

Sightless Navigation And Perception

Objective

Our goal is to create a series of algorithms that utilize computer vision (OpenCV) and 3D binaural sound (OpenAL) in order to create a highly detailed, acoustic picture of a user's surroundings granting them the ability to efficiently navigate their environment.

The previous group created a working algorithm as a proof of concept. Our job was to take that algorithm and expand it into robust and configurable software system and build a virtual testing environment to aid researchers in finding the best possible visual to audio algorithm.

Requirements

Visual-Audio-Engine

- Allow multiple audio navigation algorithms to be tested on a single platform.
- Optimized shared memory block communication.

Configurations

- Create configuration files that can be saved, loaded and shared.
- Create a configuration menu to adjust settings.

Logging

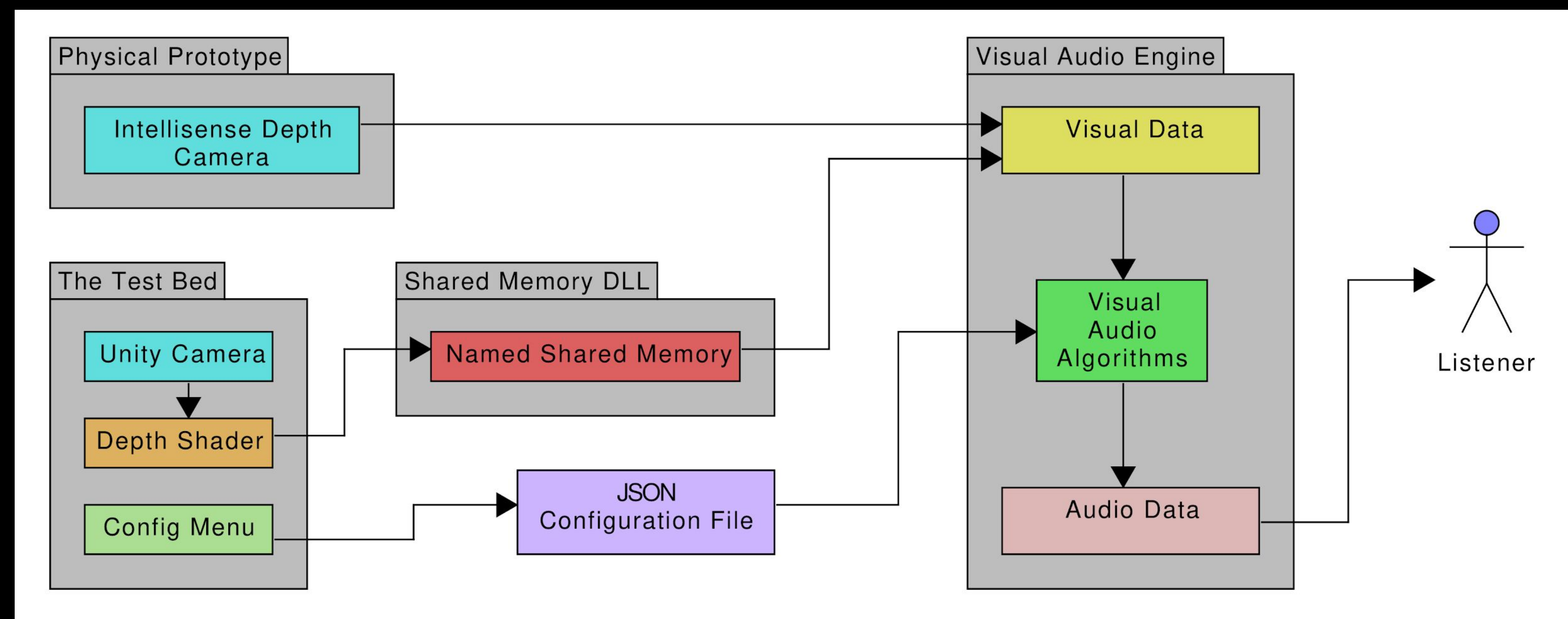
- Log information from each test session.
- Allow easy data export for analysis.

