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**Project Name:** World of Synesthesia

**Project Synopsis:** We are creating a VR application that will promote awareness of synesthesia condition by providing experiences similar to what people with synesthesia have in real-life.

**Architecture:**

### **Introduction**

The primary objective of this project is to expose people to how it feels to have Synesthesia. This condition is unknown to many due to which it is not accepted as a disease and has no cure. We decided to provide virtual reality for people to hear and see things the way synesthetes do so that perspective regarding this might change and it might start to get accepted by others

### **Main Body**

#### **1. Front- End:**

Front end will mainly consist of UI component, which will have the following features:

##### **a. Menu**

The menu component will show us all of the options regarding the application that a user can choose. For example, the menu will list the settings as one element which will let us change the volume etc. Another feature would be to let the user choose the type of

synesthesia they want to experience as there are different types of synesthesia. In the beginning of the application, we will just provide a quick info session on Synesthesia and what the application is all about.

**b. Cursor**

We will have a cursor being shown both during the actual virtual reality being shown and during the starting screen of the app so that users can conveniently change the options being shown by either moving their heads or using buttons on the VR-headset.

**c. Buttons**

As discussed earlier, the main screen will have a menu with all the options for that, we will need to have virtual buttons on the screen placed systematically so that a user can tap on them to proceed. Something we will want the user to experience is that this application provides a real feel of being in a musical game. So, when the application starts, the user will be in the world of Synesthesia and see visuals in the background such as nature with different shapes and colors and then see the menu options in front of them

- i. Choose background: Users can choose from various backgrounds. We haven't decided the options for it, but we will at least keep 3 for users to have a diverse experience.
- ii. Choosing the instrument: In the beginning, we will test it with guitar sounds and piano sounds to keep it very simple.
- iii. Choosing a song: This will be a bit challenging as there are so many chords in a single song and to incorporate the colors, shapes and the mix and match of both will probably not be the most accurate one.
- iv. Start: Start option will begin the experience for the user after choosing the various options.

**d. Display:**

what a 360-degree environment looks like when flattened. We will be using an equirectangular projection. The 360-degree environment is flattened to provide the display in these projections. In a 3D virtual environment, these projections are wrapped around a sphere to mimic the real world.

## **2.Back- End**

The app will have a critical support system. Firstly, we will use the Oculus Home platform which will provide us with the complete set of development tools to handle different processes such as connections between the devices etc. For data to be incorporated into the VR world for our application, we will use Gear VR's Unity3D as our game engine. It will store the data that we want users to see and feel during the VR experience. There will be a database in there that will have different types of synesthesia experiences, VR environments, and the effects to be shown in those worlds. To make our application be web-based and to provide graphics for our experiences, we will use **WebVR** and **WebGR** frameworks respectively. They will handle the nitty gritty details of the common VR processes involved in the VR applications. **WebVR** uses Javascript that will provide us with an API to communicate to the web and bring in important settings for our application such as additional features of the environment to be pulled from the web. **WebGL** will allow us to present graphics for our application and since it is a dynamic library, it will let us handle the events related to the hardware devices that we will make our application compatible for.

For the hardware part, we will be using **Oculus Rift VR** Headset as it has its own sensor units too which will be important for our application. Mainly, the various environments related to different types of synesthesia and the effects related to them, will be stored in a database that we will access using APIs from Gear VR's Unity3D. For example, a type of synesthesia known as Chromesthesia, evokes an experience of color or shape when a certain sound is heard. In this case, the VR environment will be related to Chromesthesia, in

which we will access the part of the database where we will have the information related to this condition stored. First, for this synesthesia condition, our VR environment could be a room, where the user is hearing a piano and so, whenever a note or key is played, we see a specific image or shape that is in the database for this condition. The effects in this example are not only the chromesthesia triggering factors, which are notes and keys but also the shapes and images that are produced.

