RealSpace3D Audio Plugin for Unreal Engine 4

VisiSonics Corp.

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1 Overview

RealSpace3D is an audio plugin for game engines and middleware that delivers three-dimensional spatialization of sound over standard two-channel headphones. The plugin integrates highly optimized low-level libraries with a number of APIs for converting audio streams into physically accurate binaural audio that will immerse the listener in acoustic environments. This document covers the RealSpace3D audio plugin integration with Epic Game's Unreal 4 engine which allows for real-time modeling of 3D sound sources within the Unreal editor.

Modeling 3D audio is a complex process as the process derives from a physical process of how sound waves interact within the space between your ear drums and the environment. Such factors may be broadly categorized into how sound is colored from both **a)** scattering off of your own anthropometry and **b)** scattering and attenuating off of surfaces and mediums in the external environment. The plugin exposes a range of features from personalizing your spatial audio experience according to your unique anthropometry to the approximation of the external environment using room geometries within the Unreal editor. Of course, modeling all the characteristics of 3D sound is computationally demanding and may not exceed your application's available resources (memory, latency, and CPU usage). Thus, we expose parameters such as impulse response lengths, filter orders, and room reflection orders that allows the user to manage the plugin's resource consumption.

2 Prerequisites

System requirements:

1. Operating System: Windows XP, 7, 8 (32 or 64 bit)
2. Working Memory: 2 GB

Third-party applications:

1. Integrated Development Environment (IDE): Microsoft Visual Studios, Professional, 2013
2. Unreal Editor 4.8 or Higher

RealSpace3D Package

1. Plugin Package:

   `RealSpace3D.zip`

2. Valid License Key

3 Integration Tutorial

The integration with the RealSpace3D plugin is straightforward. We provide a tutorial below:

