution is represented through the manipulation of the total mix of the sonification. Weight distribution on the x, left-right, axis is mapped to the panning of the total mix. If a dancer is leaning too heavily to the right, the total mix will pan to the right ear. Weight distribution on

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the y, forward back, axis is mapped to the frequency of amplitude modulation. As a dancer becomes moves further away from center, the modulator frequency increases. The downward force of the dancer is mapped to the total volume of the mix. As the dancer leaves the floor for a jump, the mix fades out, and upon landing, the mix fades back in. In training mode, you can manipulate weight distribution by adjusting the 2D slider and the total volume slider.

Other Notes

The start and end of JSON events manipulate a total gain envelope, where the start of the event sets the gain to 1 and the end of the event sets the gain to 0, 200 ms later.