INSIDE

Sonic College 2018
Jakob Schmid

Overview

- Introduction
- Audio Engine Overview
- Animation Events
- Cloth
- Voice Sequencer
- Voice Configuration
- Wrapping Up


INSIDE
PLAYDEAD
Released for Xbox One, PS4, PC, iOS
Developed over 6 years
INSIDE
playdead.com/inside

Game Developers Choice Awards 2016

Best Audio, Best Visual Art

Game Critics Awards 2016

Best Independent Game

The Game Awards 2016

Best Art Direction, Best Independent Game

DICE Awards 2016

Spirit Award, Art Direction, Game Direction

13th British Academy Games Awards

Artistic Achievement, Game Design, Narrative, Original Property

The Edge Awards 2016

Best Audio Design

Playdead

Released LIMBO in 2010

Copenhagen-based

Around 25 employees

INSIDE Audio Team

Martin Stig Andersen	audio director, sound designer, composer
Andreas Frostholm	sound designer
Søs Gunver Ryberg	composer, sound designer
Jakob Schmid	audio programmer

Audio Engine Overview

INSIDE Technology

Unity

Audiokinetic Wwise

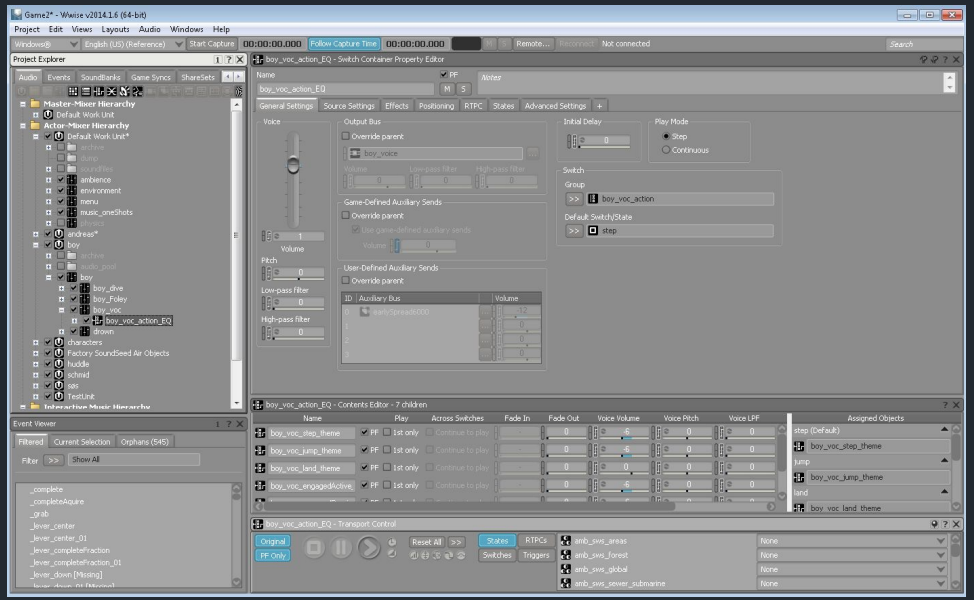
Modified Wwise-Unity plugin

PlayMaker

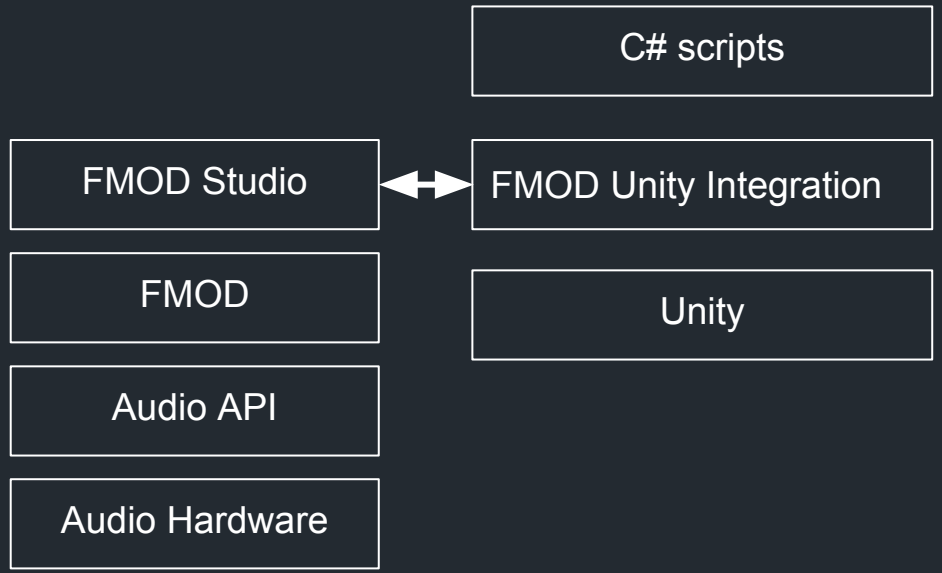
FMOD vs. Wwise

- Both leading sound engines
- FMOD has focused on programmer flexibility
- Wwise has focused on sound designer flexibility

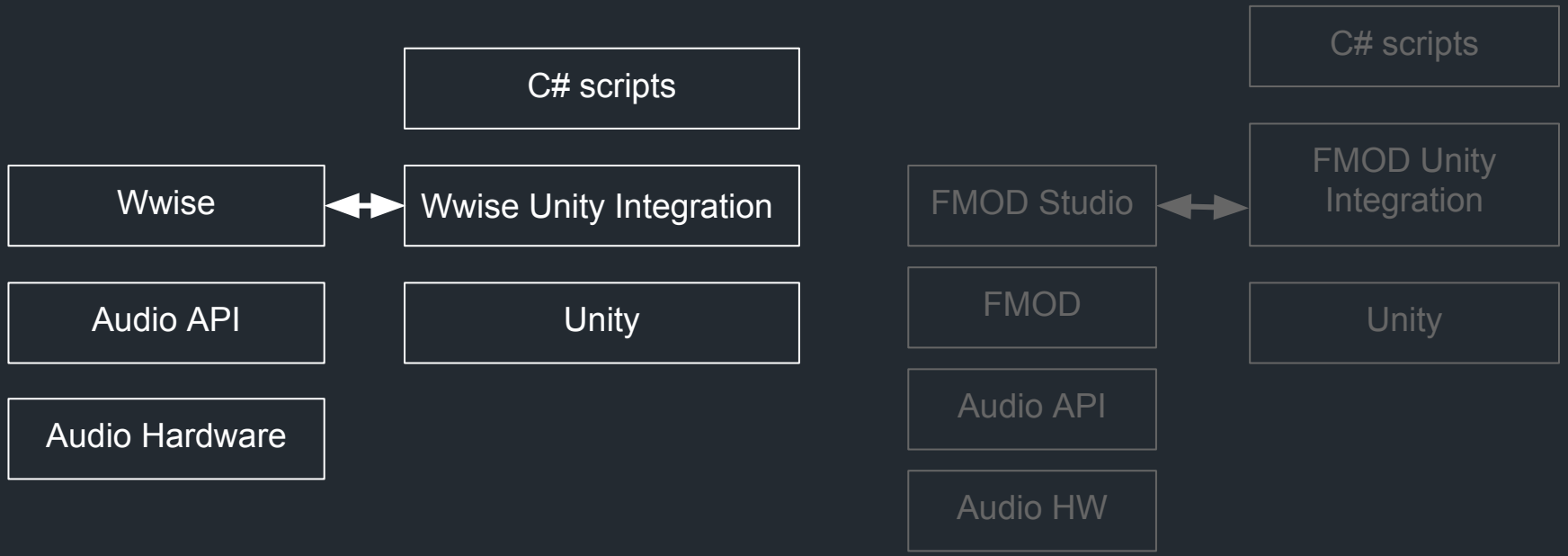
Wwise Authoring Tool (2014.1.6)



FMOD Studio / Unity Setup



Wwise / Unity Setup



FMOD Unity Integration Code

FMOD Unity Integration audio:

```
[FMODUnity.EventRef]
public string mySoundEvent;
EventInstance mySound;


fmod = FMODUnity.RuntimeManager;
mySound =
fmod.CreateInstance(mySoundEvent);
mySound.start();

// modify sound while playing
float t;
mySound.setParameterValue("health", t);
```

Wwise Unity Integration Code

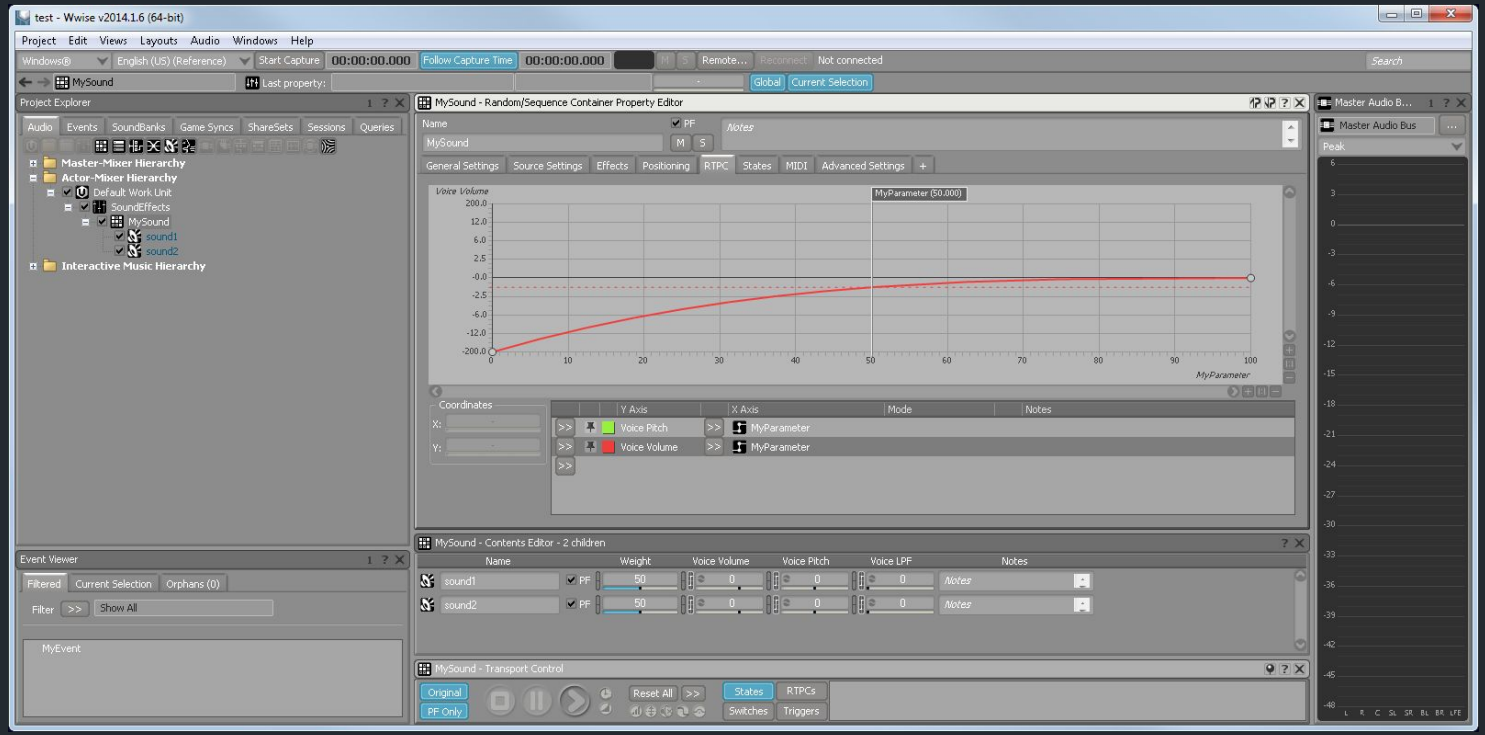
Wwise Unity Integration:

```
GameObject go = this.gameObject;
AkSoundEngine.PostEvent("MySound", go);

// Modify sound while playing
// - modification is defined using external tool
float t;
AkSoundEngine.SetRTPCValue("MyParameter", t, go);
```

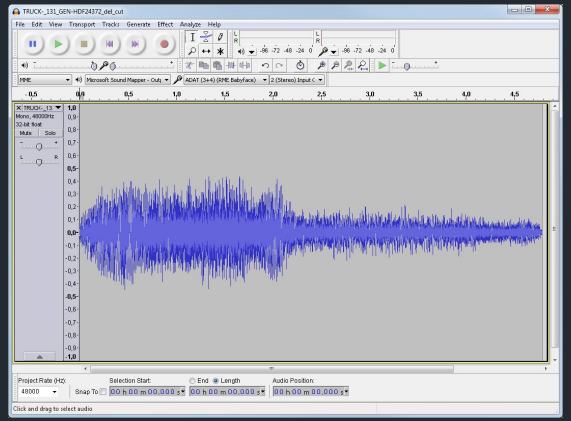
FMOD Unity Integration audio:

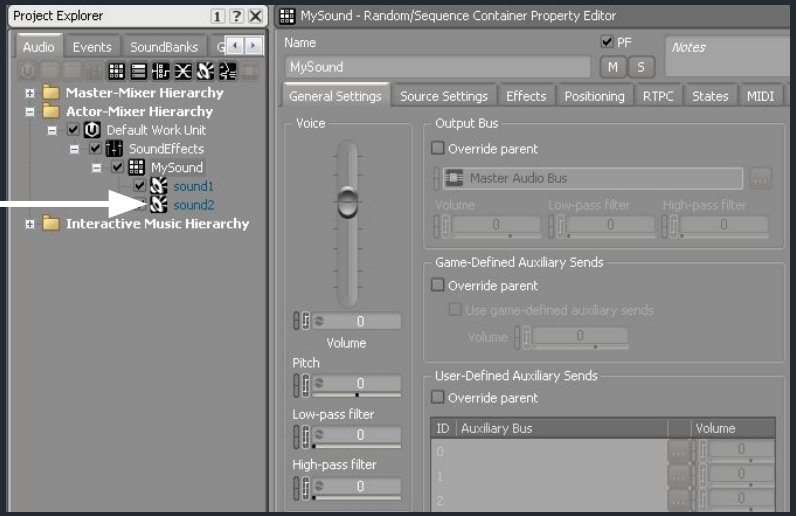
```
[FMODUnity.EventRef]
public string mySoundEvent;
EventInstance mySound;

fmod = FMODUnity.RuntimeManager;
mySound =
    fmod.CreateInstance(mySoundEvent);
mySound.start();

// modify sound while playing
float t;
mySound.setParameterValue("health", t);
```

