# How can virtual reality technology be used to revive the arcade experience for a contemporary audience?

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# 1 Objectives

The aim of this research is to determine if and how virtual reality technology can be used effectively in an arcade setting; both to provide access to the technology for a higher number of users, and to renew the experience of going to an arcade for new audiences. The research investigates the views on VR and arcades within a focus group to identify the key issues that must be overcome, and the aspects of each that should be implemented into the artefact.

The artefact is a prototype VR arcade hub, from which players at a physical arcade can select and access VR games and experiences, interact with other players and collect digital rewards with tokens won in games. This research is being conducted to explore the potential of a perceived gap in the VR market.

# 2 Research Context

## 2.1 Video Arcades

The 80's and 90's were a golden age for video arcades, but these businesses faced growing competition from home consoles as technology advanced (Wolf, 2008). And, as Wolf suggests, audiences stopped favouring arcades when the so called "console war" began. Video game enthusiasts were presented with a broadening catalogue of games, and arcades with their single game cabinets couldn't keep up.
Hodges (2014) credits this decline to the inability of classic arcade games to offset maintenance and real estate costs. The application of virtual reality technology in arcades has the potential to reinvigorate a struggling market and introduce a new form of community-based gaming, one that caters to an audience interested in multiplayer games and immersive experiences but for a number of reasons cannot buy their own virtual reality equipment.

While consoles are relatively cheap and easy to set up; virtual reality headsets, sensors, and computer hardware powerful enough to run games for VR quickly add up in cost and require a

large empty space to be used in many cases. Arcade spaces dedicated to VR offer everyone an opportunity to play with VR, and in amounts of time that won't cause motion sickness.
A key advantage of a VR arcade over a home set up is the potential for additional hardware: circular treadmills like the Omni (Virtuix 2020) that allow players to walk in place, would be too large for an individual's home. VR arcades could also make use of haptic feedback suits, such as the TESLASUIT, which can deliver haptic responses to digital stimulus and immerse the user in their VR environment; and glove controllers that better simulate real life than standard VR baton remotes (TESLASUIT, 2020).

## 2.2 Support for VR

As major games development studios look for new avenues of innovation, the potential of VR is limited by the comparatively small number of people using it, as in 2016 only around 150,000 had purchased an HTC Vive (Lang, 2016) of the 14 million average users on Steam per day (Soper, 2017). However, some companies see the niche as being worth the investment of resources. Ubisoft is researching VR games for arcades as means of creating new experiences for their customers (Papiernik, 2019). A major studio becoming involved in arcades means that their existing audience is likely to boost the usage of VR spaces and encourage even further investment. There are existing VR arcades around the world but they are relatively few and far between, and these are independent businesses with isolated systems. The development of a standard software package would enable the players in one arcade to interact with those in dozens of others internationally. This would introduce the potential for the online multiplayer games that currently dominate the market to succeed in VR.
One of the limitations to VR compared with traditional gameplay is the lack of games being developed for it. When designing for VR developers must put more consideration into certain aspects of design. As mentioned in some interviews (2/3, 3/11), motion sickness is a significant issue for many people when playing in VR, one that may put audiences off using the technology at all.
Jesse Schell highlights the importance of designing to avoid motion sickness in VR. He suggests maintaining a framerate about 60 fps and avoiding Virtual Camera Motion (movement of a camera not controlled by the player's VR headset) to reduce motion sickness (GDC, 2016). Shaun Patton discusses the importance of affordances, small interactions with the VR space that immerse the player by making the environment feel real, as well as ensuring that the space

is comfortable for the player, matching their physical position to that of their position in-game as best as possible (GDC, 2016).

# 3 Methodology

## 3.1 Establishing Goals for the Artefact

The nature of the artefact presented with this study requires insight into the opinions of a contemporary audience to inform the visual, audio, and technical decisions made during development. The goal of the artefact is to show how a VR arcade may be implemented practically.

As the data being gathered was essentially the respondents' opinion, qualitative collection methods were the most appropriate approach to gaining valuable information. An interview method was chosen as it offered the best opportunity to collect relevant data, as respondents were able to ask for further explanation to the meaning of the questions they were asked. If a written questionnaire had been offered instead many fields would have been filled with answers that misunderstand what was being asked, and the interview method also offered the opportunity to inquire further into some of the answers given by the respondent.

