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EECS 581

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Initial Architecture Document

Team Number
4

Team Members
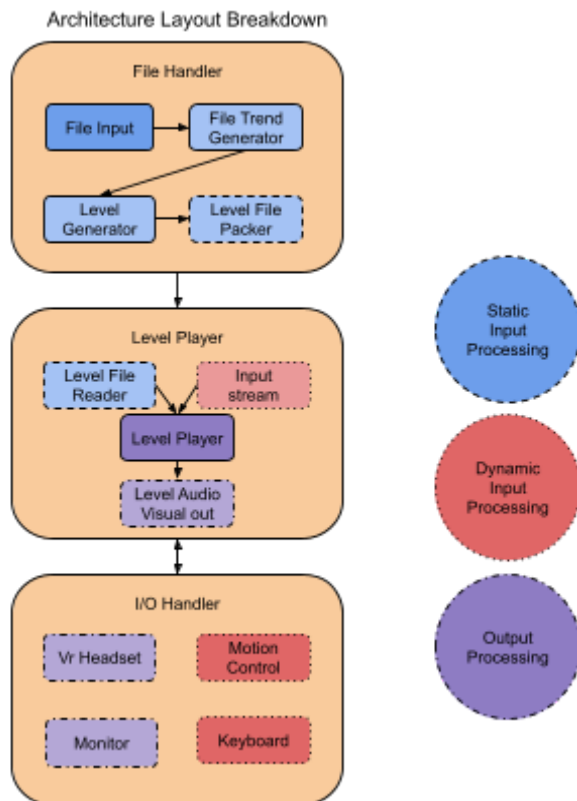Tyler Atkins, David Dahl, Tram-Anh Ho, Konrad Chen Kahnert, Maggie Swartz

Project Name
Psychoacoustics

Project Synopsis:
VR rhythm game with procedurally generated graphics and beat maps.

Architecture/Design:

Vocabulary:

Rhythm Games: Music-themed games where the player must press buttons/perform actions to the rhythm of the music. Famous rhythm games include *Dance Dance Revolution*, *Guitar Hero*, *Osu!*, *Beat Saber*, *Taiko no Tatsujin: Drum 'n' Fun!*, and *Just Dance*.

Beatmaps: Levels of rhythm games — these indicate both what action the players will take (e.g. what move to perform/what button to press) and when the player will perform that action. These actions are synced to the game's music, creating the rhythm aspect of the gameplay.

Our software will be a rhythm game developed in Unity or Unreal Engine, with assets created in Blender, and possibly utilizing Machine Learning algorithms for beatmap generation. It'll be inspired by similar games like *Beat Saber* and *Osu!*, and we will incorporate aspects of those games in our design.
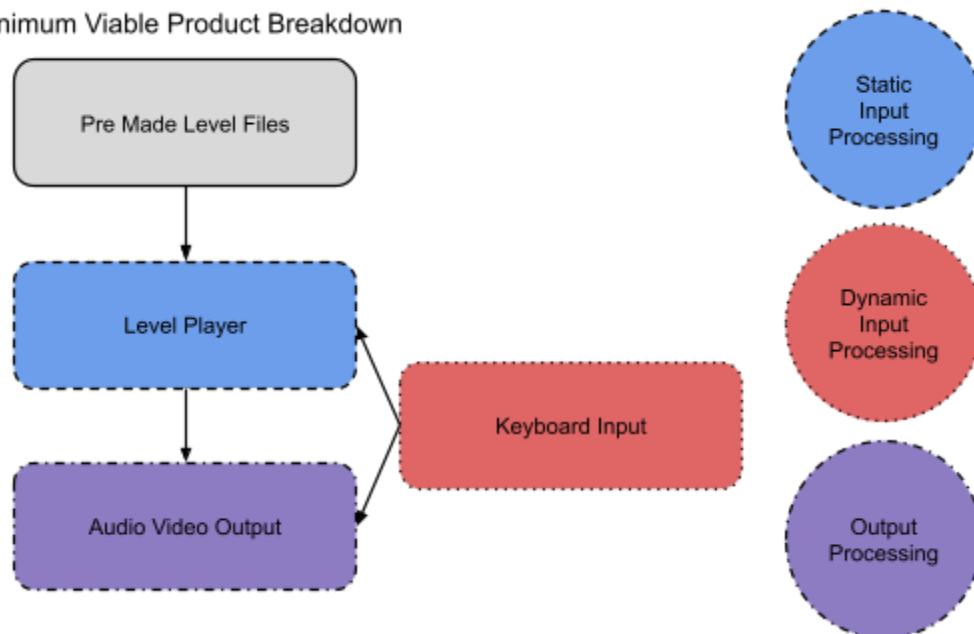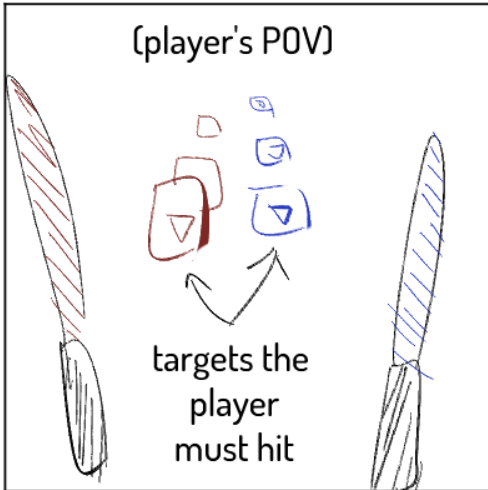