Wwise Workflow: Wwise Authoring Tool

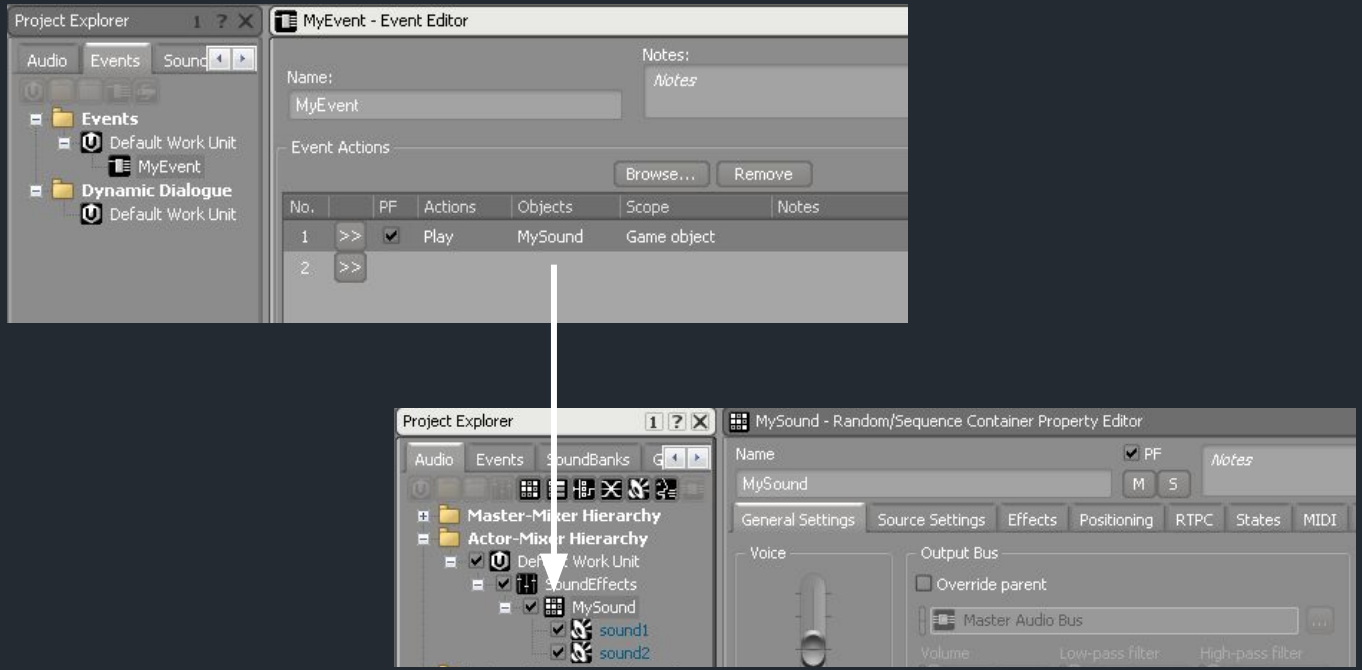


Wwise Workflow: Defining Sounds

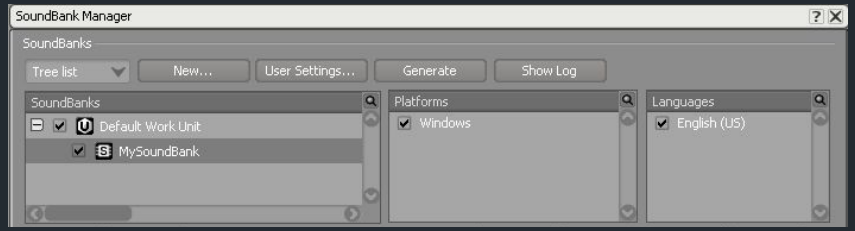




Wwise Workflow: Events



Wwise Workflow: Output Sound Banks

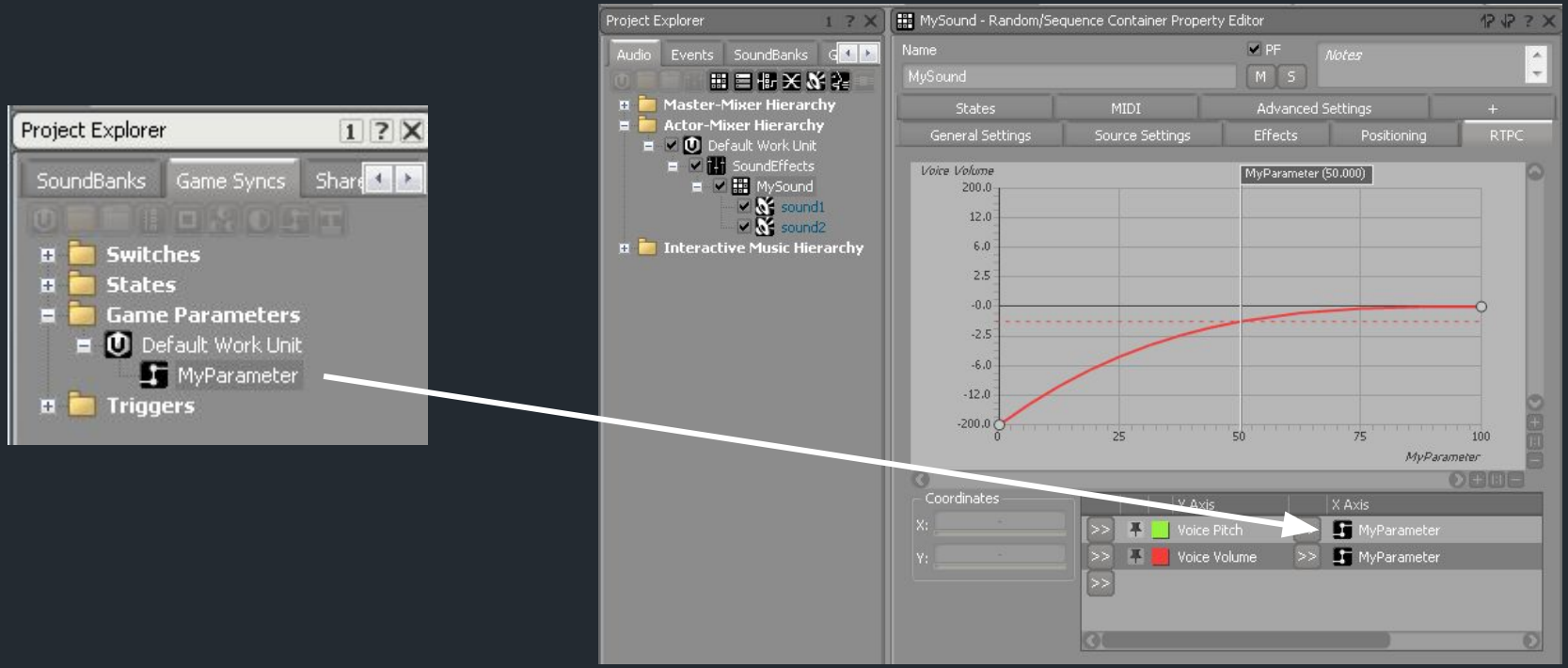


- Sound Banks contain a list of events
- ... And all the sounds used by the events

Wwise Workflow: Scripting

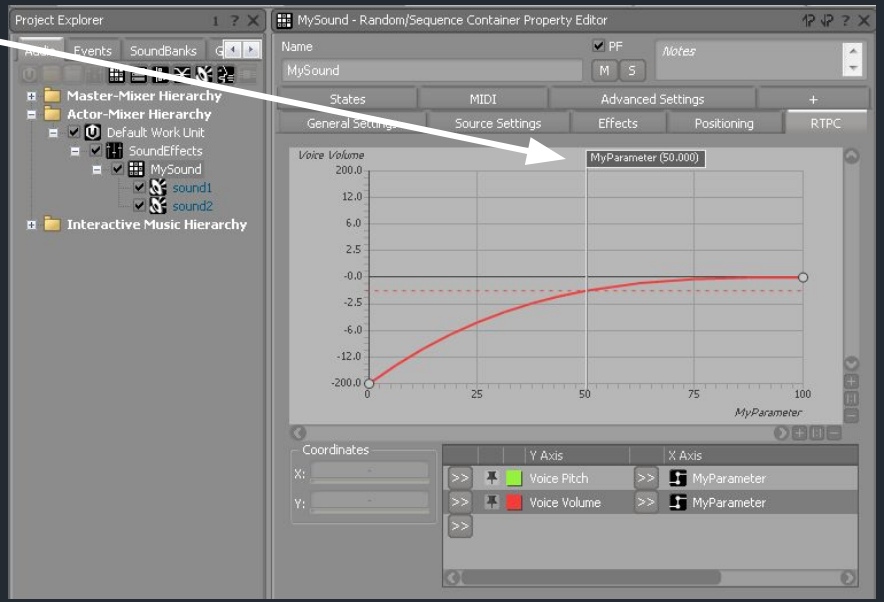
```
AkSoundEngine.LoadBank("Init.bnk", ... );
AkSoundEngine.LoadBank("MySoundBank.bnk", ... );

AkSoundEngine.PostEvent("MySound", go);
```

Wwise: Modify Playing Sounds



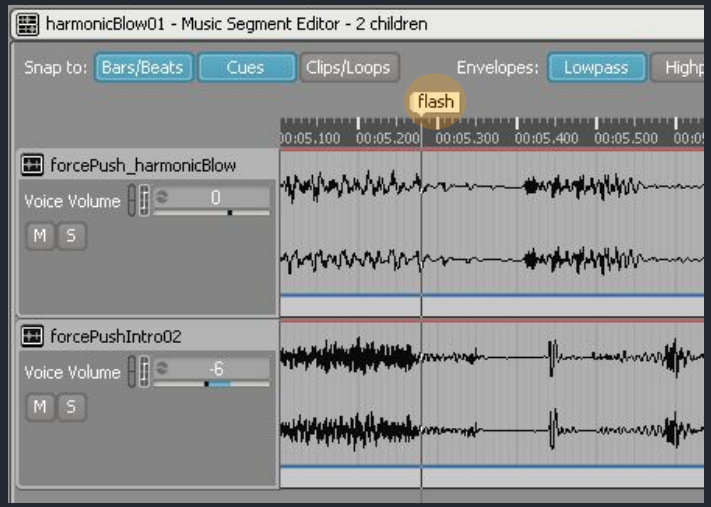
Wwise Workflow: Scripting

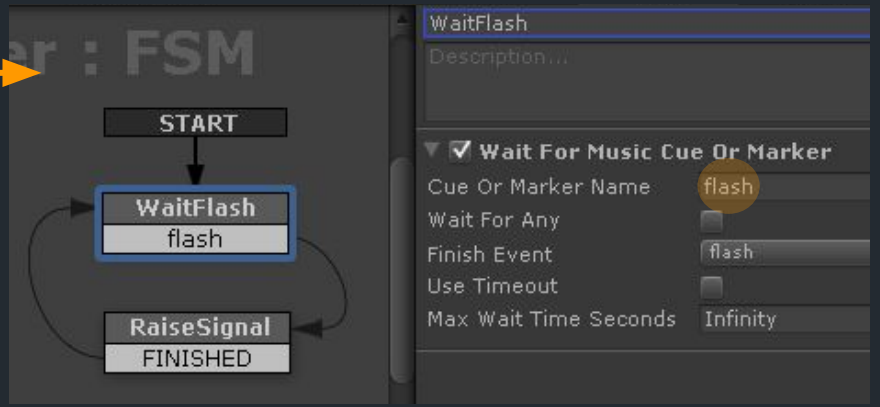
```
AkSoundEngine.PostEvent("MySound", go);
float t;
AkSoundEngine.SetRTPCValue("MyParameter", t, go);
```



Audio-driven Gameplay: User Cues

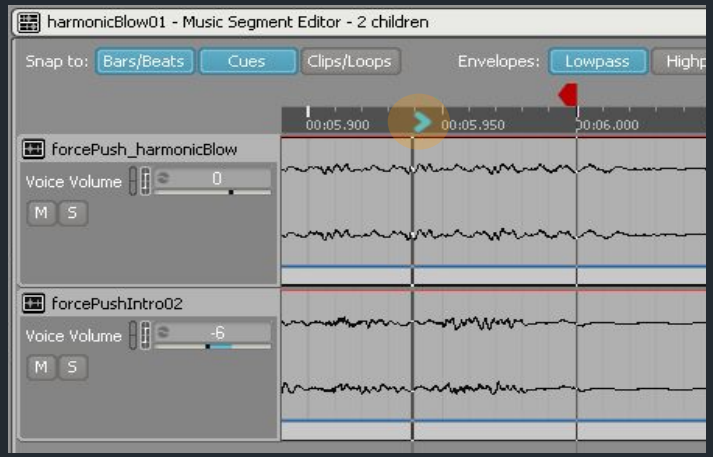
- Named User Cues can be placed in music segments
- Received in Unity the next frame

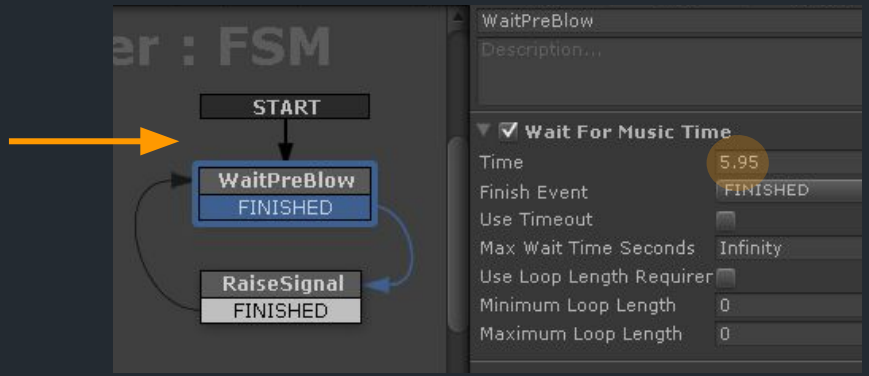




Getting Music Time

The game can also get music time information directly from Wwise

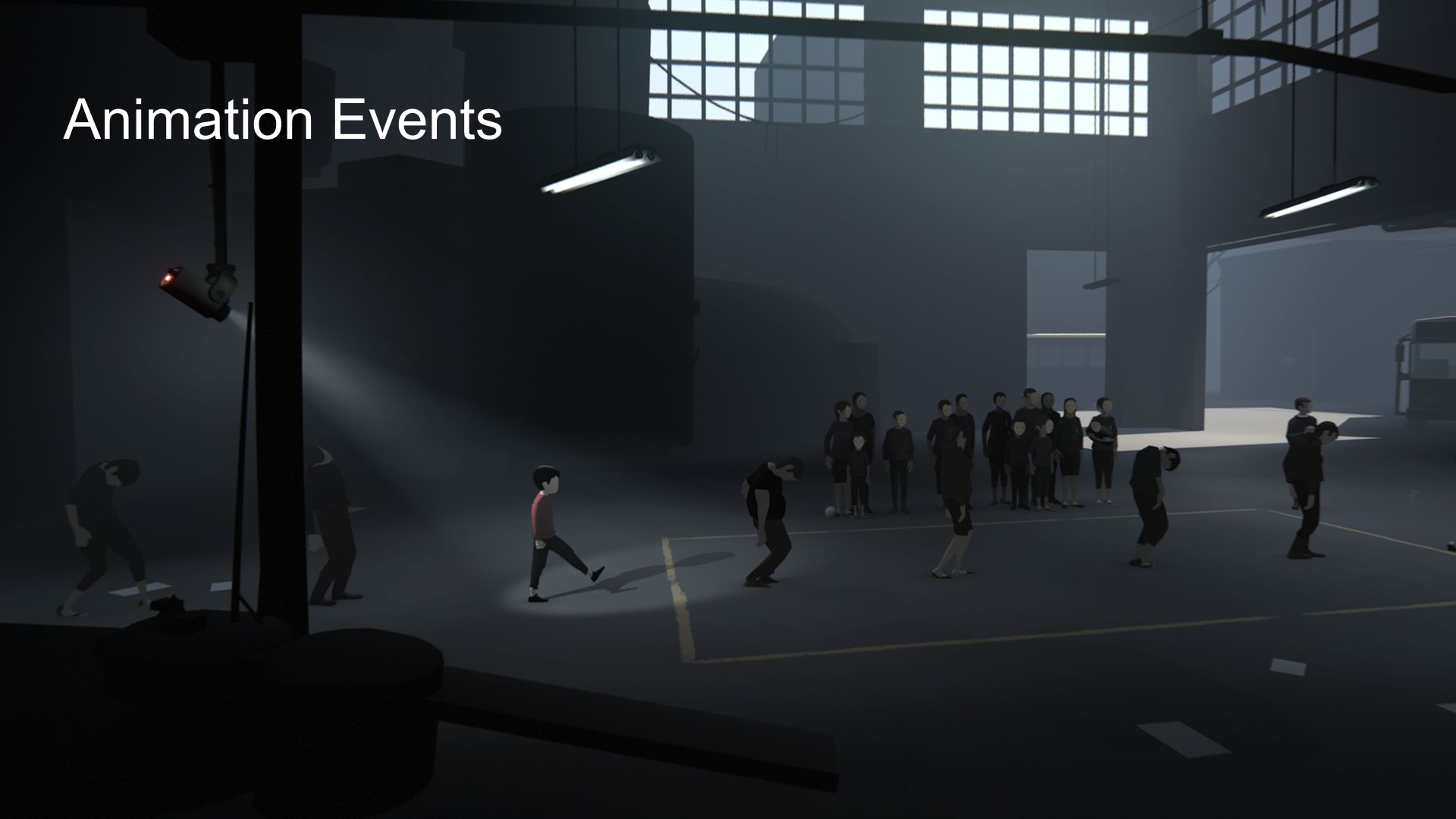




Audio Engine Summary

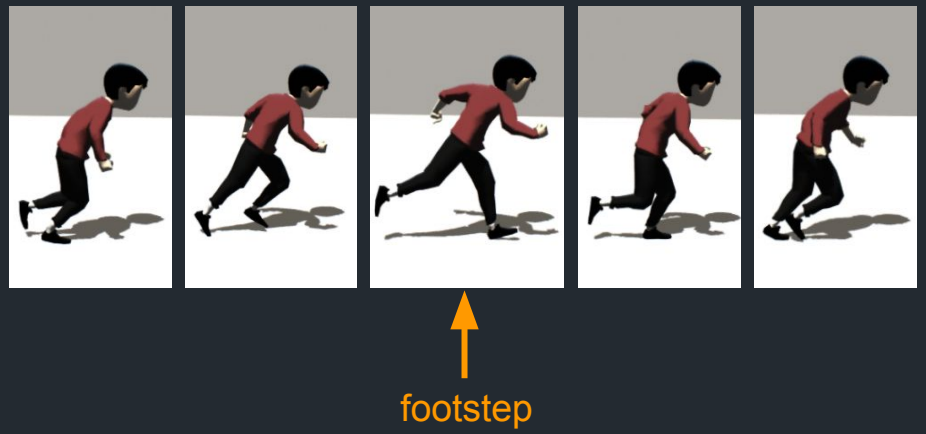
- INSIDE uses Wwise-Unity integration
- Wwise Authoring Tool defines events, parameters, etc.
- Wwise Authoring Tool exports soundbanks
- Wwise can be controlled from Unity
- Music User Cues and time information can be received from Wwise in Unity