1. Unzip the RealSpace3D package into the plugin folder

   `UnrealEngineDirectory\Engine\Plugins\Runtime`

2. Enter your license key ("NAME-XXXXX-XXXXX-XXXXX-XXXXX" without quotes) in

   `RealSpace3D\Binaries\Win64\RS3D\lic_key.txt`

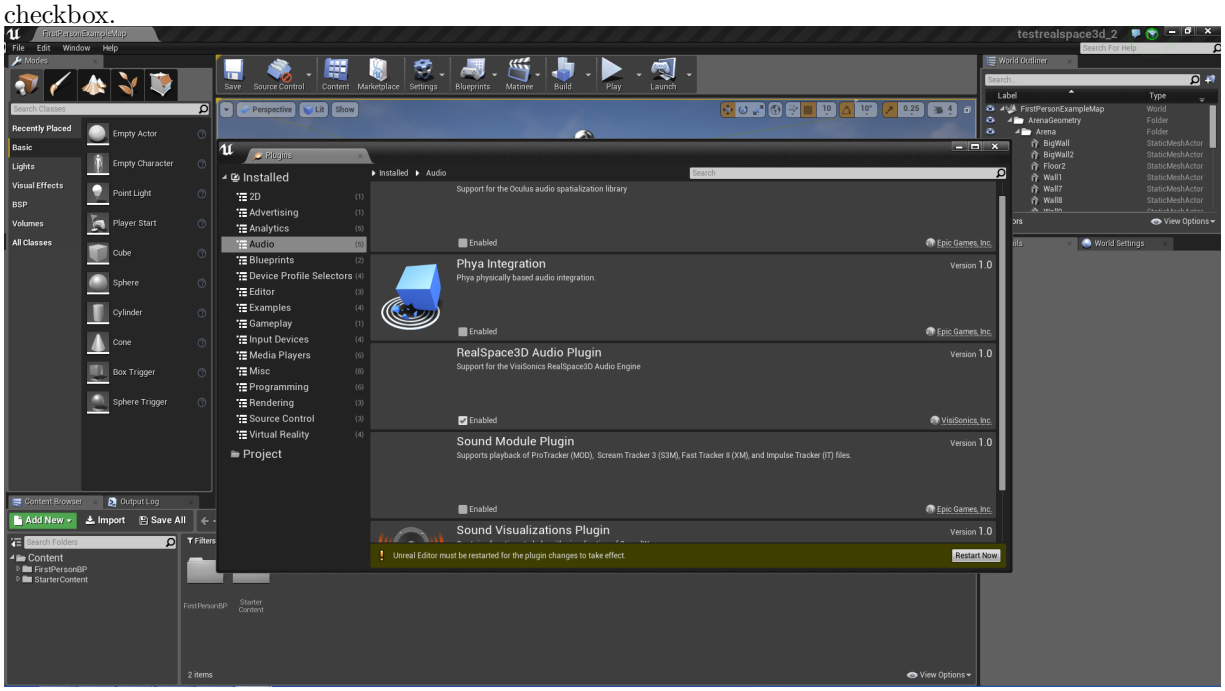
3. Call the batch file

   `UnrealEngineDirectory/GenerateProjectFiles.bat`

   to generate the secondary header files

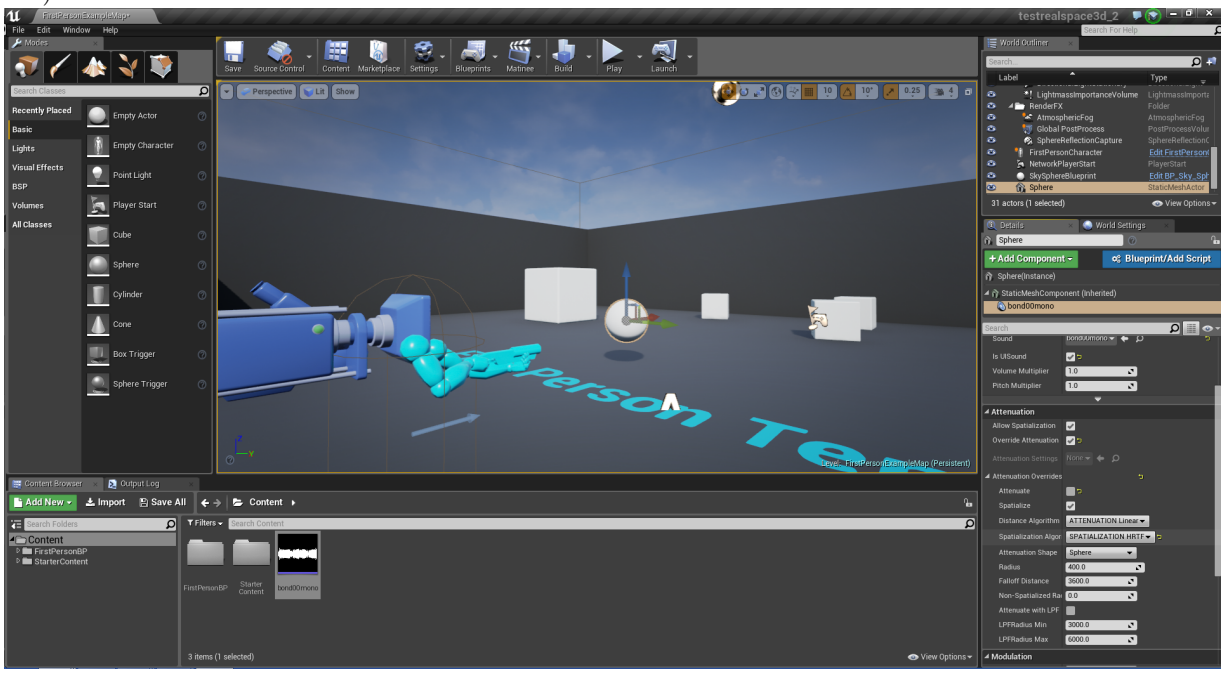
4. Launch the Unreal editor and create a new project (first person blueprint)

5. **Loading the Plugin:** Add an empty C++ class (File, New C++ Class) so that the project can compile the plugin. Add the plugin (Window, Plugins, Audio) by enabling the RealSpace3D plugin checkbox.