The interviews carried out in this research were semi structured, there was a set of questions that formed the main focus of the interview, but where the interviewee offered a particularly insight time was taken to ask further questions on that topic (Hammond, 2013). Interviewing was carried out in three stages:

## 3.2 Stage One

Stage one sought to establish the interviewee's opinion on VR technology and software, and the arcade experience. These questions were intended to give context to some others in stage two; though questions 6, 7, and 8 identified elements of an arcade that respondents considered important and so directly informed the design of the artefact.

This was followed by exposing the respondent to VR gameplay, they played one round of the rhythm game Beat Saber (Beat Games, 2019), and up to 5 minutes of SUPERHOT VR (SUPERHOT Team, 2017), which in some case was cut short by discomfort or motion sickness felt by the respondent.

## 3.3 Stage Two

Stage two collected the opinions of the respondent with a recent VR experience in mind and asked how best VR technology could be applied to an arcade setting.
The benefits of carrying out this research before developing the artefact were twofold. Firstly, the insights established what a VR arcade experience might look like, how sound should be implemented, and where there were opportunities for interactivity. Additionally, the responses given to question 15 reinforce the context in which this research is being carried out, meaning consideration was given to issues that previously went unnoticed.

## 3.4 Stage Three

After reviewing the data collected in the first two stages development on the artefact was carried out. Once the artefact met the initial development goals, respondents were asked to evaluate artefact. They were asked whether it met their expectations, where it did well, and what they felt could be improved.

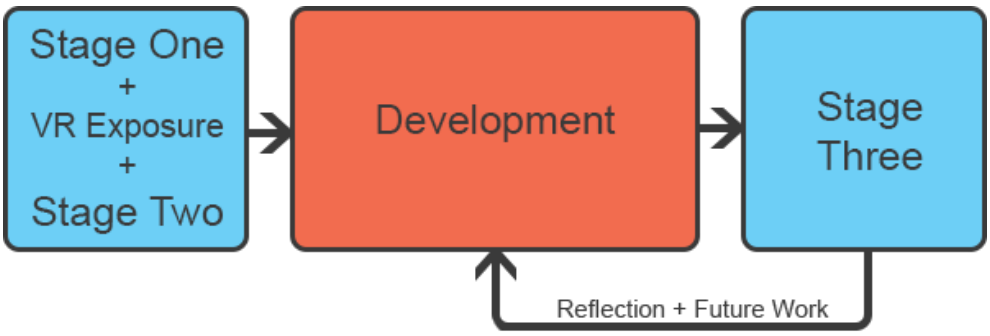


**Figure 1:** Graphic showing the workflow of research and development.

# 4 Production

## 4.1 Look and Feel

The VR hub environment is a floating platform in space, with portals to games lining the edge and a planet hanging above. This design was chosen as the data collected prior to development showed respondents wanted a futuristic style present in the arcade (Interview 4/15). The data also indicated that certain parts of the retro arcade aesthetic are still popular, so the carpet of the central dais matches those found in older arcades, and classic game cabinets were scattered around the middle of the environment (Interview 1/15, 2/8, 4/14).
The spinning “VRCADE” sign that hangs above the centre of the arcade is a combination of retro and futuristic styles, and was inspired by the design of the ”Oasis” from Ready Player One (2018). Interviewees largely agreed that the environment should be as dim as possible and lit only from ambient sources, so the signs above each portal are designed to look and emit light like neon (Interview 1/8, 1/15, 3/8, 4/8).

## 4.2 Interaction

To go from the arcade hub into a game the player must step into a portal rather than interact with any kind of menu. The data collected indicated some may experience a steep learning curve in VR (Interview 2/11, 3), so it was important for the system to be as intuitive as possible for a range of users. The size of each portal is intended to indicate to the user how many players each game can take per match, with the smallest being single player and the largest sandbox type area. The raised dais that the player spawns on is intended to make it easier for them to see where everything is over the heads of the other player avatars that would theoretically populate the area.

With more time for development the crane and retro cabinets could be made functional to provide users with a greater variety of activities within the arcade, making it less like an interactive menu and more like a social space (Interviews 3a/4, 5a/4).