Animation Events



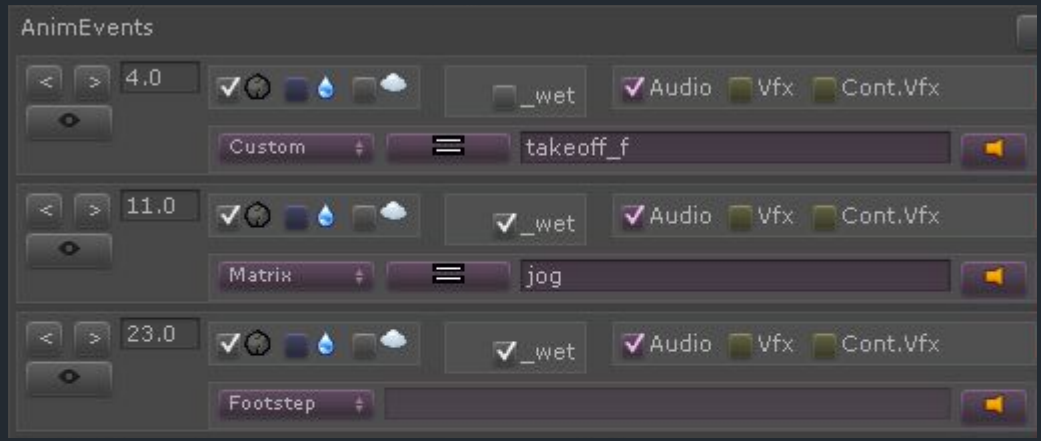
Animation Events

- Associated with a specific animation
- Occur at a specific animation frame
- Can trigger sounds or visual effects



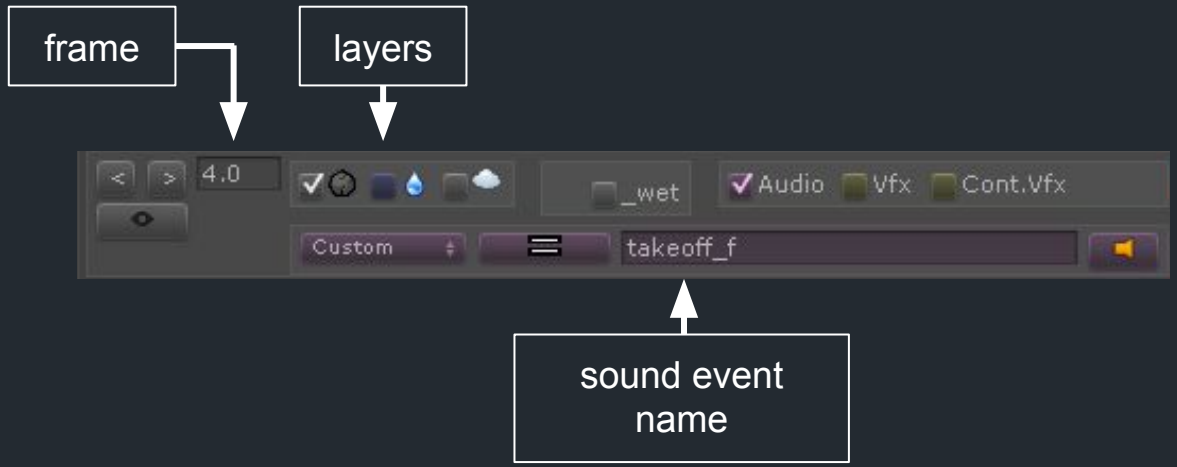
Animation Events

- Animation event types:
  - Custom
  - Matrix
  - Footstep
- Also used for VFX



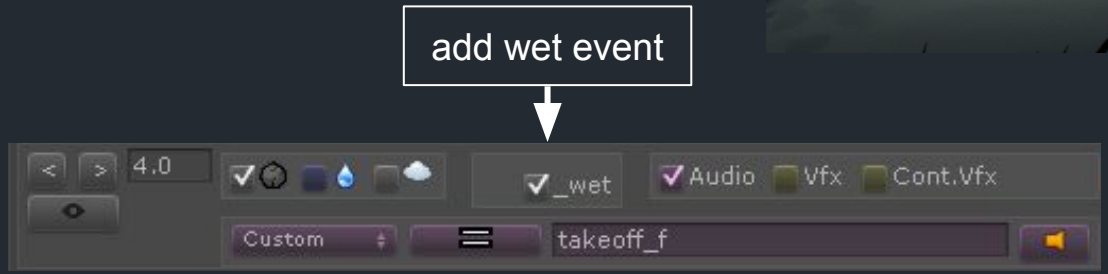
Custom Animation Events

- Name of sound event specified directly
- Fires when animation frame has been passed
- Checks layers: ground, water, air



Wet Animation Events

- Optionally plays additional wet sound event
- Current wetness is sent as a parameter
  - Is set high when in water or on a wet surface
  - When dry, approaches 0 over time



Matrix Animation Events

- **Matrix key** instead of sound event name
- Context-dependent sounds

  e.g. from 'run' to 'stop' yields 'brake'

Matrix Animation Events

previous key

current key

previous key \ current key	any	idle	sprint	run	jog	walk	sneak	JumpUp	JumpForward
any	none		sprint	run	jog	walk	sneak	jump_2feet_f	jump_1foot_mf
idle					takeoff_mf	takeoff_mp	takeoff_p		
sprint									jump_1foot_f
run									jump_1foot_mf
jog			run						jump_1foot_mp
walk			run	jog					jump_1foot_p
sneak			jog	jog	walk				jump_1foot_p
JumpUp									
JumpForward									
RunTurnRun									
RunStop									

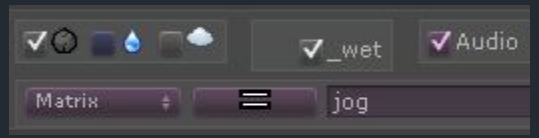
Current Matrix Key

- Current key is specified in current animation event

jog

current key: jog

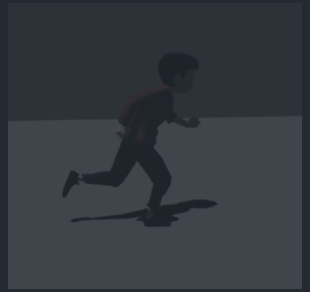
	any	idle	sprint	run	jog
any	none		sprint	run	jog
idle					takeoff_mf
sprint					
run					
jog			run		
walk			run	jog	
sneak			jog	jog	walk
JumpUp					
JumpForward					
RunTurnRun					
RunStop					



Previous Matrix Key

- Previous key was specified in previous animation event

idle



previous key: idle

	any	idle	sprint	run	jog
any	none		sprint	run	jog
idle					takeoff_mf
sprint					
run					
jog			run		
walk			run	jog	
sneak			jog	jog	walk
JumpUp					
JumpForward					
RunTurnRun					
RunStop					

Play Sound

idle

jog

previous key: idle

current key: jog

	any	idle	sprint	run	jog
any	none		sprint	run	jog
idle					takeoff_mf
sprint					
run					
jog			run		
walk			run	jog	
sneak			jog	jog	walk
JumpUp					
JumpForward					
RunTurnRun					
RunStop					

play sound 'takeoff_mf'

Context Sensitivity

- If previous matrix key was 'sneak', a different sound is played

sneak

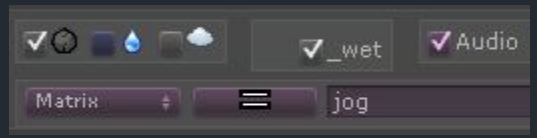
jog

previous key: sneak

current key: jog

	any	idle	sprint	run	jog
any	none		sprint	run	jog
idle					takeoff_mf
sprint					
run					
jog			run		
walk			run	jog	
sneak			jog	jog	walk
JumpUp					
JumpForward					
RunTurnRun					
RunStop					

play sound 'walk'



Column Default

- Empty entries are replaced with column default

idle

run

previous key: idle

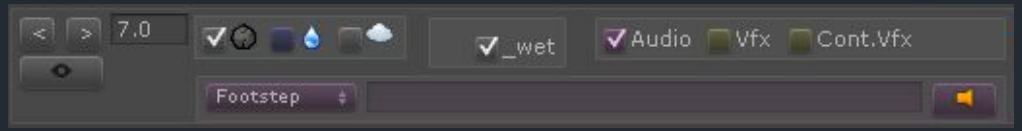
current key: run

	any	idle	sprint	run	jog
any	none		sprint	run	jog
idle					takeoff_mf
sprint					
run					
jog			run		
walk			run	jog	
sneak			jog	jog	walk
JumpUp					
JumpForward					
RunTurnRun					
RunStop					

play sound 'run'

Footstep Animation Events

- Matrix events!
- Key is determined from movement speed:
  - idle : speed < 0.07
  - sneak : speed < 0.37
  - walk : speed < 0.70
  - jog : speed < 0.92
  - run : speed < 1.30
  - sprint : speed >= 1.30
- Robust with smooth animation blending
- Simple to define



Animation Events Summary

- Animation events occur in a specific frame in an animation
- Animation events trigger sounds and visual effects
- Custom events specify sounds directly
- Matrix events are used for context-sensitivity
- Footstep events are matrix events, automatically selected based on speed

Cloth

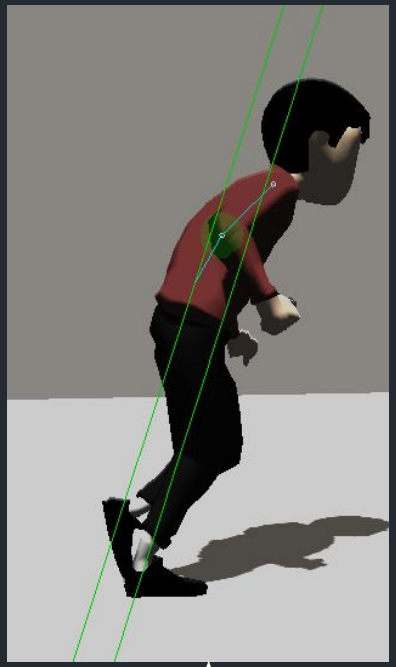
Cloth

- Sound of clothes rubbing against itself
- Generated at runtime from character geometry
- Sounds are selected based on movement speed

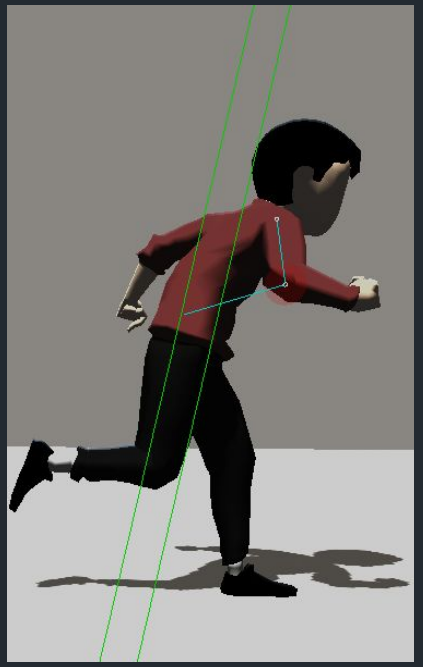
Elbow Torso Pass

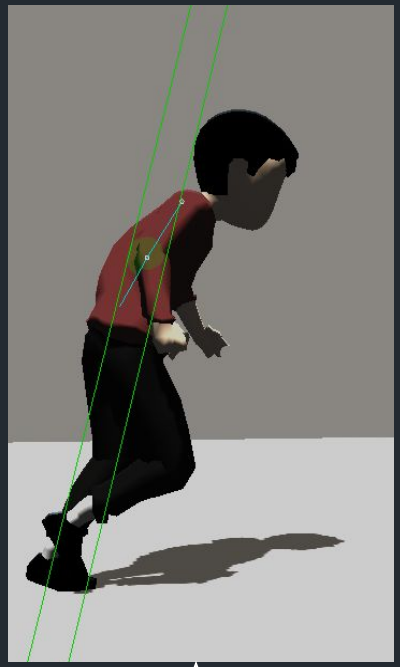
- Send elbow speed parameter
- Play sound when elbow enters 'brush zone'