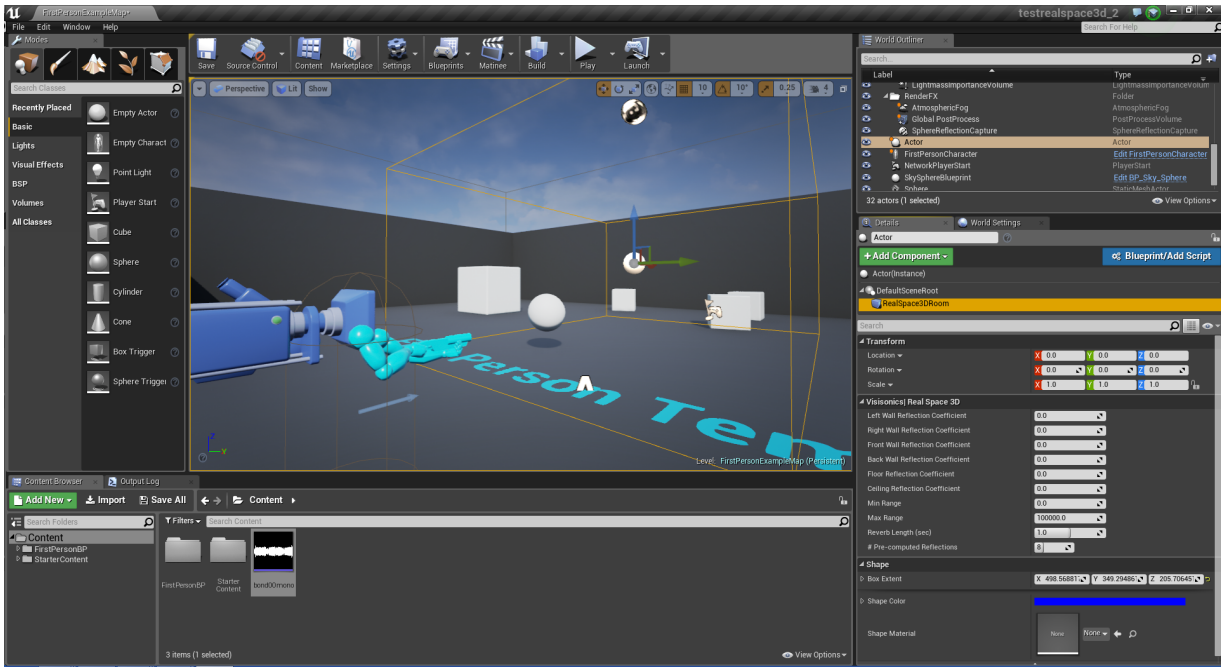
Note that this will restart the Unreal editor. Open your project's Visual Studio solution file and rebuild the project under configuration settings development editor and x64. This will build the plugin along the way.

6. **Adding a Sound-source:** The current plugin spatializes mono-channel audio streams into two-channel (left and right) streams. Add (click and drag) a mono-channel audio file (bond00mono.wav) into the content browser. The audio asset will be attached to an object. Add (click and drag) a sphere object class to the scene. Add the audio asset to the sphere instance (click and drag into the tab).



To enable spatialization, click on the audio instance and check "Allow Spatialization", "Override Attenuation", "Spatialization", and select "SPATIALIZATION HRTF" under Spatialization Algorithm. To have the audio instance also play within the user interface, check "Is UISound". Note that under the current settings, the audio instance will will not play unless it is within a "room".

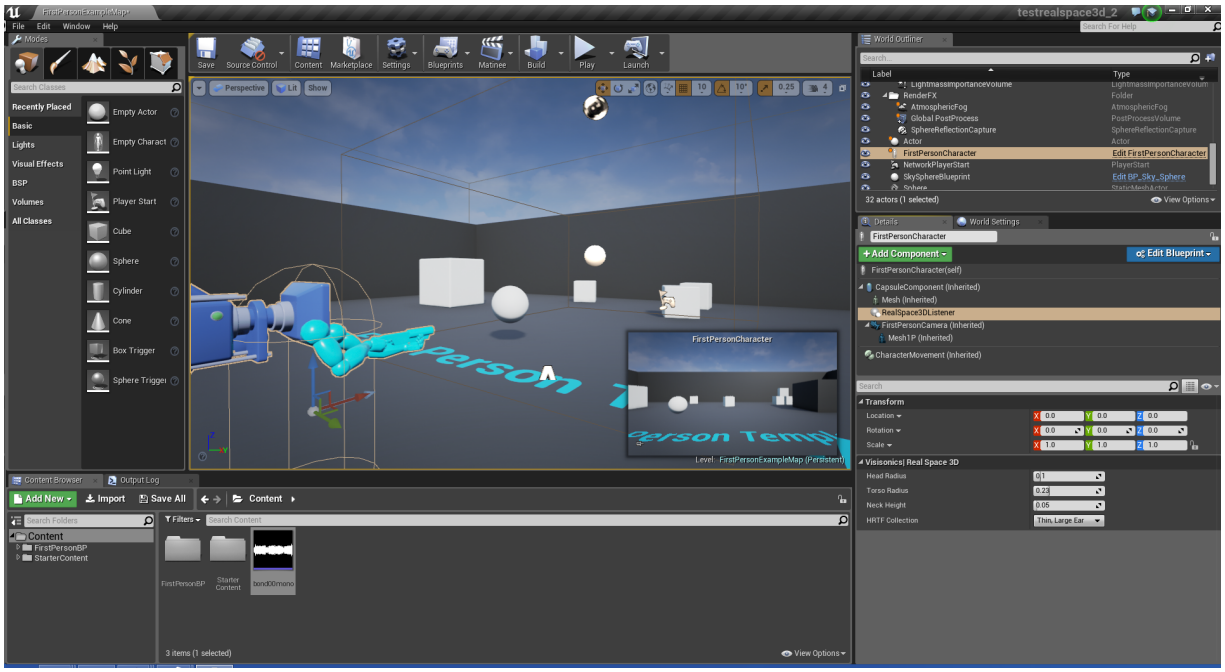
7. **Adding a Room:** RealSpace3DRoom instances can be attached to objects in the scene. Add an "Empty Object" to the scene and in the Details tab, attach (+ Add Component) a "Real Space 3D Room".



