Heart Rate Monitors in Conjunction with VR to Increase Immersion in Horror Games

How can multiple emerging technologies be used to enhance the players experience to become more interactive and immersive?

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Abstract—This paper will explore the topic of utilizing two forms of emerging technology together in a horror game, making a more immersive experience for players. Graphically, games are looking more real than ever. However, games are on the brink of becoming physical as well. Introducing Virtual Reality is the tip of the iceberg. By connecting human bodies to video game avatars, the sense of embodiment is exponential. This project will utilize emerging technology to create a heart rate horror game in VR with adaptive game play reflective of the players heart rate. Utilizing biometrics in video games can have significant benefits in cognitive development. Using Virtual Reality on top of this will increase immersion and can benefit the players experience. By combining the two, cognitive growth can be maximized when it comes to biometrics. This paper will explore the use of multiple emerging technologies simultaneously to better understand technological limitations when it comes to realism in games. Will it be too much to process or will this be the future of gaming? The goal of this project is to explore the functionality of VR and Heart rate sensors working together to produce a more interactive horror game.

Index Terms—Horror, Virtual Reality, Heart Rate Monitor, Embodiment, Biometrics, Video Game.

I. Introduction

Games have utilized immersive technology such as virtual reality and augmented reality for a few years now. However, this technology is still new as updated iterations are being released every year. The use of biometrics such as heart rate can help develop cognitive skills such as emotional responses [1]. By utilizing this in a horror game, it is possible to help players overcome fears. When combining this with VR to make the experience more immersive, cognitive growth could be exponential. Virtual Reality increases player presence leading to heightened emotions and decreases heart rate variability [2], which can lead to more accurate results. Because of these factors, putting the two together could be a recipe for success. This is only the beginning. When all of our senses are transferable to a virtual environment, the metaverse could become much more than thought to be possible. This technology has been predicted and showcased in modern media such as the popular anime/manga "Sword Art Online"

among others, where humans are digitized into a virtual world and their senses become real when putting on a headset. At this point, this technology is closer to reality than fiction. Using biometric technology for social events has been considered when Raquel Robinson designed a way for twitch viewers to view the streamers heart rate [3]. This is another example of how these immersive technologies can be used to improve games, not only for the player, but for viewers too. As one can see, this is the future of the gaming industry and by exploring it now, there is the possibility to expand upon it and turn it into something never before seen. Using heart rate monitors has positives and negatives [4]. However, with Apple releasing their watch series in 2015 [5], heart rate monitors have become a lot more accessible which is why using this technology is viable. Design thinking is a great way to capture user needs [6]. Utilizing this in the preparation phase helped in discovering problems and realizing new solutions to bring this idea to life. Studies show that virtual reality has the highest perception of immersion when compared to other forms of media such as videos or PC interactions [7]. This project focuses on using these facts to increase immersion and embodiment to create a maze exploration horror game.

See Appendix A for Immersion Rates Chart.

II. Methods

The most important aspect in implementing immersion into horror games would be first to focus on ensuring that the system, and game by proxy, has an understanding of the player's emotional state ahead of anything else. As discussed by Mike Ambinder in his presentation, biofeedback when combined with current player input, adds a new layer to the player experience that was previously ignored [4]. In saying all this, focus should be applied on what kinds of emotional tracking systems can be considered in order to try and measure the player's responses. There are currently various methods that can be used to track this data. The first of which would be Skin Conductance Level Reactivity (SCLR) which can be

used to track the electric resistance on the skin. This is great for vigorous movements and tracking minimal lag response. It does however, have the issue of being unable to track valence, a term used to describe what direction the emotion is headed in, assuming sad and happy were two sides of the same coin in this instance [4]. Facial expressions and eye tracking can also be considered since it can track both the valence, and level of arousal. The technology for this however, is fairly expensive. EEGs are another method that can be considered as this can track electrical movement in the player's brain. This however is currently too expensive, very intrusive, and there is some difficulty in the validation [4]. Lastly, there are heart rate sensors which can track the player's current BPM. This method, as noted, is already familiar to most users since smart watches use this, such as Apple Watches. However, There are downsides to this. Getting live heart rates does not always give exactly accurate results because of a small time delay [4]. This does not seem like it will affect the data collected but is something to keep in mind. By utilizing the hyperate API, Unity will be able to receive the users heart rate sent through an Apple watch. This will then be used to alter the speed of enemies within the game. Players will be able to set their resting heart rate as a base line. Players will navigate through a maze-like cave to reach the finish line. They will need to traverse this maze whilst in VR and while keeping their heart rate low enough as to not trigger the enemy's attack. This project has been broken down into five stages and multiple sub-stages in a gantt chart on Monday.com.