Elbow Torso Pass



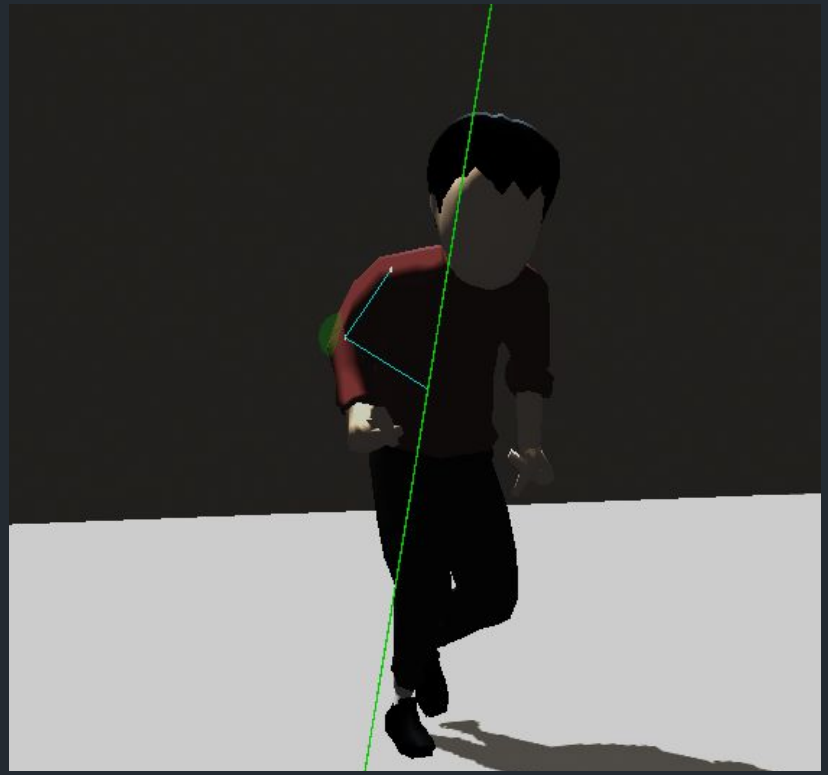
brush

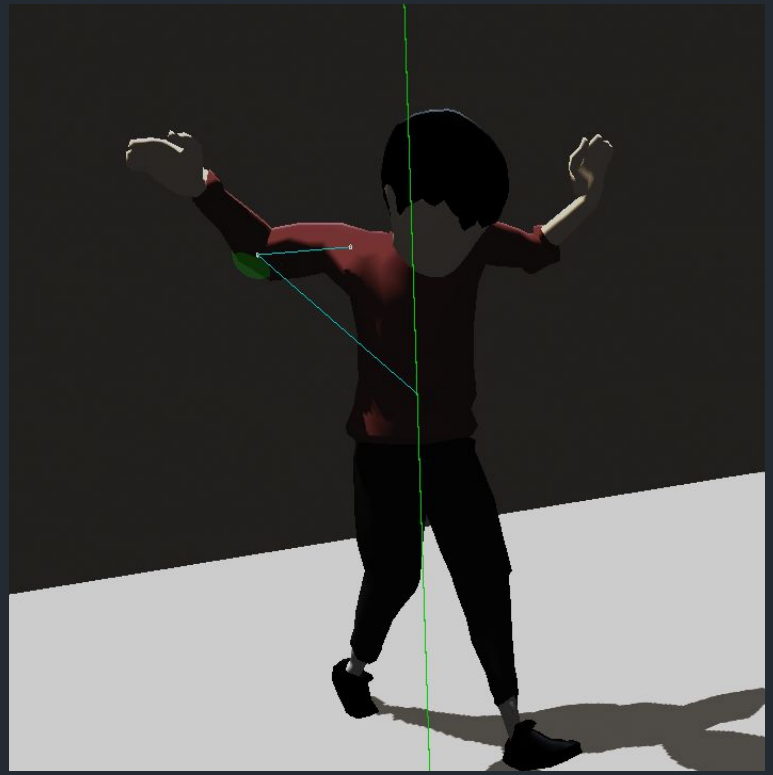




brush

Arm Angle





Cloth Summary

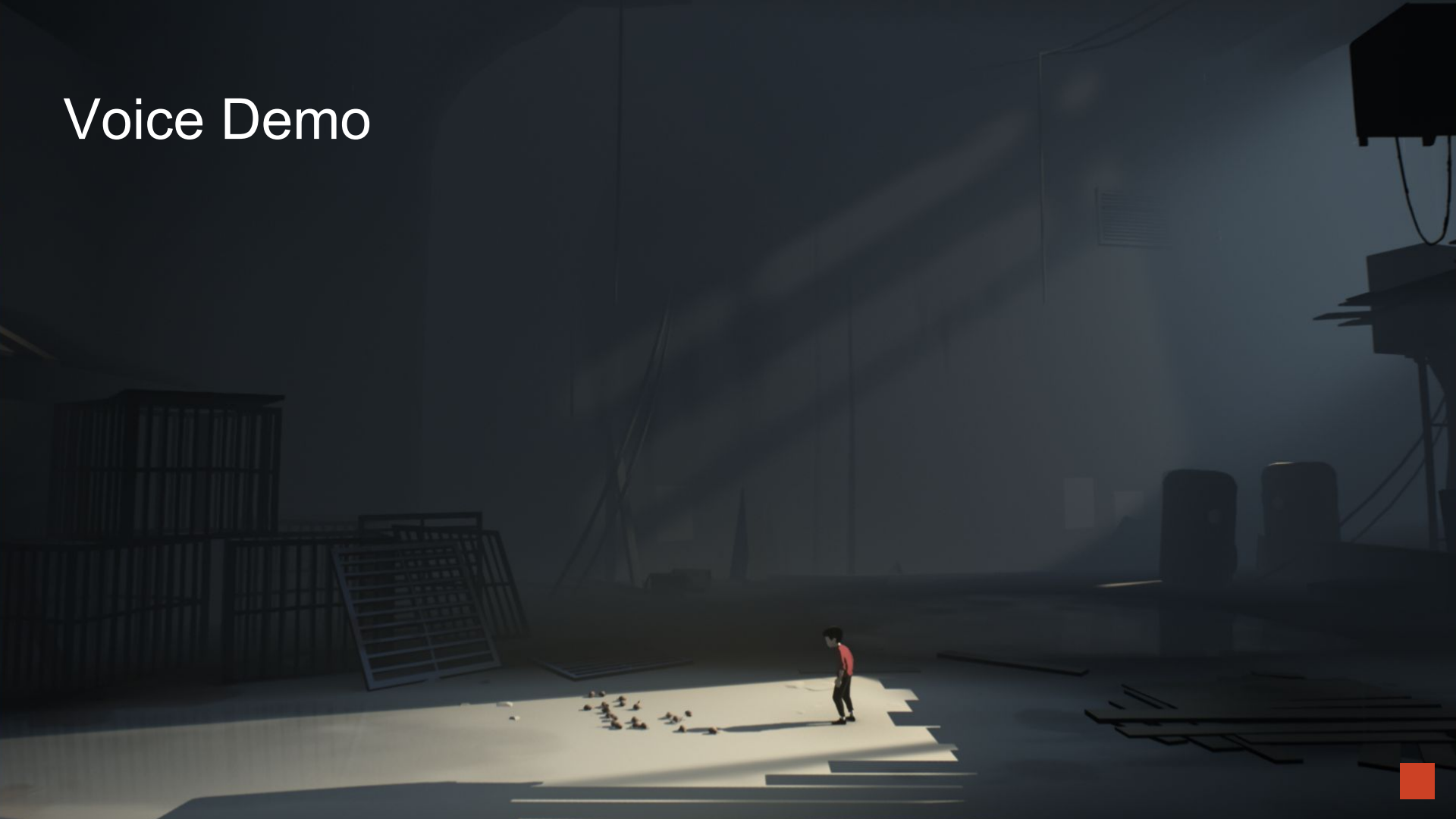
- Sound events generated from geometry
- Tracking a single elbow was enough
- Creates coherence between discrete foley sounds

Voice Sequencer

Voice Concept

- Natural and adaptable audio playback
- Integration of physical and emotional states

Voice Demo



Voice Sequencer

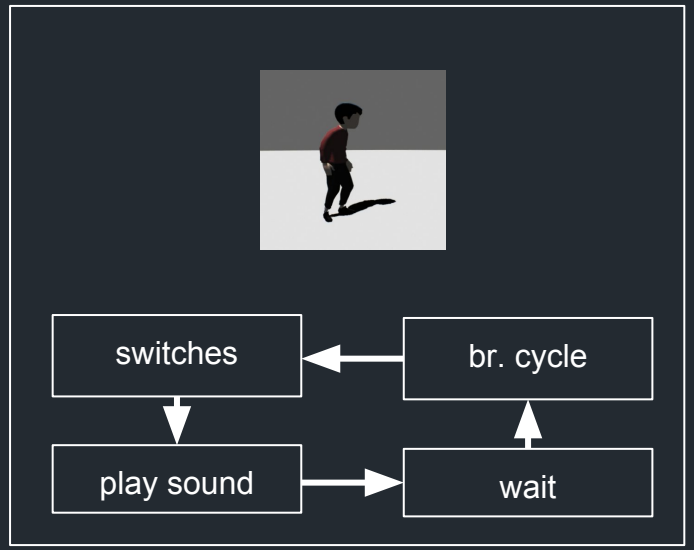
- Sequencer implemented in C# using Wwise callbacks
- Sequences voice sound events, alternating between inhale and exhale

Voice Sound Events

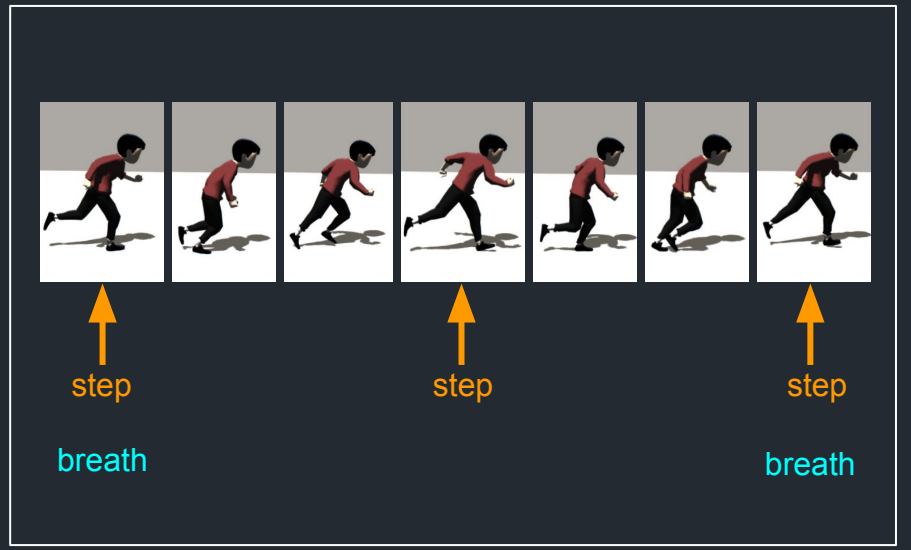
- Which sound to play is defined by switches:
  - Action
  - Emotion
  - Intensity
  - Etc.
- Intensity is a numeric value:
  - Increases with physical exertion
  - Decreases when idle