Maps/Tests

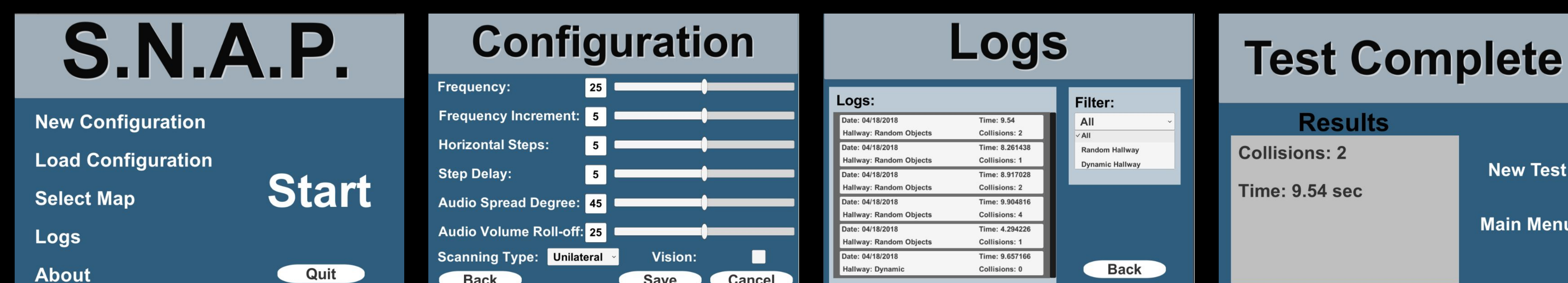
- Create stochastic maps that can be used to test navigation.

Installation

- Must include an easy installation/build script that minimizes the need for user input and installs all required .dll files.



The Test Bed



Main Menu

Users can access sub menus and start tests from this menu.

Configurations

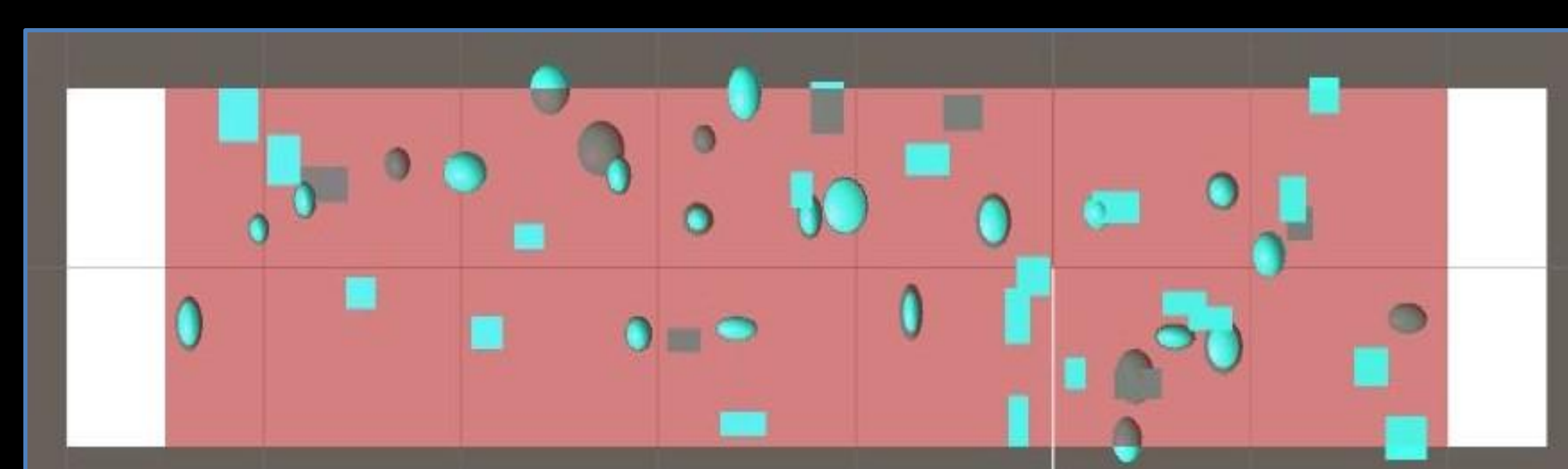
Menu that allows the user to adjust audio algorithm settings.

Logs

Menu where the user can see all completed tests. You can also filter through logs based on map type.