### Diagrams

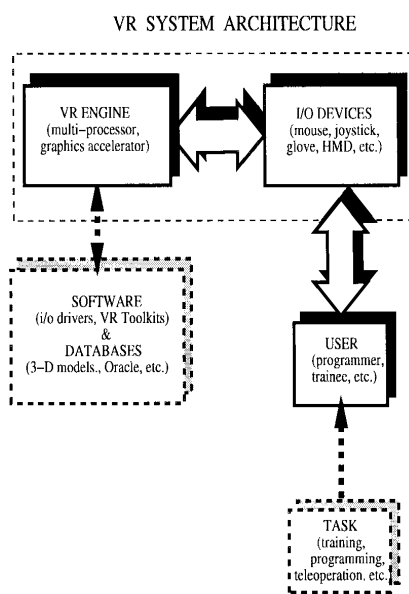


Fig: [System architecture of VR products](#)

Fig: [Synesthesia colors and visuals example](#)

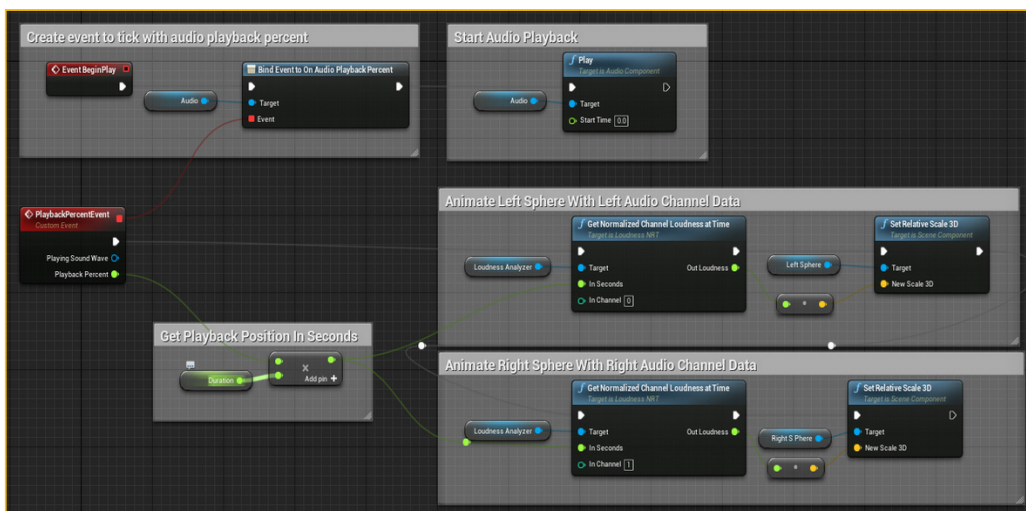


Fig: [Audio Synesthesia](#)

## Display view



Fig: [Sample menu view \(subject to change\)](#)

We are planning with the display view still and how we can make it clean and interactive for the user. As we said earlier, there will be floating options for the user to choose from which will take the user to experience synesthesia. There will be volume controls to give the user to choose the intensity of the sound. There will be waves and shapes generated depending on the sound. These shapes and waves will correspond a lot to the frequency of the sound like Apple music apps used to have waves created on the basis of the frequency.



Fig: [Collection of sound waves \(sample\)](#)

### **Design constraints**

One of the major challenges for the project is giving an uniform experience to the user. According to the pitch, Synesthesia is a variable experience. Person A will experience Synesthesia in a different manner to person B. Now, we will have to come up with a base model that will give a generic experience to all who don't possess the ability to experience Synesthesia. There are various forms of Synesthesia and we will work on Chromesthesia that triggers someone to see colors when they hear sound or music.

Another issue that can be faced is making sure the program doesn't create any epilepsy. Some of the visuals have to be very light in terms of the color and the shapes. There are some videos on Youtube that we checked on and the visuals seem a bit too much to take for a person as there are waves, shapes and various forms of colors. The biggest goal would be to make the UX very clean and crisp to prevent users from leaving the program right away.

The project will have some hardware constraints like making sure our application works with the VR. The space constraint is another thing to consider. We will have to decide if we want to make it infinite or make it confined to a limited space.

### **Ethical issues**

There are some ethical issues concerning users. One of them is motion sickness. What if the application makes the users feel uncomfortable because of the various visuals. The other safety concern would be making sure the user doesn't bump into anything if they walk in the world of visuals. Lastly, the VR headset and tool should be light and comfortable for all users to prevent neck pain.