Voice Sequencer Modes

Continuous Mode

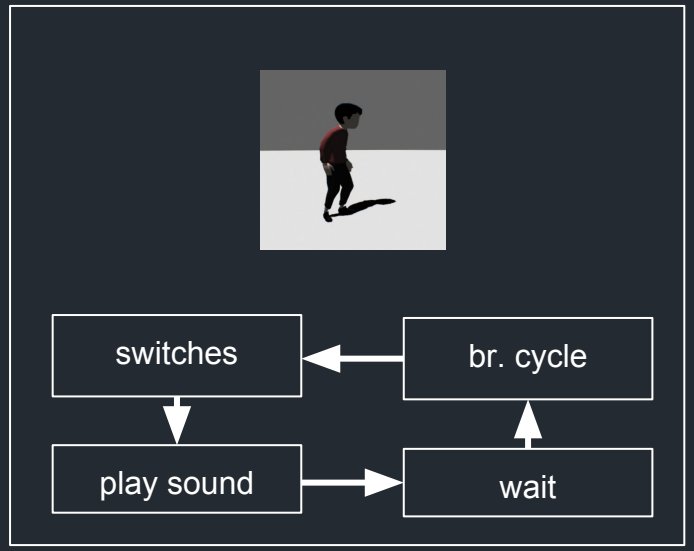


Rhythmic Breathing



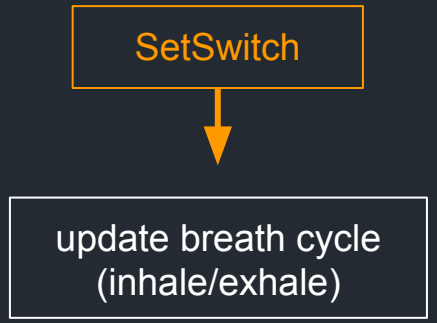
Voice Sequencer Modes

Continuous Mode

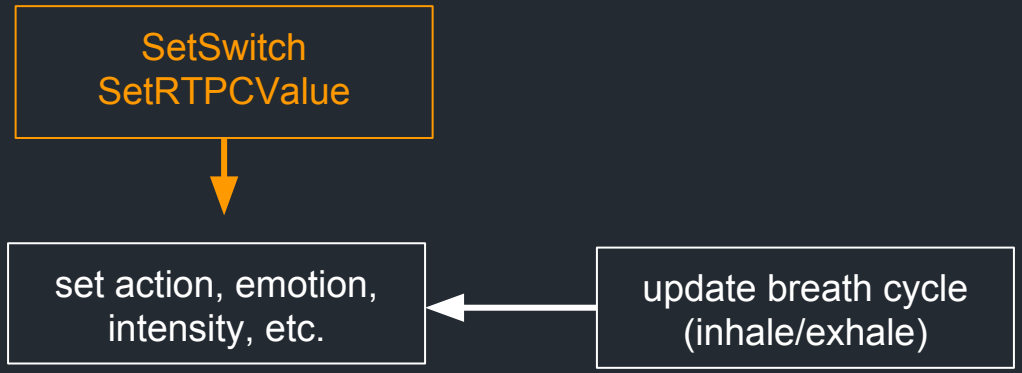


Rhythmic Breathing

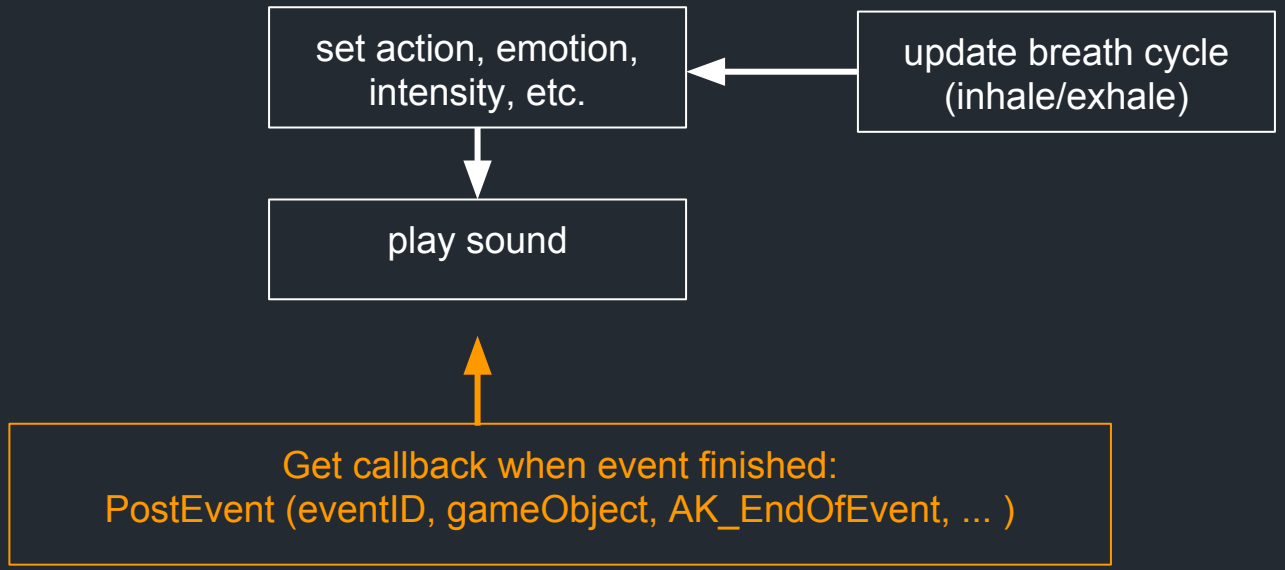
Voice Sequencer: Continuous Mode



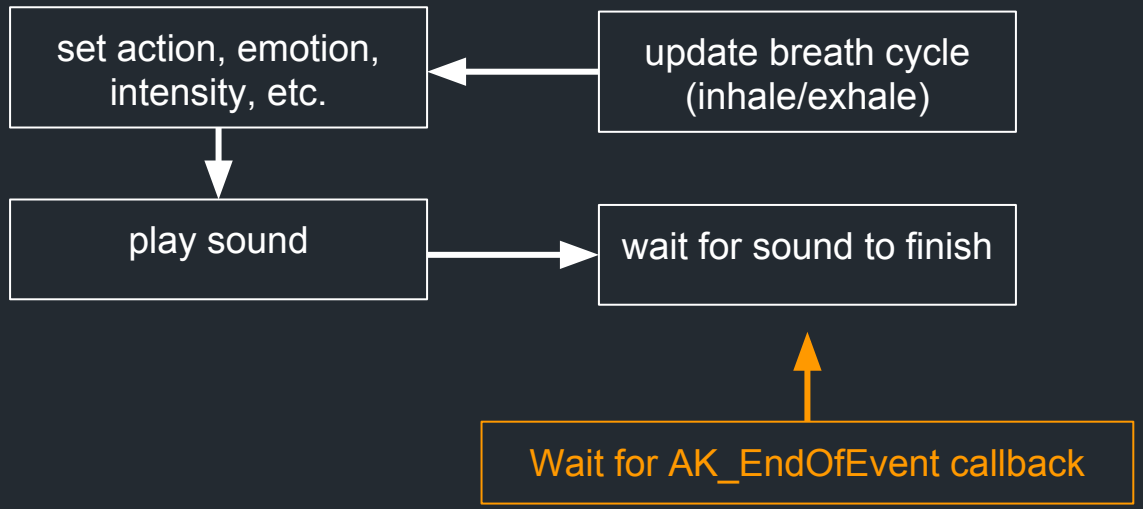
Voice Sequencer: Continuous Mode



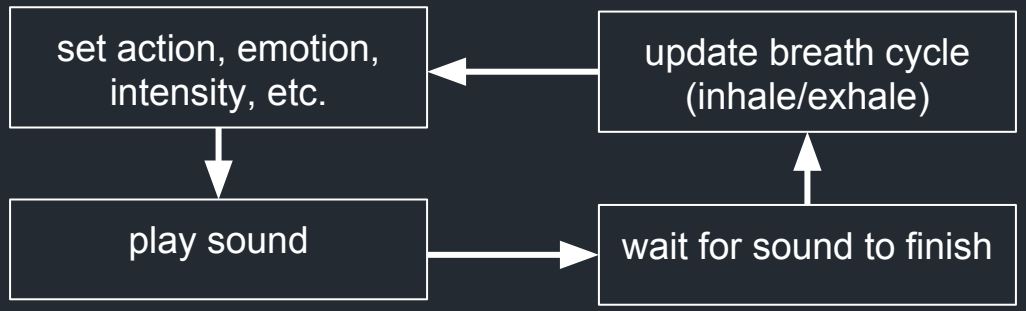
Voice Sequencer: Continuous Mode



Voice Sequencer: Continuous Mode

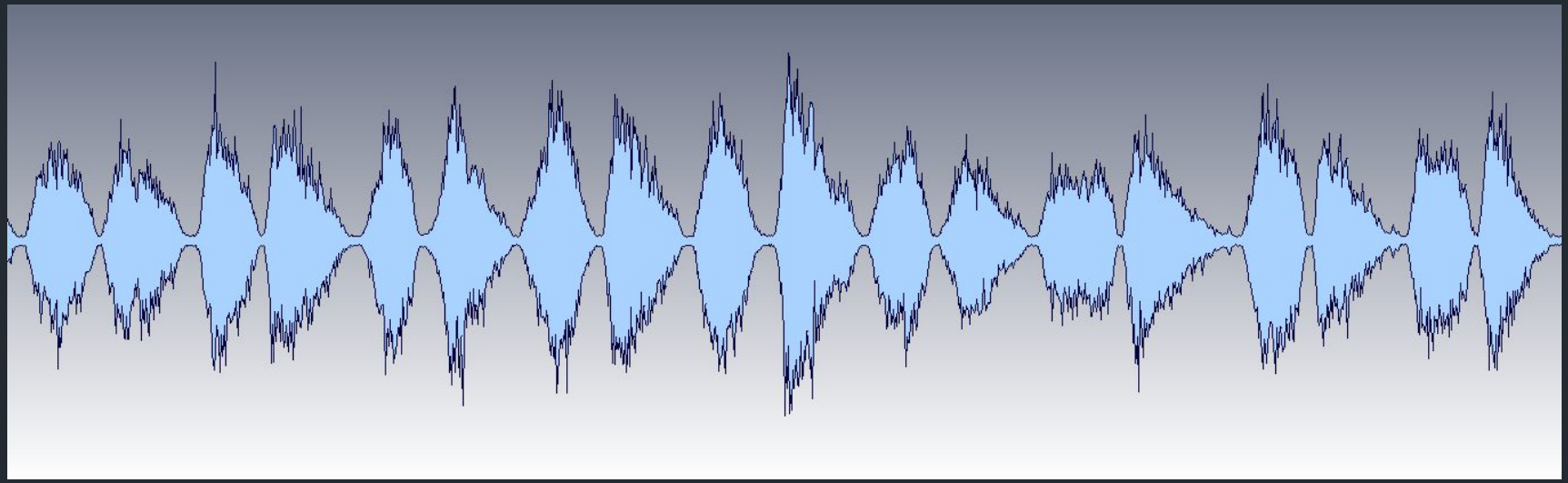


Voice Sequencer: Continuous Mode



Natural Breathing

- Recorded breath sounds have varying durations
- Continuous sequencing results in natural, uneven breathing pattern



Animation Feedback

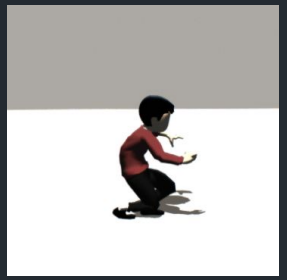
- Every breath results in a callback to the game
- Callback controls additive breathing animation, affecting boy pose

Holding Breath

On jump:

if currently inhaling, stop afterwards

if currently exhaling, do a quick inhale, then stop



On land:

restart breathing with exhale (action = land)

soft impact: normal exhale, hard impact: grunt

Engagement Actions

Special actions indicate performing work, uses different set of sounds

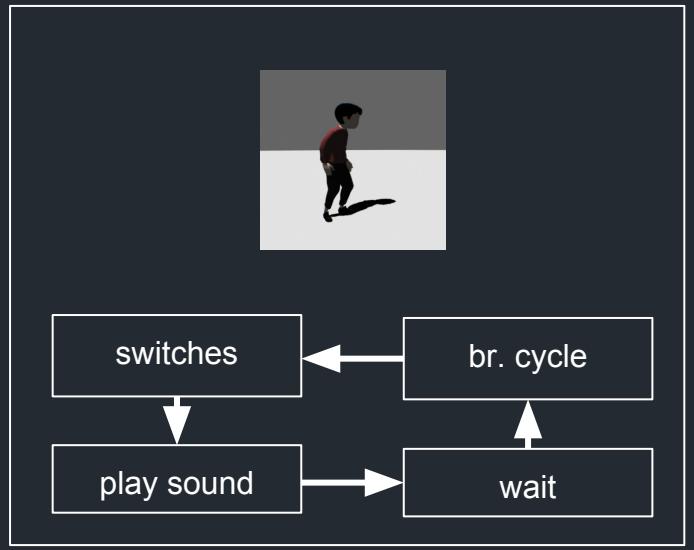
not engaged

engaged passive

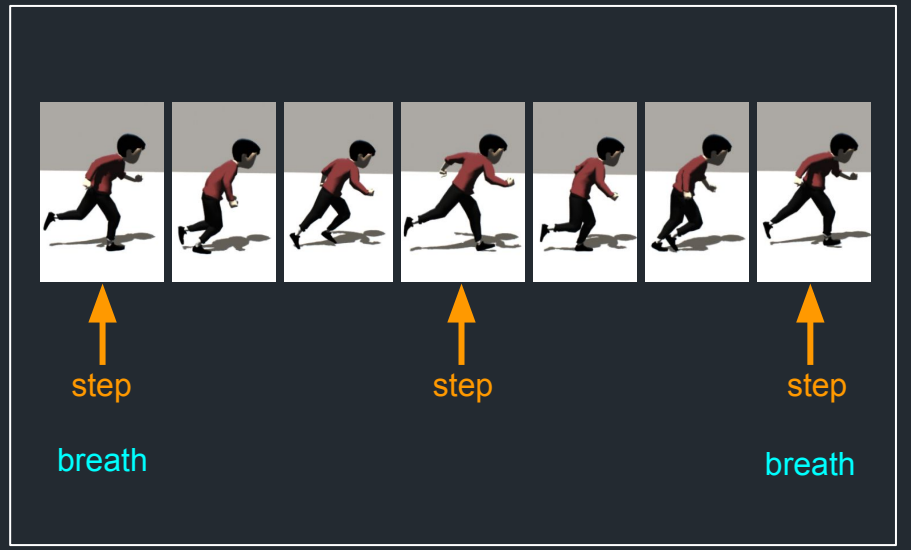
engaged active

Voice Sequencer Modes

Continuous Mode

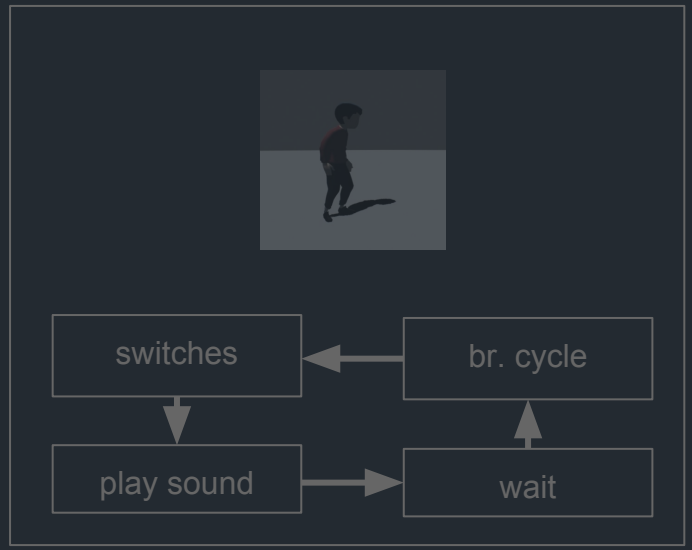


Rhythmic Breathing

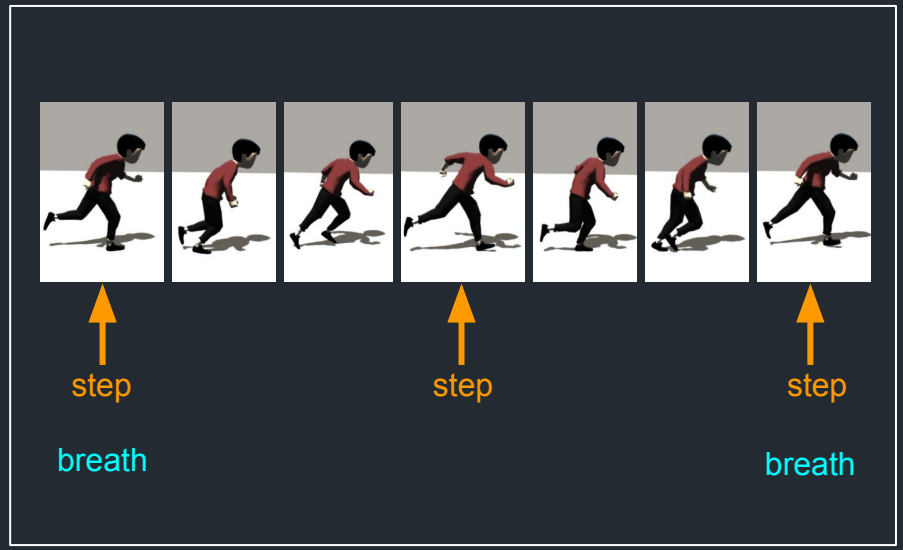


Voice Sequencer Modes

Continuous Mode



Rhythmic Breathing



Rhythmic Breathing

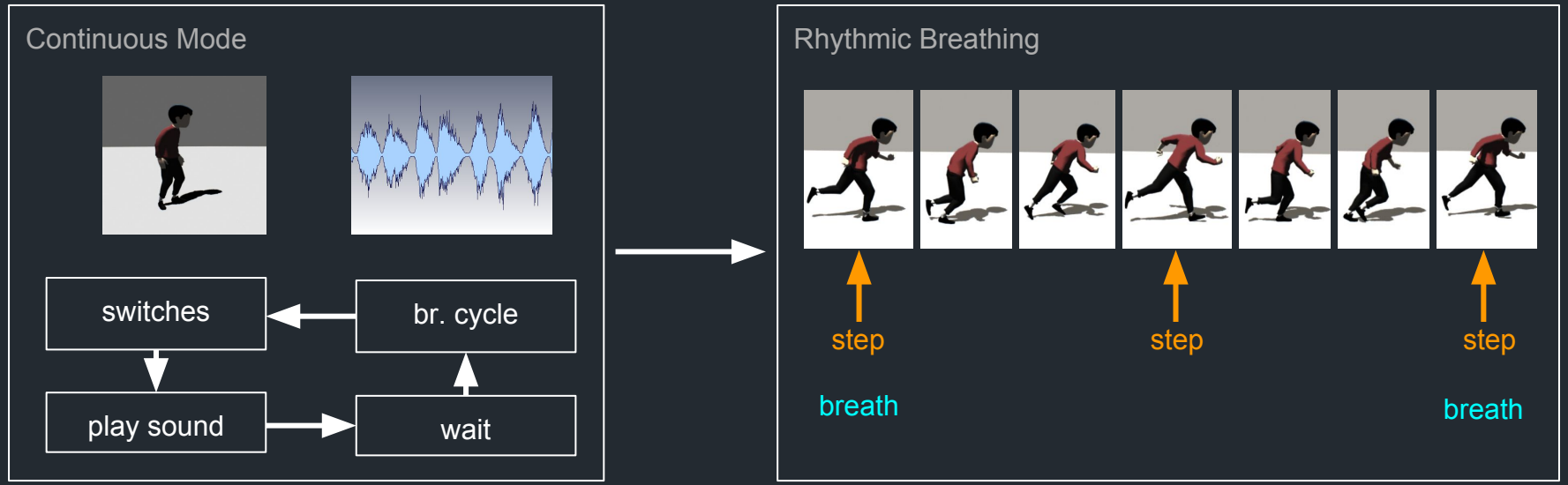
- Goal: breath should align with footsteps when running
- Non-continuous sequencing

Rhythmic Breathing

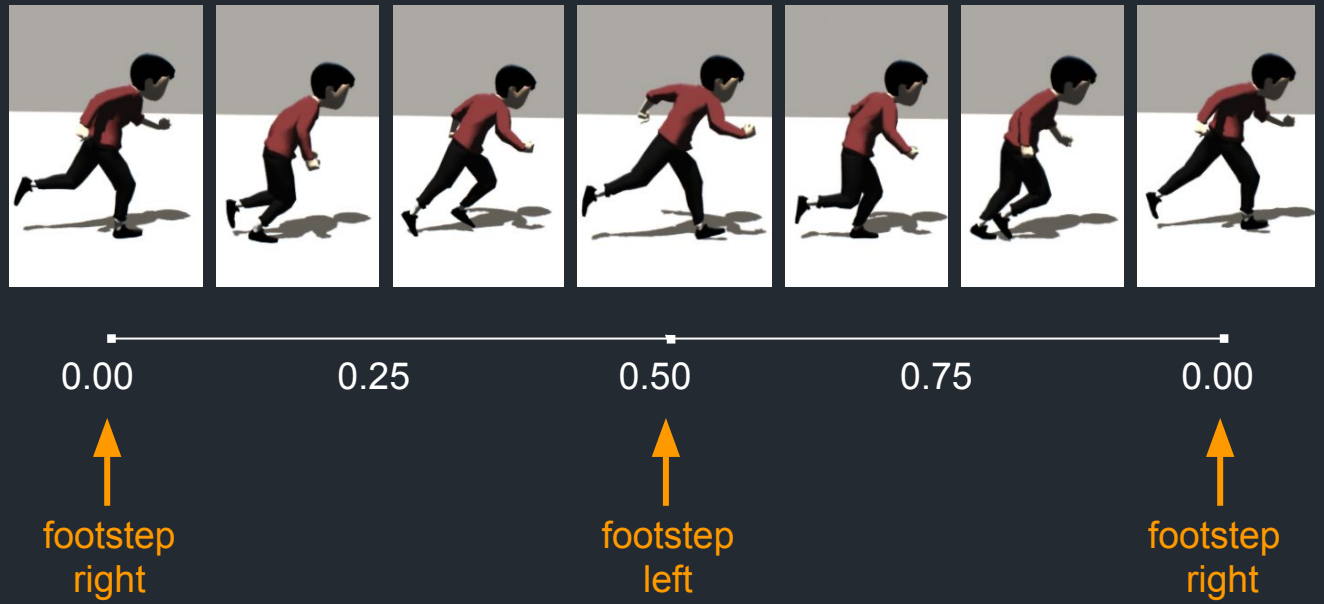
- Goal: breath should align with footsteps when running
- Non-continuous sequencing
- 1 breath for every 2 steps