Results

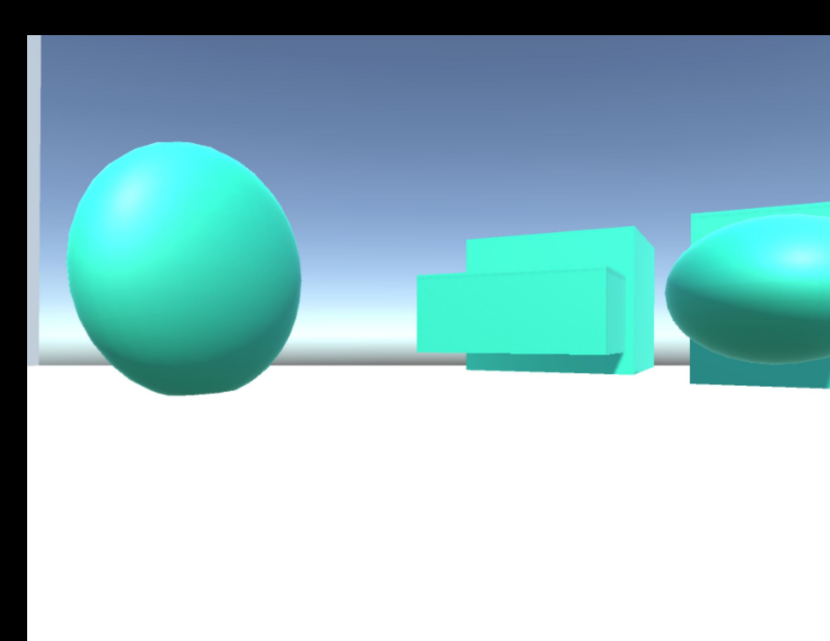
Menu that shows your results after completing a test.



The Testing Maps

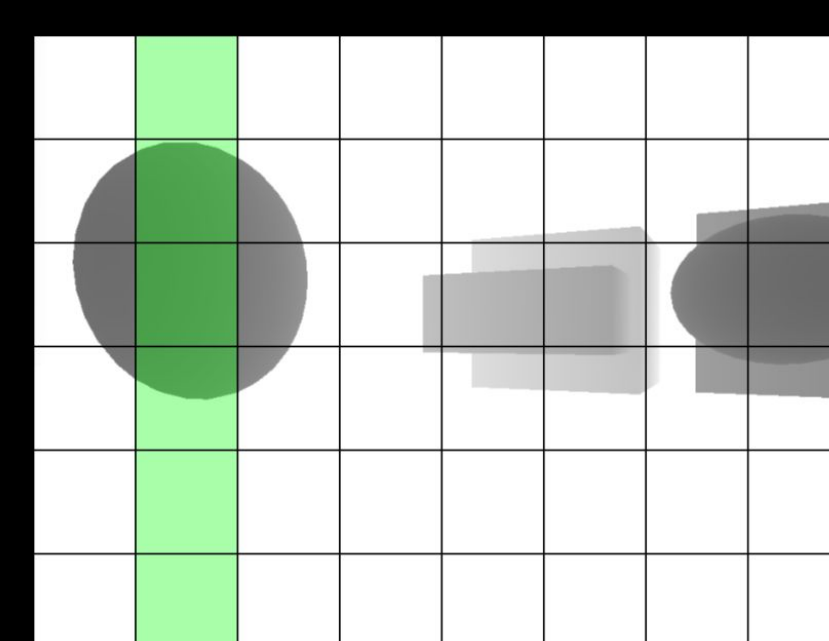
Top down view of our map that randomly generates objects. The user starts from the left side and makes their way across the map. Once they reach the finish line the results menu opens up to show the user their test results.