Click on the RealSpace3DRoom instance in the Details tab to expose the room properties. The room center can be adjusted by modifying either the transform of the Empty object instance or that of the RealSpace3DRoom instance. The size of the room can adjusted by modifying the "box extent" sliders. Other properties such as reflection coefficients (percent of energy reflected off each wall), minimum and maximum sound-distance to listener range, the reverberation length, and the order of the number of pre-computed reflections can be modified. Note that for low-memory and low-CPU usage, it is advisable to decrease the reverb length and set the reflection coefficients to 0 (only the direct sound-path will be rendered).

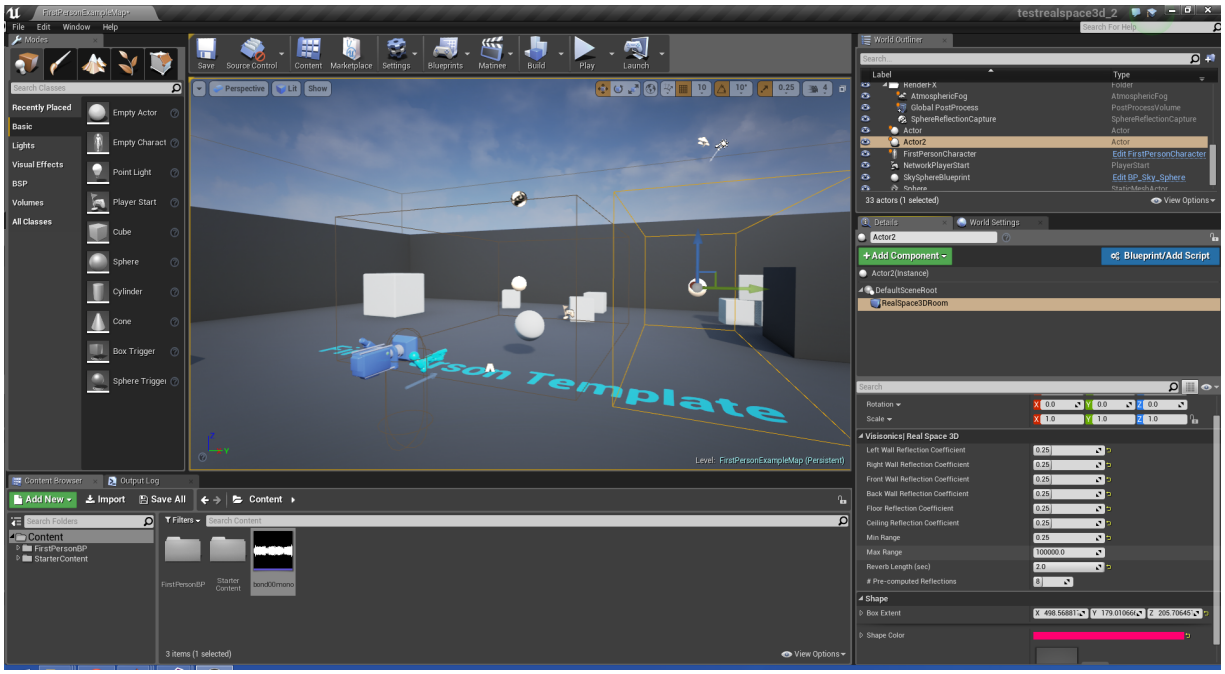
If the sound instance is also a UISOUND, you can directly listen to it in the editor if the room extents intersect the sound-source's position. Any modifications to the room properties should immediately update the audio stream of any sound-sources that are within the room.