Rhythmic Breathing Transition

- When not running, breath runs continuously
- When starting to run, gradually transition from continuous rhythm to footstep rhythm



Run Cycle Phase

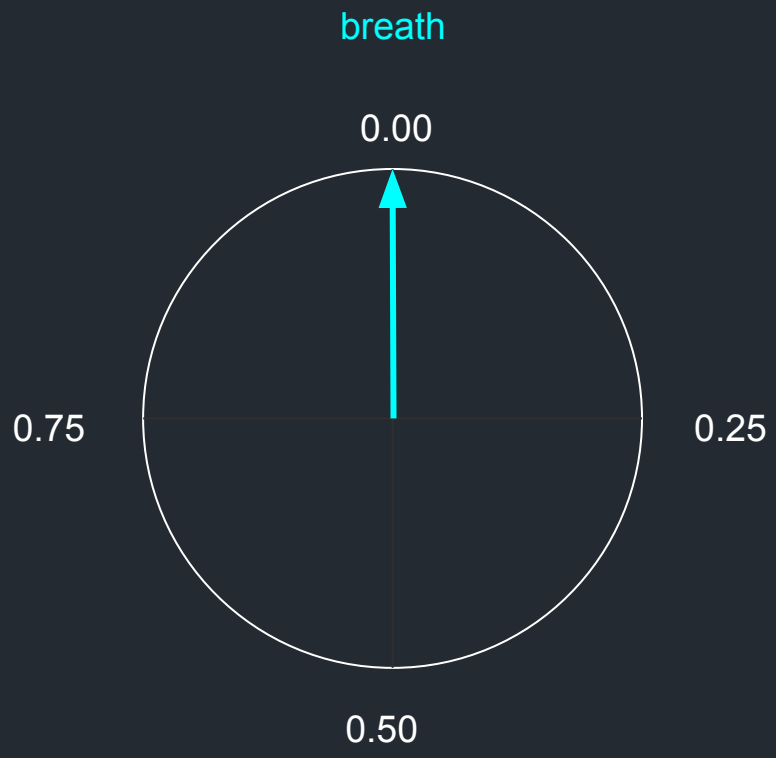


Run Cycle Phase

- Full cycle is 2 steps
- Right footstep on 0.0
- Left footstep on 0.5

Breath Phase

- Breathe when phase is 0
- Full cycle is 1 breath
- When switching from continuous to rhythmic breathing:
  - Compute frequency from last 2 breaths
  - Compute phase from frequency and last breath time



Gradual Alignment

- Gradually align breath rhythm to run cycle rhythm
- Align two **frequency, phase** pairs

Gradual Alignment Problem

- Who knows about aligning two **frequency, phase** pairs?

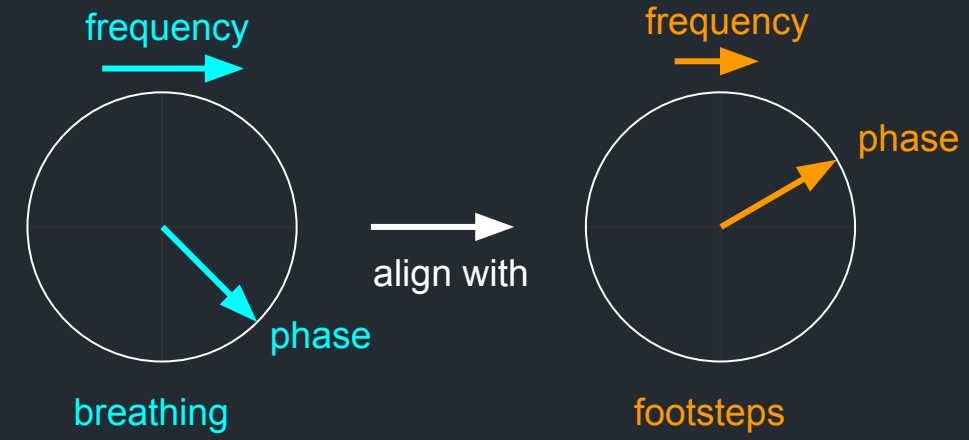
Solution: Beat Matching

- Who knows about aligning two **frequency, phase** pairs?
- DJs do.

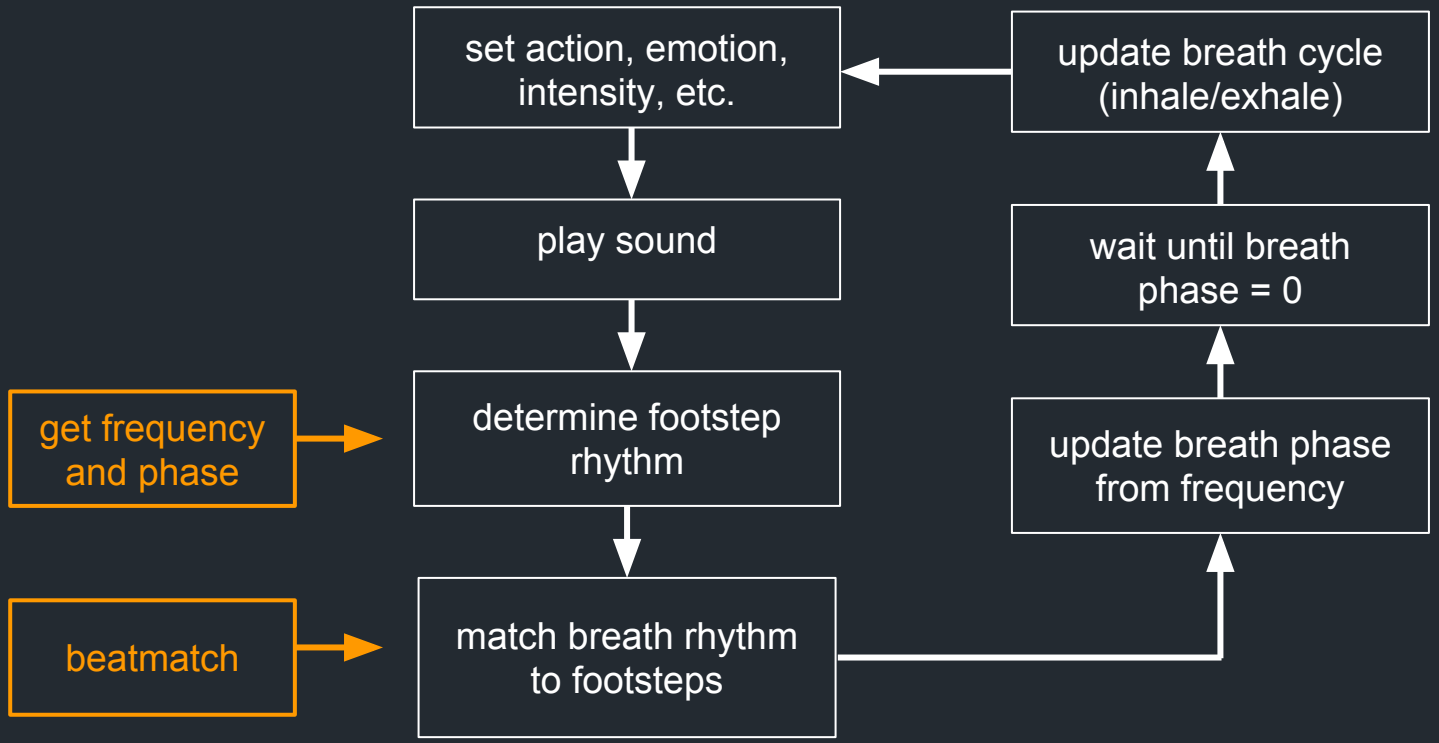
Solution: Beat Matching

- Gradually interpolate breath frequency towards run cycle frequency
- Compensate breath frequency for phase offset

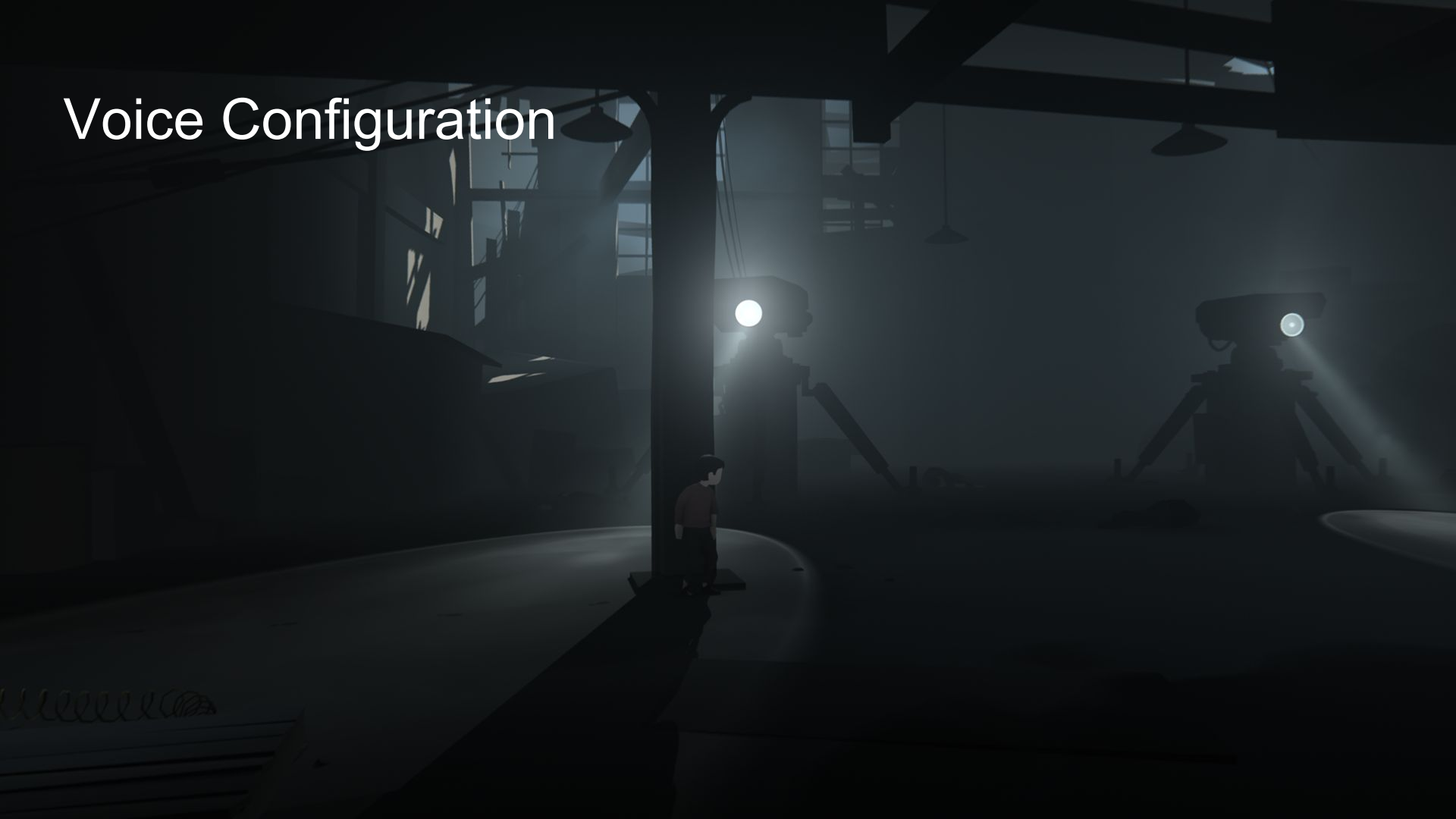
- Like a DJ that uses pitch adjust without nudging the record



Voice Sequencer: Rhythmic Breathing



Voice Configuration



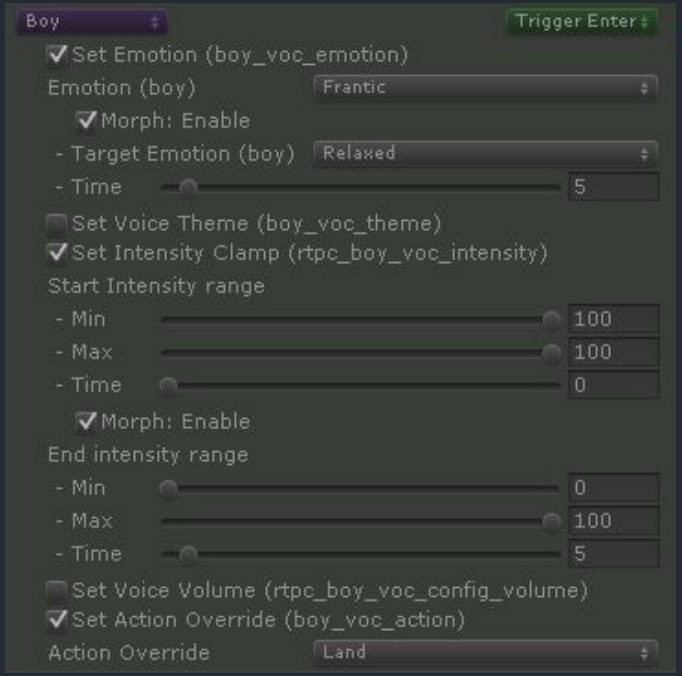
Voice Direction

- Voice direction is accomplished using our voice configuration system
- The director (Martin) instructs the actor (voice sequencer) how to emote:
  - based on location or
  - based on reacting to events

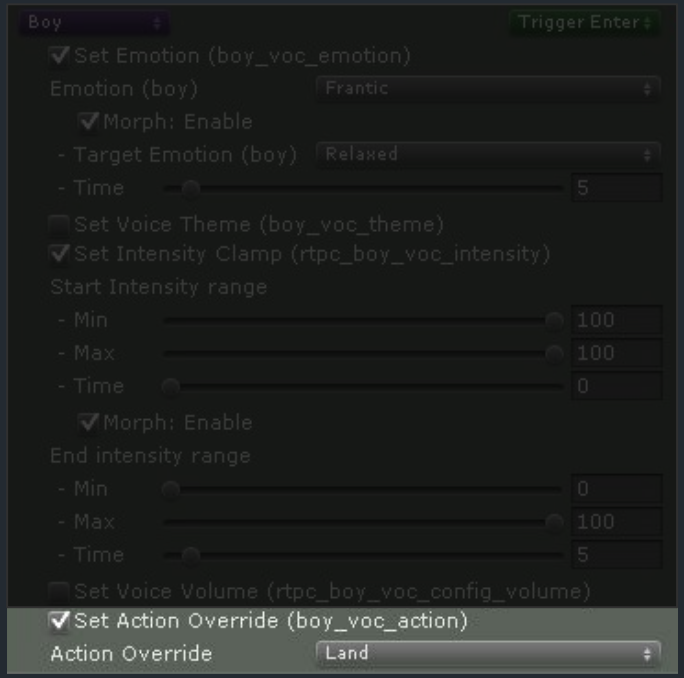
Voice Configuration

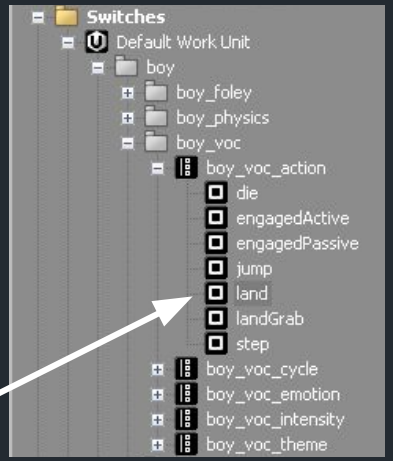
- Trigger boxes
- State machines
- Scripts
- Gives full control over voice parameters
  - action
  - emotion
  - intensity