See Appendix B for Project Progression Chart.

III. RESULTS

When creating any product it is always important to consider the design thinking process. This process is meant to understand the user, figure out what they need, and deliver. This process is split up into 6 steps: empathize, define, ideate, prototype, test, and implement. In other words, understand the user, define the user's needs, generate ideas to satisfy said needs, create a prototype, refine said prototype, then deploy a finished product for the user to use [6]. When creating a horror game, the user's needs must be understood. If someone is playing a horror game, they most likely want to feel a sense of excitement and adrenaline, which is easier to accomplish when the user is immersed in the game [8]. Otherwise, the player gets separated from the game world, and they remember they are simply playing a game, and their brain realizes there's nothing to be afraid about. Therefore, in order to ensure the player stays immersed in the game, it's needed to deploy certain tactics to keep the player on edge whilst playing the game. Additionally, a different, more immersive medium can be used for the gameplay experience; virtual reality. Using the relatively new medium of virtual reality allows the user to experience the game world first hand, rather than consuming it from a flat screen. This is especially effective with horror games, as it is easier to disconnect from the horror when you can look away from the screen; with virtual reality, that isn't an option. There are other systems to increase player immersion, and those ways are underutilized despite being effective tools. One option that fits quite well with the horror genre is heart-rate monitoring. Heart-rate monitoring, along with other forms of biofeedback, are a great way to collect information about the player's current emotional state in the game, and thus, how immersed they are. If a player's heart rate is low during a tense period of the game, that could be an indication that the player isn't immersed in the game, which means the game isn't achieving its goal. Additionally, this data can be used in a gameplay sense, with scaling difficulty based on player biofeedback [9]. Using heart rate monitoring as an example, it gives the player "physical" feedback, as this isn't some made up mechanic from the game; this is your real life reaction to the game, and nothing is more immersive than real life itself [10]. This also solves an issue where, when a player is not immersed or not utilizing self-efficacy [8], the game can be doubly boring, as the horror is not working, and most of the game's difficulty comes from the horror, so without that sense of fear and panic, the game becomes too easy to be enjoyable. Using biofeedback, the game can adjust the difficulty level and personalize the gameplay experience based on the player's current mood, whether it be positive or negative [11].

See Appendix C for Design Thinking Process.

IV. CONCLUSION

In summary, the hypothesis to combine VR with heart rate monitoring to create a more immersive experience has merit. During the design thinking process, it became clear what tasks needed to be accomplished in order for this idea to be successful. While talking with people who fall into this target demographic, it was discovered that they do in fact feel more immersed when they have a virtual reality headset on. On top of this, research suggests that using biometrics can amplify emotions of the user [1]. In conducting this design thinking method, gaps started to appear. It was brought to our attention that having the heart rate appear from the player's wrist, like a watch, would be an immersive way to showcase the player's heart rate in VR. This would indeed be the best way to allow the player to see their heart rate, so that is the goal. Although there are some knowledge gaps when it comes to implementing these features, there are plenty of resources in class and online that will help with the development process. The goal of this project is to create a simple virtual reality horror game where players navigate a maze-like cave while being chased by an enemy. The player's heart rate will also be factored into the gameplay by changing the enemies speed according to how high their heart rate is compared to their base heart rate. The player will be able to look at their wrist, like a watch, and see their heart rate in beats per minute using the hyperate API. Finally, the question, "does combining biometrics with VR make a more immersive experience?", will be answered.
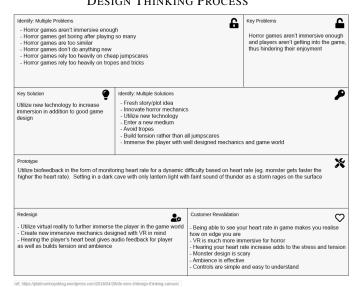
APPENDIX A
IMMERSION RATES

	Interactivity	Immersion
Video	Low	Low
PC	High	Low
VR	High	High
VR-video	Low	High

APPENDIX B
PROJECT PROGRESSION CHART

APPENDIX C
DESIGN THINKING PROCESS

ref: https://platinumboysblog.wordpress.com/2016/04/28/de-sem-4/design-thinking-canvas/...

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