The most basic, prototypal version of our game will be a rhythm game played on PC devices using a keyboard and mouse, with beatmaps manually created by us, Team 4. As it grows more complex, we will add elements of:

- VR Design and Gameplay — We wanted to challenge ourselves by developing for something that none of us had ever had experience with. We also considered that one of the most popular rhythm games, *Beat Saber*, is a VR game, and continues to be popular. This will require us to develop in 3D, and it was the reason why we picked 3D design software like Unity, Unreal Engine, and Blender.
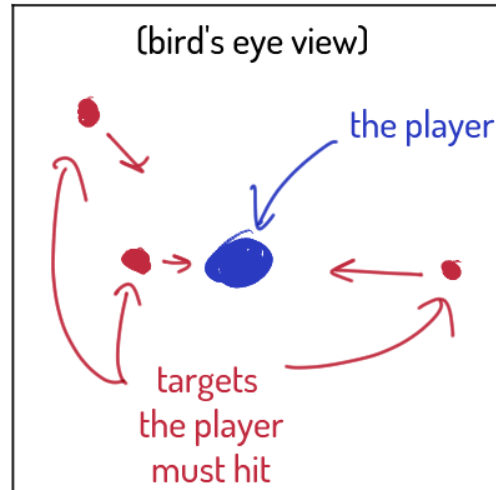
  We will reference Beat Saber and other VR games to find other ways to incorporate the third dimension and 360° spaces into rhythm games. This could take the form of the

player hitting objects with a sword like in *Beat Saber*, or making the player dodge incoming obstacles by moving their body, like in *Just Dance* or *Beat Saber*. Or, the player could turn in place to hit beats that are behind them, sort of like a 3D *Asteroids*. The player could also use their VR controller like a gun and shoot targets that are synced to the music.
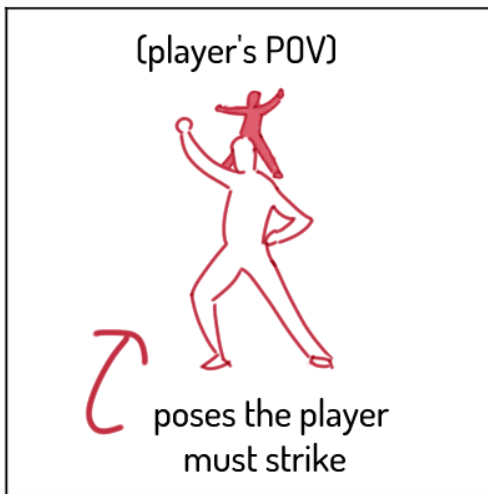
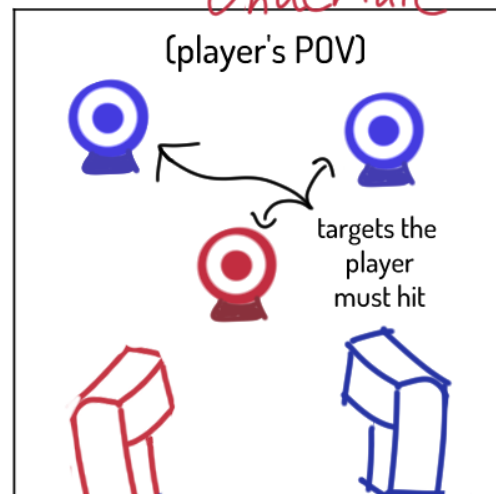Here are sketched thumbnails of some of our ideas:

(player's POV)	(bird's eye view)
targets the player must hit	the player — targets the player must hit
Inspirations: Beat Saber	Inspirations: Asteroids, Undertale
(player's POV)	(player's POV)
poses the player must strike	targets the player must hit
Inspirations: Just Dance, Wii Sports	Inspirations: FPS Games

Early in development, the gameplay will likely not be this complex. The proof of concept will probably resemble simpler games like *Stepmania*. Later on in the development process, we will expand upon this gameplay as much as possible within reason.

- External/custom built controllers — some rhythm games have their own controllers to help with the immersion of the game, such as how *Guitar Hero* has its own guitar controller, *Dance Dance Revolution* has its own dance pad, and *Taiko no Tatsujin: Drum 'n' Fun!* has its own drum. If we decide to go this route, it will be difficult to integrate with the VR, as the player would not be able to see the controller during gameplay, so we would only add this aspect if we were not able to or decide not to incorporate VR into our game.