Voice Configuration: Trigger box

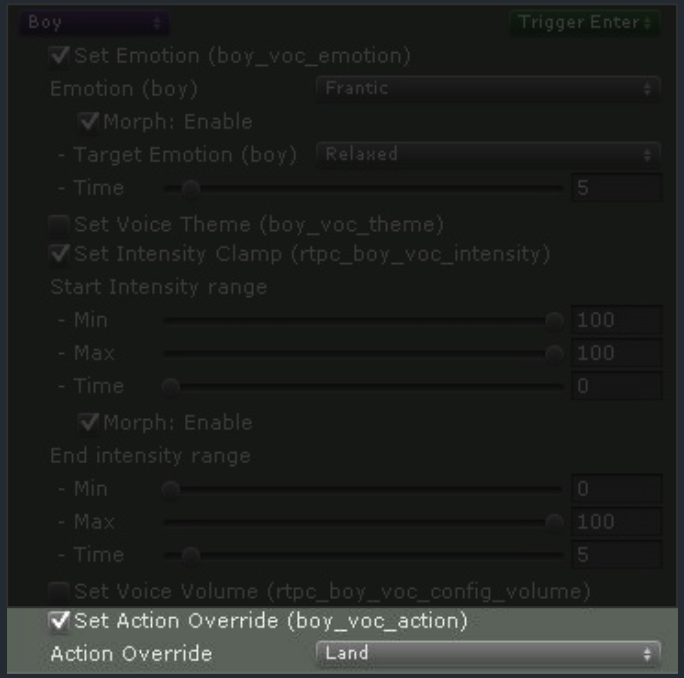


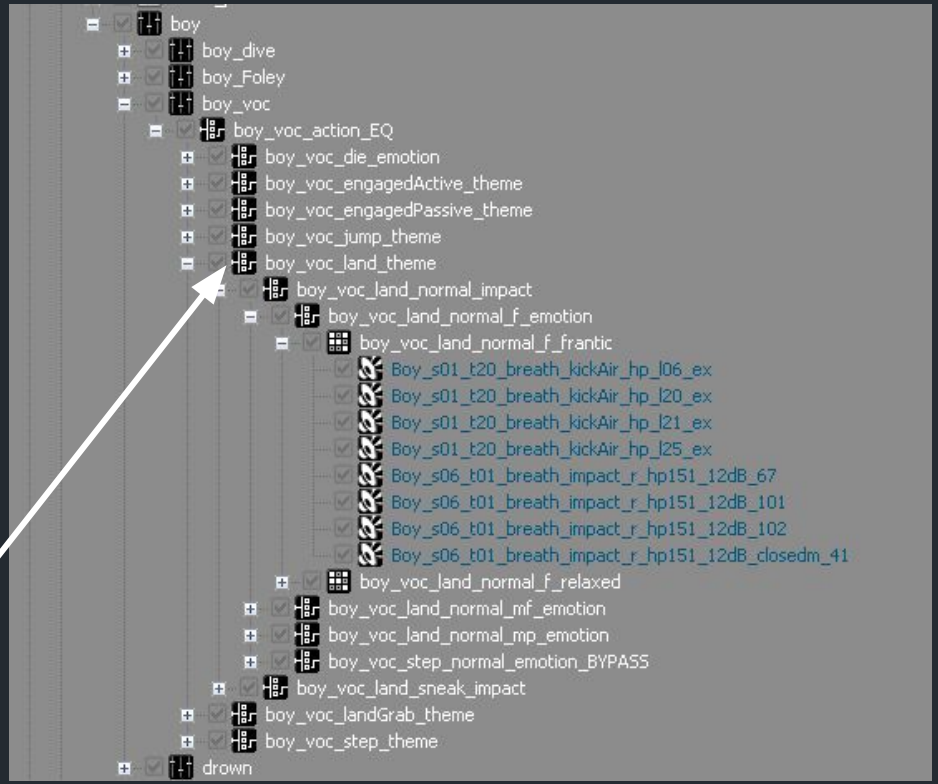
Switch


Boy
Trigger Enter
Set Emotion (boy_voc_emotion)
Emotion (boy)
Frantic
Morph: Enable
- Target Emotion (boy)
Relaxed
- Time
5
Set Voice Theme (boy_voc_theme)
Set Intensity Clamp (rtpc_boy_voc_intensity)
Start Intensity range
- Min
100
- Max
100
- Time
0
Morph: Enable
End intensity range
- Min
0
- Max
100
- Time
5
Set Voice Volume (rtpc_boy_voc_config_volume)
Set Action Override (boy_voc_action)
Action Override
Land

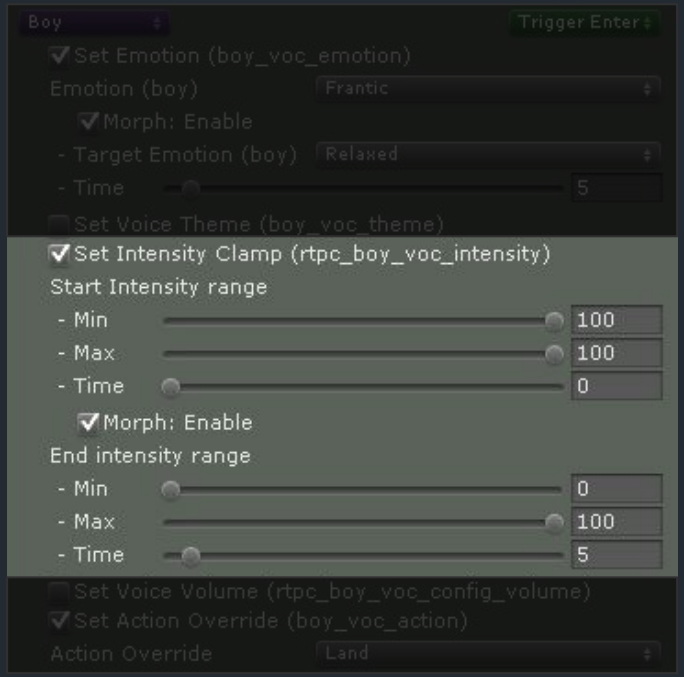

Switches
Default Work Unit
boy
boy_foley
boy_physics
boy_voc
boy_voc_action
die
engagedActive
engagedPassive
jump
land
landGrab
step
boy_voc_cycle
boy_voc_emotion
boy_voc_intensity
boy_voc_theme