Similarly the portals are non-functional due to lack of access to the appropriate tools, such as the official Steam VR library programming. If this project were pursued with official Steam VR support the process of loading into games would be streamlined.

# 5 Findings and Discussion

## 5.1 Compared with Existing Literature

The feedback collected from post development interviews (Interview 3a/4, 5a/4) supports Shaun Patton's assertion that having a number of affordances is integral to level design for VR, especially when the environment itself has a limited core function (GDC, 2016).
Interest expressed in having more immersive control methods (Interview 2/13, 5/13) indicates that support for devices like the Omni (Virtuix, 2020) or the TESLASUIT gloves (TESLASUIT, 2020) would significantly improve VR arcade experiences over current home VR setups. The additional cost and space required for these technologies benefit from a dedicated, publically available setting, ie VR arcades.

## 5.3 Applying Results to Industry Knowledge

The results of this research indicate that the most significant barrier to consumers playing in VR is the high cost, as one has to pay for the VR equipment and have a computer with sufficient specifications to run VR games. Similarly data shows that playing in VR with more immersive technologies would appeal to a wide audience.
However, the research here was carried out with a small sample group of five participants, meaning that the data cannot be considered representative of contemporary audiences as a whole. The data here is reliable as the participants returned to review the artefact after their initial interview, providing feedback and noting the elements that they previously discussed.
The high cost and inconvenience of VR in its current state is limiting the rise of VR as an independent platform. Several participants cited the expense of equipment as preventing them from engaging with VR. If the platform is to grow and reach its potential for developers creating unique experiences then brands working to sell it must first find a means of making it more widely available. As this research indicates, the brick and mortar arcade is well suited to this goal.

## 5.4 Implications of this Research

This artefact can be presented as a prototype for real-world application of a VR arcade software suite. Evidence of an effective method to bring VR experiences to arcades may encourage developers, publishers, and arcade owners to invest more time and money into the technology. Were this the case VR would rapidly become available to higher numbers of consumers and potentially put the platform on level standing with long established mediums such as the home console.

In future, research could be undertaken into how the artefact generated here can be refined into a releasable product. The key focus in this research would be creating a network of VR arcades in multiple locations using the same software, putting their players in the same digital space. Research could also be undertaken into the development of original, purpose built VR arcade games. Identifying important design features that should become a standard for the genre would be beneficial before the development of such games became widespread.

# 6 Conclusions

This research aimed to identify how VR could be used to revive the arcade experience and has found that VR arcades would be well received by contemporary audiences seeking the opportunity to experience VR without having to invest in their own equipment. And that incorporating immersive technologies like haptic feedback, arcades have the opportunity to revive the arcade experience for a new generation.

In addition, this research has shown that arcades may also be the medium through which VR is able to proliferate to a much wider audience.

From the perspective of level design, this research shows that combining elements of the retro arcade such as patterned carpet, flashing lights and winning prizes does well to familiarise players with a VR arcade space.

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# 8 Appendices

## 8.1 Interview Questions

1. What exposure have you had to VR before today (playing, watched videos, seen adverts, etc)?
2. If you haven't played VR before now, why not?
3. What are your general feelings about VR?
4. What kind of games, if any, do you usually play?
5. Do you enjoy games from the retro/arcade era?
6. Have you ever been to a video arcade?
7. If yes, what was that experience like?
8. What aspects of the arcade do you feel are essential to its identity?

9. What do you think of VR now?
10. Would you want to play in VR regularly? If so, how often?
11. Are there any drawbacks to VR that you experienced?
12. If a VR arcade were available in your area, would you consider using it?
13. What kind of equipment would you hope to find there?
14. What kinds of games would you want to play?
15. What do you think are the most important things for a VR arcade to include?

