STAR

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STAR: Superhuman Training in Augmented Reality

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ABSTRACT

The goals of Superhuman Sports games include to involve physical activity and enhance the skills and abilities of a human through technology. They are played for fun, competition or to improve the players' health condition. To meet these goals, we designed and developed STAR: Superhuman Training in Augmented Reality, an augmented reality adventure shooter, and implemented it on the Microsoft Hololens. Our game promotes physical activity by making you avoid dangerous enemies and gather energy to deal with this threat while navigating a narrow path above lava. Social interaction is stimulated by its multiplayer mode, in which players have to work together to destroy an energy core. Player testing showed that we achieve our goal of physical exercise by making the player move at a pace slightly less than brisk walking and that the game is fun and immersive. These results show that STAR is a promising step in the right direction for the development of superhuman sports using augmented reality.

CCS CONCEPTS

• **Human-centered computing → Mixed / augmented reality**;
• **Software and its engineering → Interactive games**;

KEYWORDS

Superhuman sports, Augmented Reality, Gaming, Exergaming

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1 INTRODUCTION

Over the last couple of decades, the use of computers and mobile devices has grown significantly. This means that people spend more time sitting inside using their devices. This reduces their amount of physical activity and is therefore considered to be detrimental to a person's health.

Exercise and sports-related activities can be augmented with technology to explore new possibilities. Kunze et al. described this research field as *Superhuman Sports* [8]. Superhuman sports combine the competitive and physical elements of a sport with technology to give a player a superhuman-like experience by virtually enhancing the abilities of the human body and removing some of its limitations present in the real world. In many cases, Superhuman Sports can also involve elements of gaming. A study of game-based approaches on improving health by Baranowski[1] shows that these game-based approaches indeed have a positive effect. According to Vorderer et al.[18], the desire to be the best and compete is one of the most important elements of sports games. Therefore, when designing a successful sports game these social and competitive aspects play an important role.

While there are games available that motivate players to exercise in some way, not a lot of them use augmented reality. Examples of these type of games that do not use augmented reality include applications like Wii Sports [14] and Wii Fit [15], as well as Xbox Kinect games like Dance Central [6]. Next to the aforementioned games that do not use augmented reality, there are games that do use augmented reality to promote exercise, such as GeoBoid [10]. In this game, you have to run around to collect virtual Geoboids that are moving in clouds at different locations. Another example of a game that uses (mobile) augmented reality and involves some kind of movement as it encourages you to walk a certain distance is Pokémon GO [13]. However, there are not a lot of these games available yet, most of them lack a social or competitive aspect. Many augmented reality applications are also for mobile phones, which are not practical when augmented reality is combined with physical activity and the players need to be aware of their surroundings.

In this paper, we present the design and implementation of 'STAR :Superhuman Training in Augmented Reality', which is our attempt at making a Superhuman Sports game which combines the attractiveness of computer gaming and exercising. STAR exploits augmented reality to augment superhuman abilities and creates a

competitive and social aspect to create an engaging and fun game. The paper is organized in the following manner: following the related work (Sec. 2), we discuss the game design of STAR (Sec. 3) and its technical implementation (Sec. 4). Later, we examine the functionality of STAR as a game and as a tool for exercise (Sec. 5), before concluding and presenting foundations for future work (Sec. 6).

2 RELATED WORK

This project's research and design are closely related to augmented reality (AR) and games that require physical exercise, also known as exergames.

When we look at games that involve augmented reality and promote exercise, we find that there are a few games out there that combine these two aspects, for example, AR Pacman [3] and ARQuake [17]. AR Pacman requires the player to collect all yellow dots just like the regular game but the dots are placed in the surroundings of the player, requiring the player to physically run around to collect them while avoiding the ghosts. ARQuake is the augmented reality version of the classic shooter game Quake where the player is surrounded by the game's environment and has to physically move and aim to shoot.

Augmented reality is not limited to specialized hardware such as the Microsoft HoloLens [11], Google Glass Enterprise Edition [20] or hardware specifically developed for the examples mentioned above. Currently, smartphones are the most accessible AR devices. Some examples of augmented reality mobile applications are Calory Battle AR[19] and the previously mentioned Geoboids [10]. Geoboids uses video see-through technology and spatial sound to make the player to move between locations. Calory Battle AR has players run to different locations in order to diffuse a bomb. Providing the player with objectives to move between is a simple and intuitive way to promote exercise with games. Similarly, we promote movement by having players search their environment while traversing a narrow path and dodge projectiles fired by virtual training robots. These aspects will be discussed in more detail in Section 3.

Similar to augmented reality, virtual reality can be used to create games that get players to be physically active. Examples of these games in virtual reality include Paperdude [2] and Astrojumper [5]. While these virtual reality games promote exercise through movement, the ability for the person to move safely is more restricted. This is due to players not being aware of their environment, as well as to the specialized equipment used for these two games. In contrast, Augmented Reality games still allow players to be aware of their surroundings, and in most cases, incorporate them into the gameplay.

3 GAME DESIGN

The name of our game is STAR which stands for Superhuman Training in Augmented Reality. It is implemented for the Microsoft HoloLens environment. HoloLenses are optical-see through head-mounted displays (HMDs) that allow STAR to use the player's physical environment and body movement. They allow the players to control the game by walking around, moving the head, using hand gestures and voice commands. Like any other game, STAR consists of a theme, a story, the goals and the game mechanics. In this section, we elaborate on these aspects with additional emphasis on how our game makes use of the HoloLens mechanics and controls. We will also focus on the sports aspects of the game in the last part of this section.