- Procedurally Generated Beatmaps and Graphics — the plan is that we will be able to take an audio file (e.g. .mp3, .wav, .ogg), and then deconstruct it with a program that can analyze the waveforms and then generate a beatmap that is compatible with our game. For instance, the program could detect the BPM and the timings of the main melody, and create a beatmap based on that. The melody can be isolated from the rest of the music by using frequency analysis. Visual aspects of the levels could also be generated by the music using a similar technique. High energy moments in a song could cause the level to change colors or shift. The players will still be able to edit the beatmap to their level of satisfaction and increase/decrease the difficulty as desired. We hope to utilize Machine Learning or some other type of algorithms in order to create beatmaps that complement the music to its fullest degree, and are also satisfying and fun to play.

  This will allow players to add their own custom songs, which is usually only done for a subset of select rhythm games by having the players manually develop the beatmaps themselves. If the players don't have to create their own beatmaps, it'll lower the barrier of entry for customization, which will improve player satisfaction. Games that allow modification and extensive customization (modded games) are some of the most long-standing games in the modern market, e.g. *Minecraft*, *The Elder Scrolls 5: Skyrim*, *Grand Theft Auto 5, Roblox*, etc. They allow the player more control, and allow for fresh content to be made for a game even after it stops being officially updated. Thus, a player community built around this modding often thrives for many years.

- Multiplayer/Online Play/Scoreboards — The most popular rhythm games or games that test skill are ones that allow players to compete against each other or showcase their scores. To improve replayability and encourage more of a player community, we will add aspects of these scoreboards and multiplayer compatibility. Players will be able to compare their scores with each other, share their beatmaps, and generally interact with each other through this game. Similar to *osu!*, players could add modifiers to levels to make them more challenging in order to gain extra points.

  This will require the use of online servers that we will need to manage, as well as knowledge of database design. This aspect will most likely be developed in the second semester, as it's not part of the core mechanics of the game, and can really only be tested once we have a working game in order.

Since this aspect of gameplay heavily relies on many people purchasing, owning, and continuing to replay the game, we will need to focus on both marketing and replayability. We are hoping that the player customization and polished gameplay will be enough for replayability, but marketing is something that none of us really have experience with, so we will have to learn a lot in this aspect as well. We are thinking that since it is a VR game, we could put it up for purchase on digital distribution services like Steam, as it has its own program — Steam Direct —which allows indie developers to publish their game on its platform.

Effort and Value of Possible Expansions
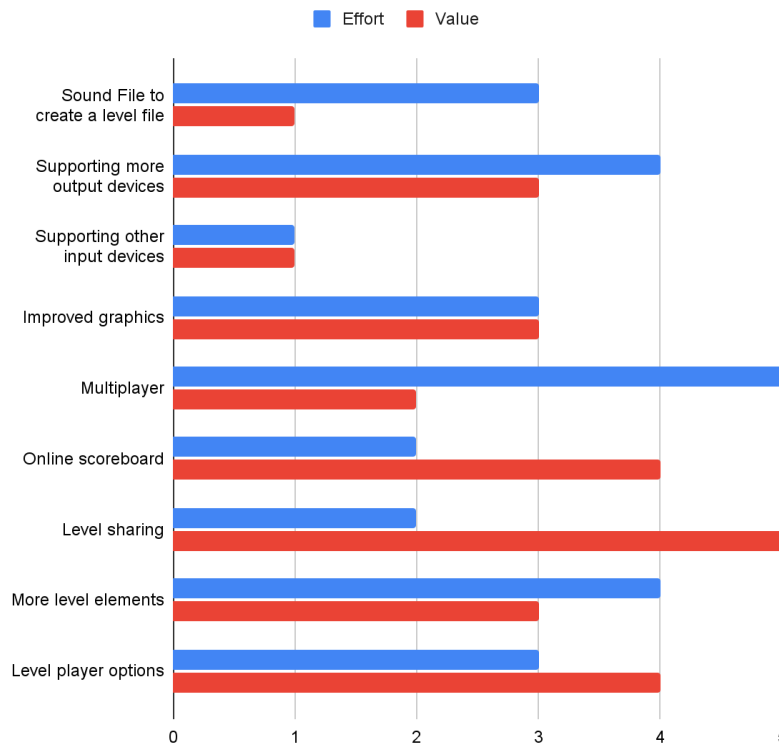
By itself, this game concept of a VR rhythm game with custom beatmaps is not that unique, but we hope that by polishing each aspect to its fullest potential, this game will be one that is fun to play and replay, as well as allow for a large player community with customization and interactivity. As the player community and the procedurally generated beatmaps will be our main draws of the game, those are the aspects that we will focus on the most.