## 8.2 Responses

### Interview 1 (Prebuild):

1. Developed for it, played with friends
2. Space
3. Fun, opportunities to explore, interactivity more natural that classic controls
4. RPGs, slice of life
5. Yes, Pacman, Donkey Kong, Mario, classics anyone can pick up
6. Amusements arcade, not exclusively video games as rare in UK
7. More fun with friends, can get expensive
8. Low light, flashy machine lights, groovy carpet, no music but game sounds, clink of tokens/coins

9. Still fun, can be stressful (having to be spatially aware/surrounded by game environment)
10. For some games
11. Can get dizzy after playing too long, can become over immersed, expensive
12. Would use, can play without spending hundreds
13. Prop shaped controllers (ie guns for shooter games), safety restraints, treadmills
14. Beatsaber, something like Dance Dance, claw machine, racing games
15. Atmosphere(cozy, familiar, retro, 80s/90s vibe, chunky patterns) dim but visible lighting

### Interview 1a (Postbuild):

1. Good atmosphere and very arcade like.
2. Looks good, is colourful, and has nice lighting effects.

3. Moving between light sources can be jarring

4. Music doesn't fade in or out very well

## Interview 2 (Prebuild):

1. Played once before
2. Access to equipment
3. Great, had heard about motion sickness issues
4. Indie games, side scrollers (Limbo, Hollow Knight)
5. Yes, nostalgic experience
6. Probably
7. Nostalgic, novelty
8. Big game cabinets

9. Immersive experience, exciting, takes getting used to
10. Once a week
11. Very different to normal controls, learning curve, stressful
12. Yes, definitely
13. More immersive feedback equipment (haptic feedback sensors)
14. Exploring games
15. Variety of games, genres, experiences

## Interview 2a (Postbuild):

1. "I like the crossover between traditional arcades and the sci-fi ish / ultra modern style"
2. "I like that you can explore the arcade and you are not limited to certain points like the games"

Interview 3 (Prebuild):

1. Some play time at home
2. Expensive
3. Good fun for short periods, still developing
4. RPG adventures
5. Likes them, didn't grow up playing so little nostalgia
6. Yes, a long time ago
7. Good but short, easy to quickly run out of money
8. Table games (air hockey etc), driving games, multiplayer games, dingy atmosphere, loud

9. Like it, it's fun
10. Would play regularly, few hours a week
11. Not very intuitive, learning curve, non standard controls across games, headset clunky and uncomfortable, motion sickness
12. Definitely use VR arcade
13. Multiplayer arena
14. Something where movement is a key feature, short/round based
15. Space/room to play, equipment training, standardised equipment

Interview 3a (Postbuild):

1. "Concept itself is really solid, and I can picture it being used."
2. "Visual design is well done, feels nostalgic, fun and vibrant"
3. "Lots of user focused elements, seems like it would be really social."

4. "More interaction with the environment would be good."

Interview 4 (Prebuild):

1. Played briefly, experienced a 360 video in VR
2. Access to equipment, don't know how/where to play
3. Potential to create interesting experiences if properly done, can cause sickness
4. Smash Bros, don't play games often
5. Not played them
6. Been to an amusement arcade, didn't play video games there
7. Fun, variety of activities,, good atmosphere
8. Playing with other people, intuitive play, flashy lights, lots of options

9. Better impression, now sees how it can work well
10. Once a month, maybe more
11. Lack of spatial awareness, began to feel dizzy/limits play time, expensive to buy headset
12. Would check out a VR arcade, probably not a regular visitor
13. Movement limitations for safety, sanitary wipe downs of equipment
14. Experiences where you feel fully immersed in the VR space, full body movement, exclusive/made-for-VR games
15. Good ventilation system, combine retro and futuristic style, high user capacity

Interview 4a (Postbuild):

- DATA WAS NOT COLLECTED

Interview 5 (Prebuild):

1. Developed in VR
2. Because it is expensive
3. It's a really cool concept, but only so much you can do with it
4. RPGs, MOBAs, simulator shooters
5. Yes, favourite game is Doom 2
6. Yes
7. Very good fun, usually only in seaside towns
8. Coin pushers, physical controllers (guns, car seats/wheels)

9. VR is definitely fun, great novelty, good step towards new game styles
10. If plenty of games were available, and had space would play daily
11. Feeling of a headset breaks immersion
12. Absolutely, chance to try all kinds of experiences
13. Real room lined up with the digital space for some games, tactile controllers (ie steering wheel, guns)
14. Sword fighting, racers, spaceship simulators, shooters
15. Good sound quality, high resolution, choice, customisable avatar and personal space

Interview 5a (Postbuild):

1. Good colours and lights

2. Very open and space

3. Retro cabinets could be arranged better
4. Players could have their own personal spaces for trophies and collectibles