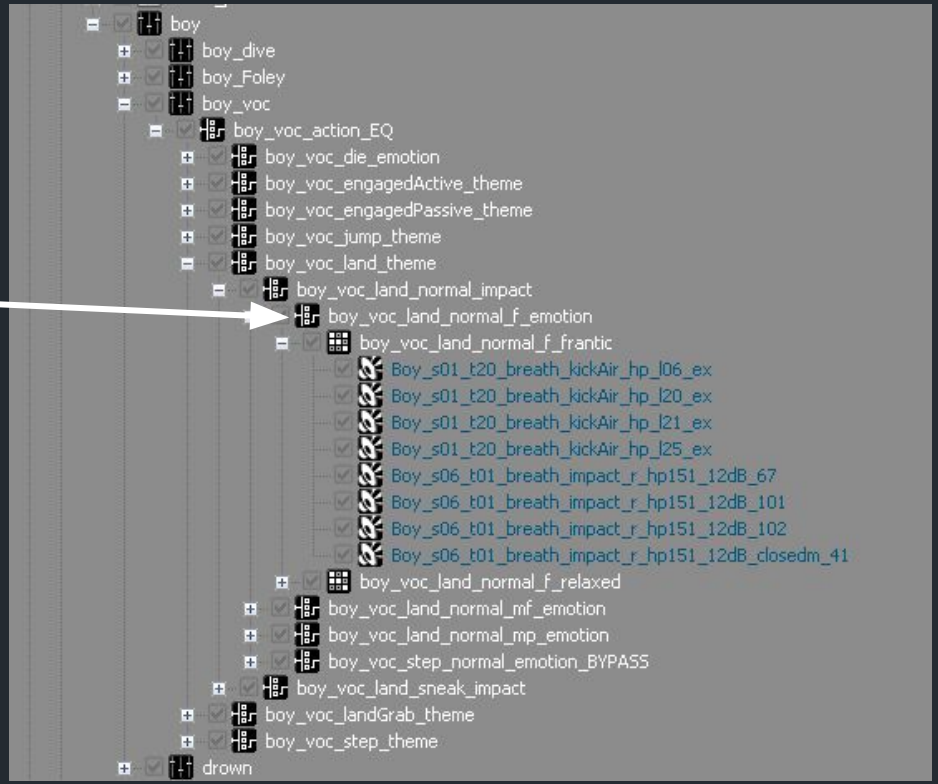
Switch Container: Action



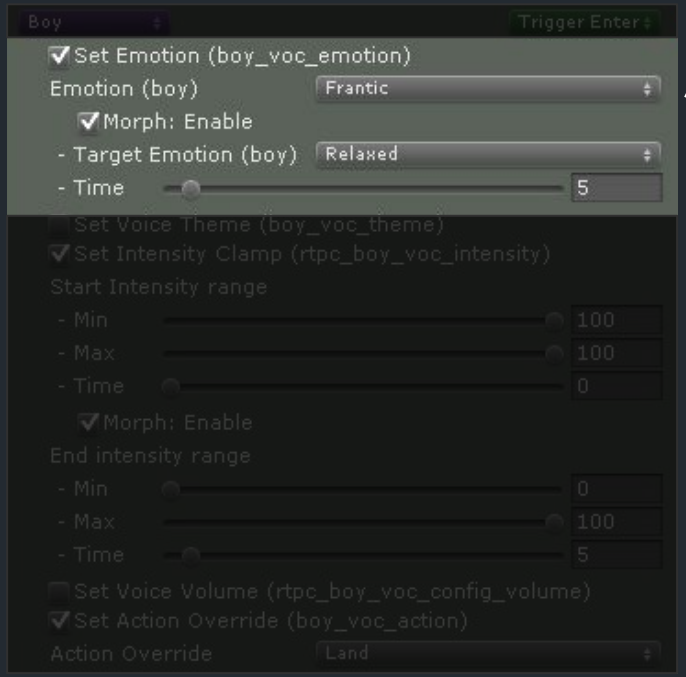


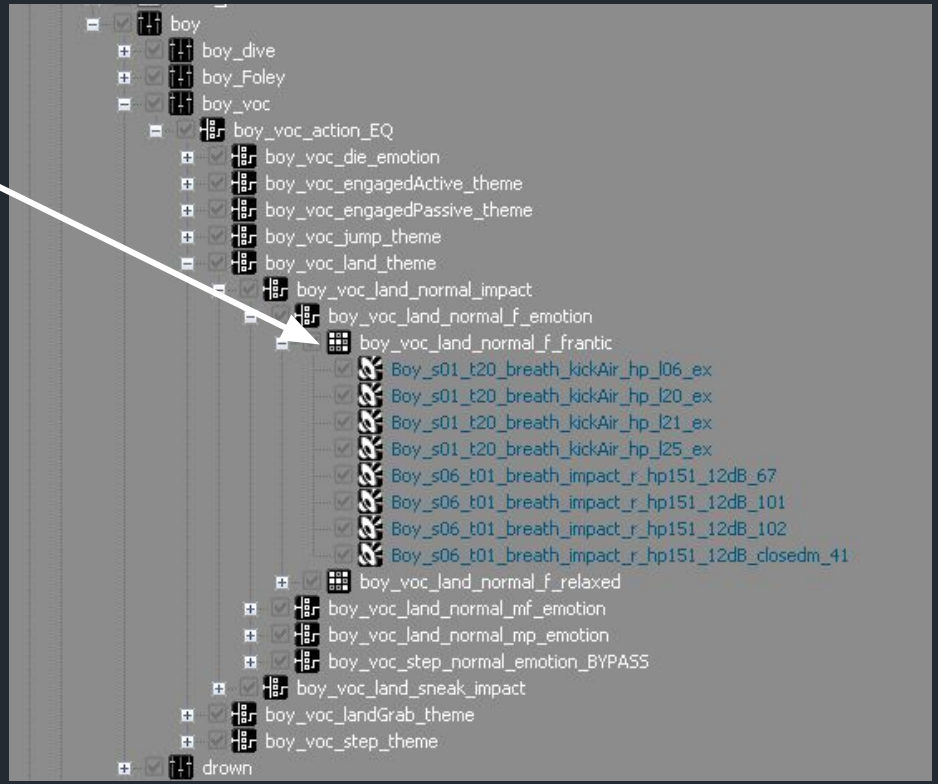
Switch Container: Intensity





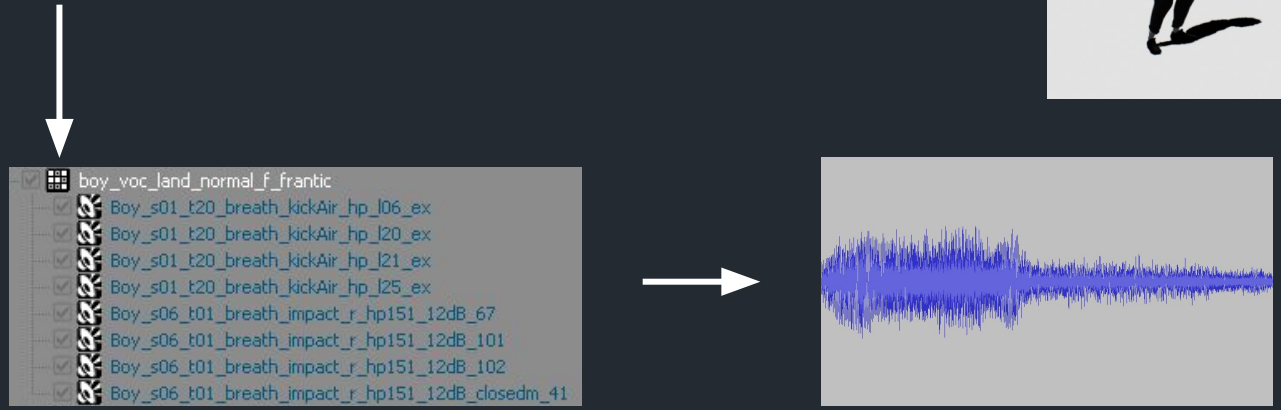
Switch Container: Emotion



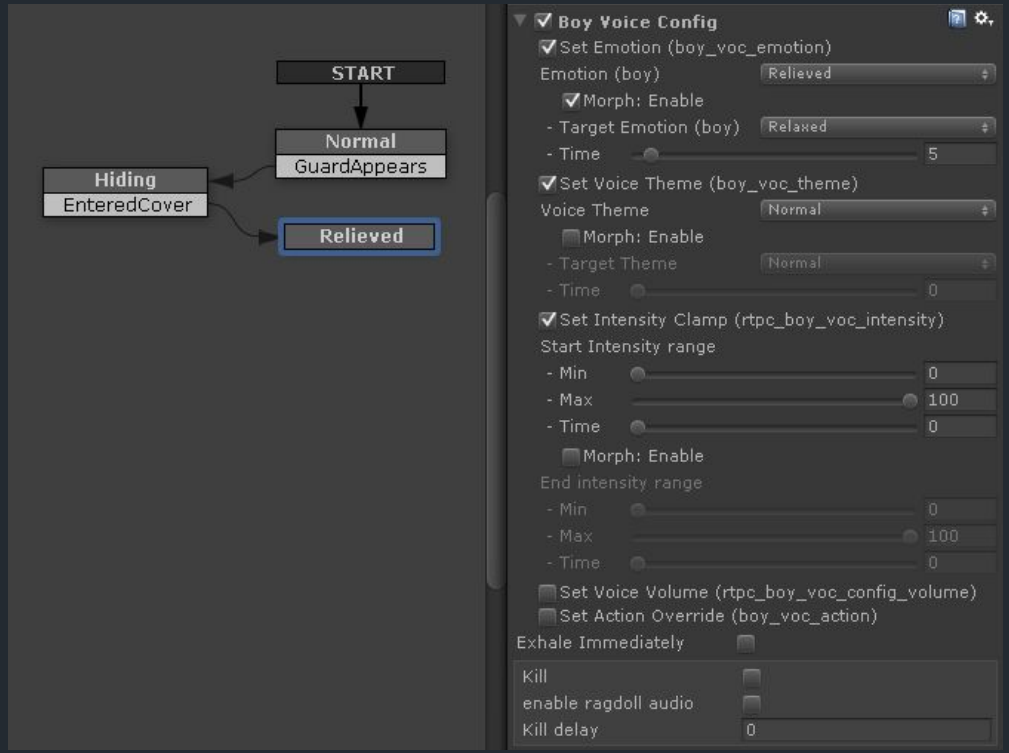


Random Container

Randomly selects and plays one of its children sounds

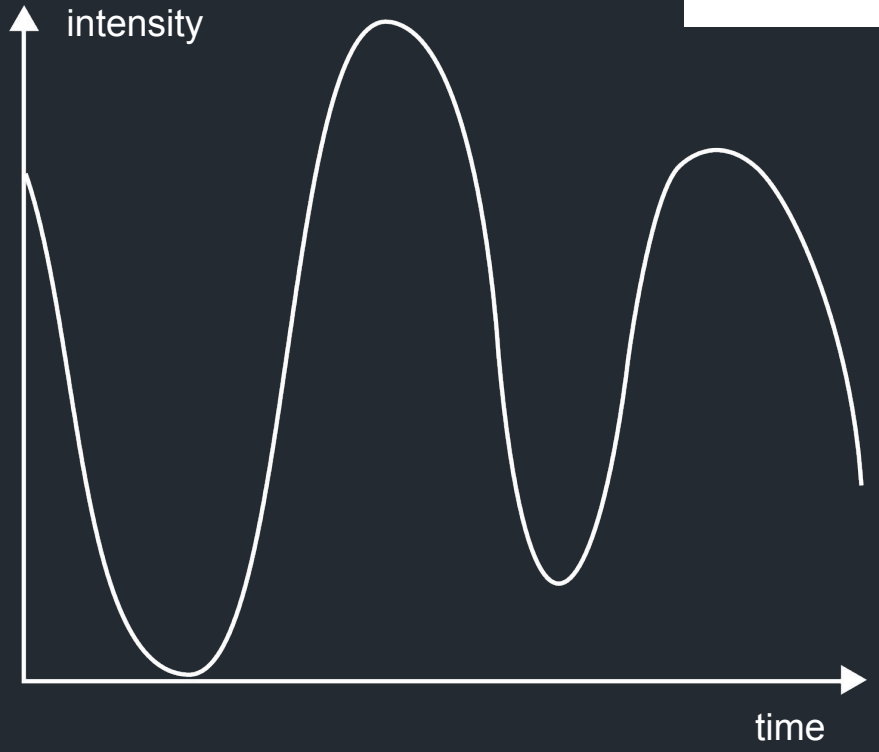


Voice Configuration: State Machine



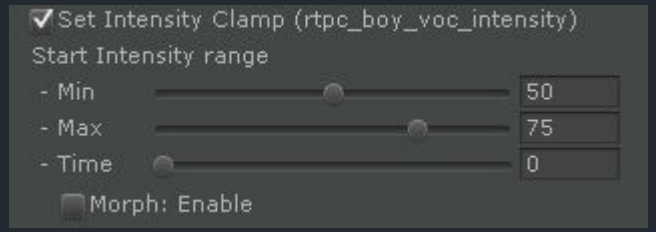
Voice Intensity

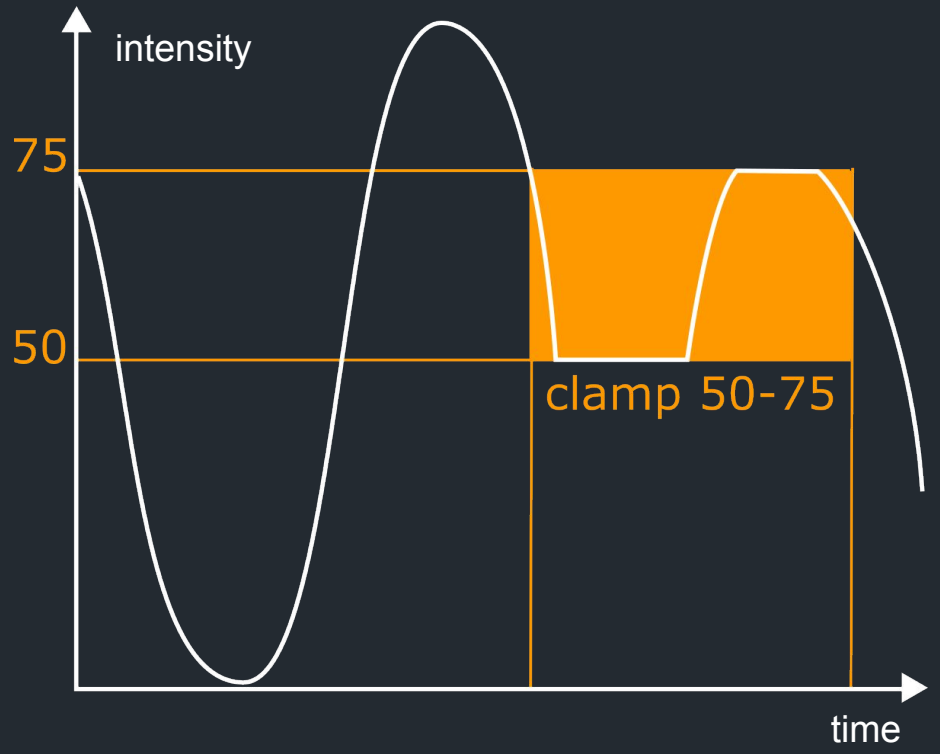
- Boy movement generates exhaustion
- Voice intensity = lowpass filtered exhaustion
- Voice Intensity selects depth and force of breathing
- Depending on the emotion parameter, intensity defines:
  - Physical exertion level
  - Intensity of character emotion



Voice Intensity Clamping

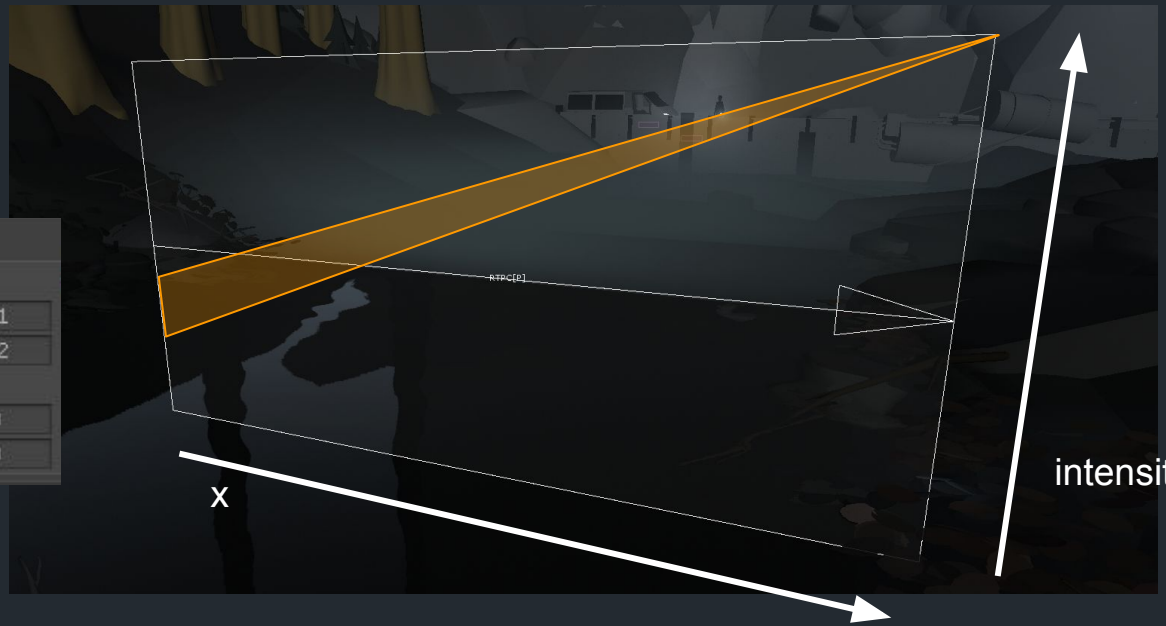
- Clamping constrains intensity to a given range





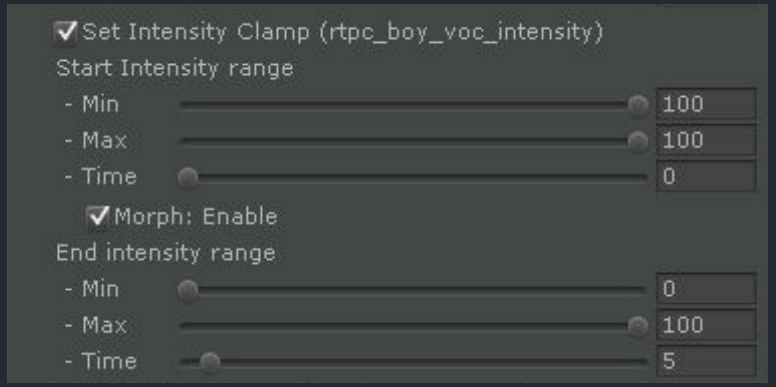
Voice Intensity Interpolation in Space

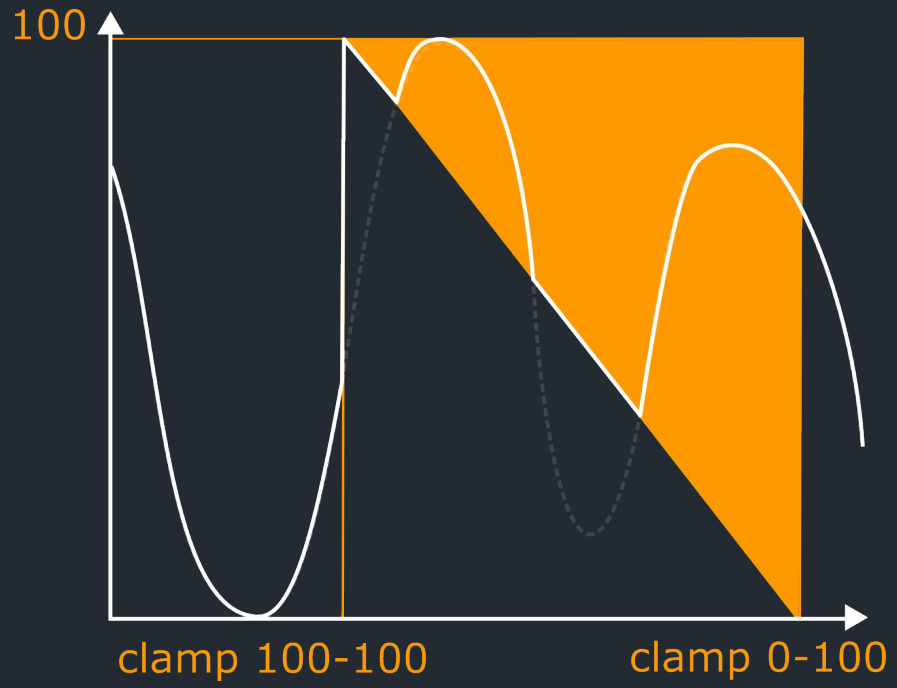
- Useful for indicating proximity to danger



Voice Intensity Interpolation over Time

- Useful for creating reactions to game events, and relaxing over time.



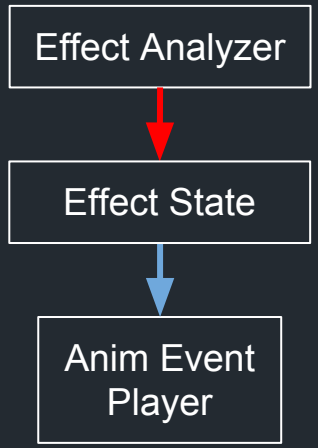


Voice Summary

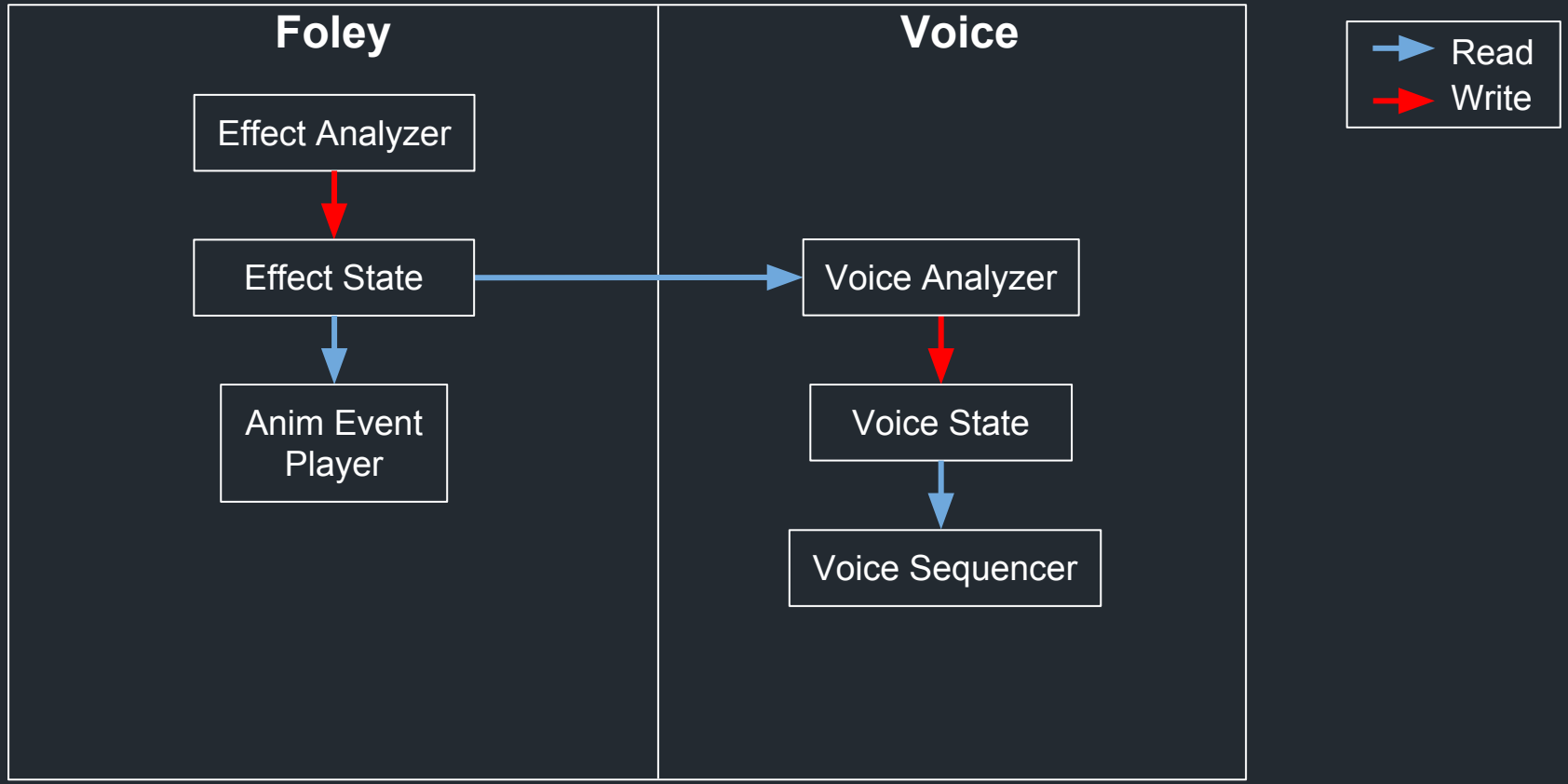
- Single event, switch hierarchy determines sound
- Continuous sequencing using callbacks
- Rhythmic breathing uses beatmatching to align breath to footsteps
- Voice direction with trigger boxes and state machines
- Voice Intensity can be clamped
- Clamping can be interpolated in space and time

Wrapping Up

Animation Events



Voice Sequencer



Full Audio Architecture for the Boy