How The Visual Audio Algorithms Work



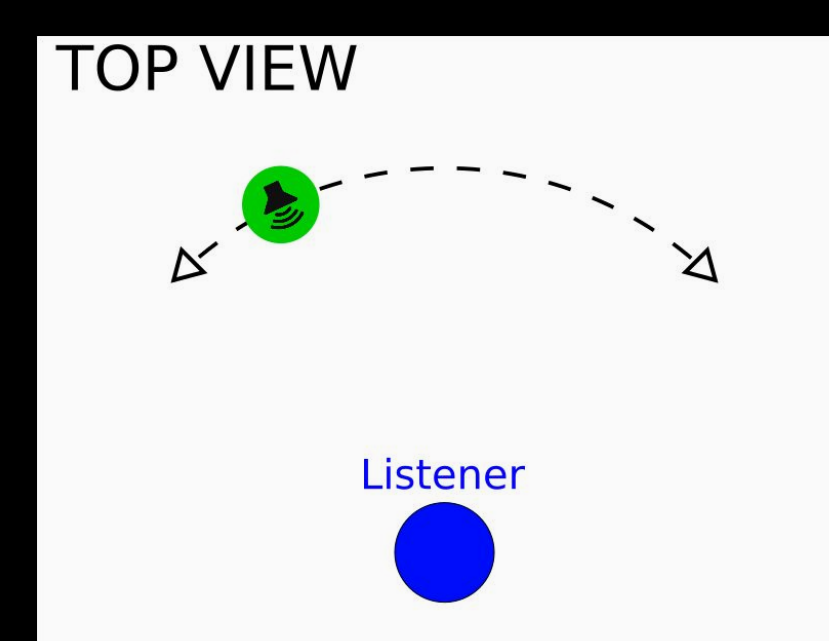
Frame

This frame is converted to a depth image in unity before sending it to the V.A.E.



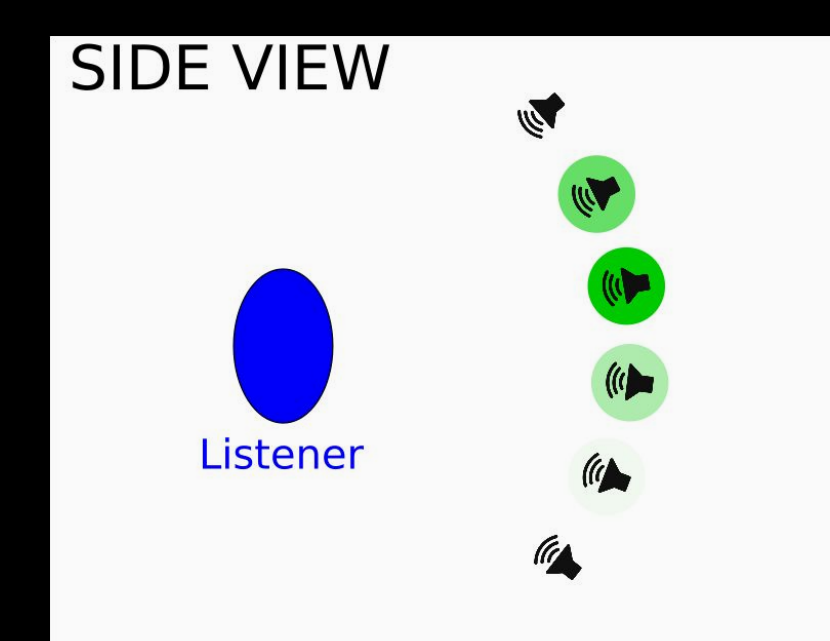
OpenCV

We subdivide the depth image into a grid to analyze average distances.



OpenAL Top

Sound sources pan in an arc from side to side "scanning" the area around the listener.



OpenAL Side

These sources are aligned in a vertical line. The green represents the intensity rating of each source based upon the average distance in the corresponding location on the depth image.

Visual Audio Engine

This is our stand alone program that runs all of the visual to audio algorithms. It is harnessing the power of open source libraries such as OpenCV and OpenAL, and is divided up into several modules to allow for maximum code reusability between each of the unique sound algorithms.

Input Module

This is an abstract class that standardizes the way the V.A.E. gets depth image input. Developers can inherit this class and create input modules for any type of camera or testbed software.

Config Module

Allows for in depth configuration files to be set by the user to control every aspect of the Visual Audio Engine, stored conveniently in JSON format.

OpenAL Module

A series of helper functions to deal with sound generation and 3D sound movement in openAL.

OpenCV Module

A series of helper functions utilizing OpenCV to subdivide the depth image and analyze each section.

Visual Audio Algorithms

This module contains each of the different algorithms and accepts an input module and a config module.

Future

Since our Visual Audio Engine is built in such a way that it can be used with any camera source as long as you create an Input Module for that source, our client can continue to experiment with different technologies and camera techniques such as prebuilt depth cameras or even Stereo depth detection.

Additional audio algorithms can also be added easily by using the openAL and openCV helper functions.

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