8. **Adding a Listener:** To customize attributes of the listener, select the camera or FirstPersonCharacter(self) instance and add a "RealSpace3DListener" component.



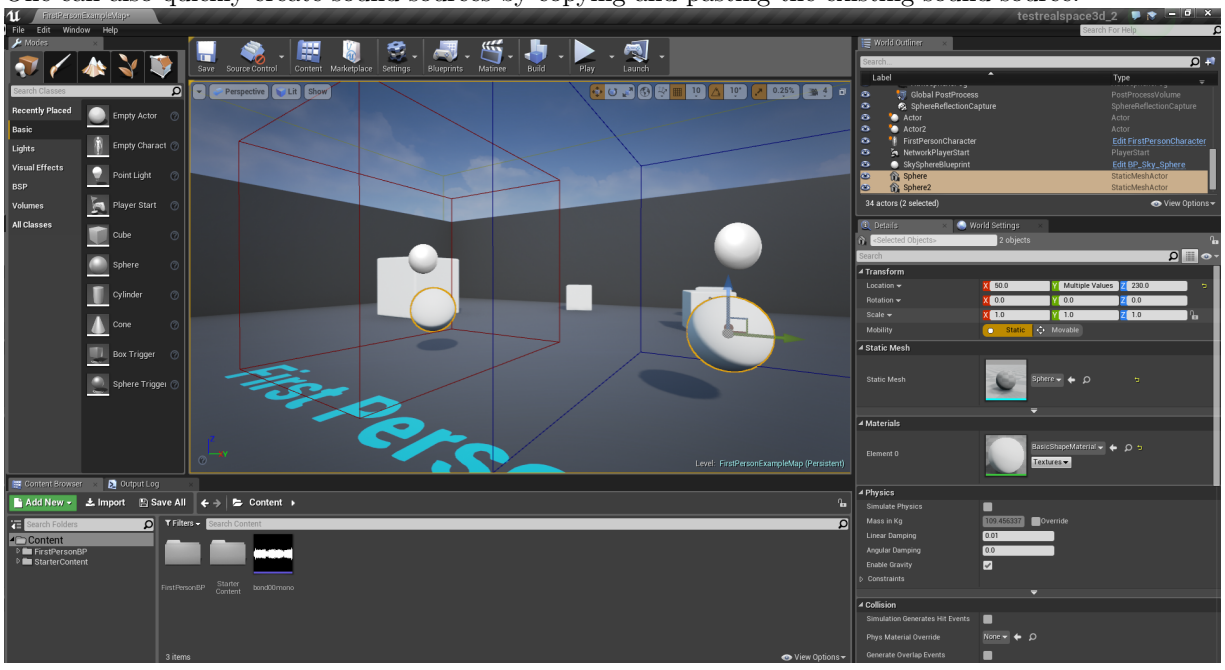
The listener instance exposes properties regarding the listener anthropometry and the choice of the Head-Related Transfer Function (HRTF) dataset to render sounds with. Broadly speaking, the HRTF collections are organized into thin/bassy spectral colorations and small/large ear anthropometries. Similar to the room properties, any modifications to the listener properties should immediately update the audio stream.

9. **Adding Multiple Rooms and Sound-sources:** You can add multiple rooms and sound-source using the same steps listed above. As a shortcut, select an existing room (click on the Empty Object instance), copy and paste, then drag the instance to a new location.



Here, we modify the acoustic properties of the new room so that wall reflections are enabled with a 2 second reverb. To listen to the modified acoustic properties, move the sound-source object (sphere instance) into the new room.

One can also quickly create sound-sources by copying and pasting the existing sound-source.



Here, we move the second sound-source in the second room so that both sources are playing simultaneously. Also note that one can restart the sound-source playback in the UI by modifying any of

the properties of the audio instance.

10. **Packaging the Plugin with Projects:**

    Static-linking method: Open your project's solution file. In "yourprojectname.Build.cs", add

    ```
    PrivateDependencyModuleNames.AddRange(new string[]{"RealSpace3D"})
    ```

    Open the Unreal editor and package your project under file, PackageProject, Windows 64-bit. Once complete, open the package folder and create a directory structure to match that of the Unreal engine's plugin folder:

    ```
    PackageOutputPath/Engine/Plugins/Runtime/
    ```

    Copy the RealSpace3D plugin folder into the above path. It is safe to include only the binaries sub-folder.