3.1 Theme and Story

STAR is a hybrid of first-person shooting, adventure and exergaming [16], a combination of gaming and exercising. It is a two player game which requires collaboration between the players in order to finish. The game transforms your surroundings into a high-tech superhuman training facility. The training facility levitates above a moving river of lava. The two players are superhumans with superhuman abilities. The game allows the players to train with these abilities to learn how to use and control them as a superhero would before they go out and use their superhuman abilities to save the world. The abilities in the game allow the players to deal with the threat of enemy training-robots which are attacking them and to scan solid game objects to see through them, more on this later. These abilities come at the cost of energy which needs to be collected. The goal is to destroy the energy core which powers the enemy robots while trying to avoid damaging yourself by falling into the lava river or getting hit by the robots shooting.

3.2 Gameplay

The goal of STAR is to survive long enough to be able to destroy an energy core and score points by shooting robots. To complete the game, the players need to defeat the enemy robots which can be done by destroying the energy core by shooting at it a number of times, each in specific places. In order to survive, each player needs energy to use their laser beams to shoot the robots. To collect energy, the players scan the paths above the lava, which also costs energy, to find energy orbs hidden at random locations underneath the path. Energy slowly regenerates over time, which prevents either player from completely running out of energy. The short-term goals are navigating the paths, scanning for energy, collecting energy and shooting training robots and the core. The long-term goal is to survive and destroy the energy source that powers the robots while scoring as many points as possible by defeating training robots.

3.2.1 Player Abilities. A player is able to perform the following actions:

- Shoot a light beam using the standard tap hand gesture which is implemented in the HoloLens
- Scan the floor/path to see through it, (de)activate it using voice commands
- Move around the environment by physically moving
- Collect energy when scanning ability is activated by moving to the position of the energy orb.
- Dodge attacks by physically moving out of the way of the robots shooting at you

These actions require a player to master the following skills:

- Accuracy in shooting
- Agility for quickly navigating the narrow paths while avoiding stepping into the lava
- Reflexes to dodge attacks
- Resource management when collecting and using energy

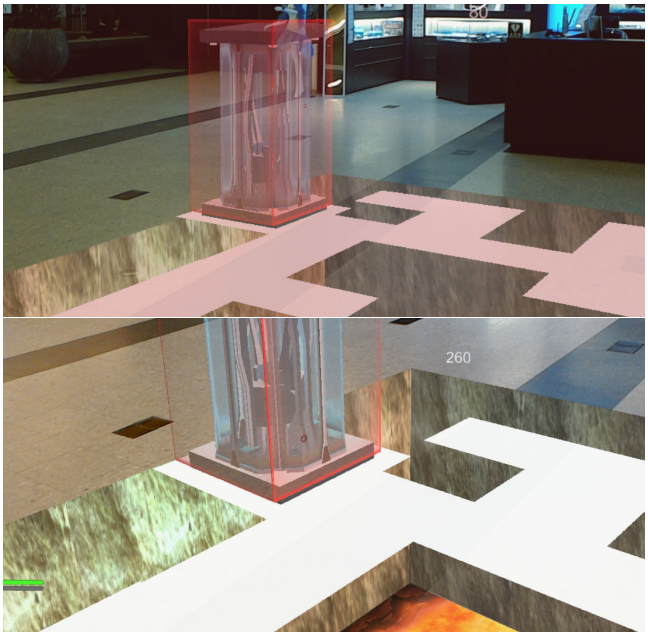

Figure 1: Views of the STAR field taken from the Hololens.

- Communicative skills, concentration and overview to communicate what players are doing and defend each other against the robots

3.2.2 *Game Mechanics.*

Movement and Scene. A player moves through the scene by physically walking in the game area, a virtual narrow, winding platform over a virtual river of lava overlaid onto an empty hall or room, as seen in Figure 1. This is possible because the HoloLens is wireless and tracks movement. The player should walk only on the narrow paths that are created above the lava river. Straying from the path will cause the player to *fall down* into the lava, which rapidly decreases the player's health until they step back onto the path. The screen of the HoloLens also turns red to warn the player. To make the paths visible to the player when looking ahead instead of down, which is needed due to the small field of view of the HoloLens, steam rises from the lava which is blocked by the paths. This creates gaps in the steam where the path is located.

Energy. To make STAR more challenging, shooting and scanning cannot be done endlessly and carelessly. For this purpose, STAR employs an energy mechanic. Energy is consumed when the player shoots at the training robots or uses the scanner to find energy orbs. Collecting energy orbs fills up the player's energy bar. The scanner uses a small amount of energy per second as long as it is activated. Every shot uses energy. To prevent the player from running out of energy and being unable to collect more orbs, the energy bar also regenerates slowly. Therefore, the player has to survive long enough without their superhuman abilities while waiting for the energy bar to be refilled to a point where the scanner can be used again.

Figure 2: The robots used in STAR that spawn around the player

Scanning. A player's scanning ability is activated and deactivated using the voice commands "activate" and "stop". Looking at the floor with the scanner activated makes part of the path the player is walking on transparent. Energy orbs are hidden underneath the path and are not visible to the player unless the scanner is activated. When an energy orb is found, it can be collected by walking over it, but only if the scanning ability is activated. The scanner uses a small amount of energy every second it is active. The player can deactivate the scanner, using the voice command "stop", to save energy for shooting or for scanning when more energy is needed.

Enemies and Health. Training robots appear around the player during gameplay, as seen in Figure 2. They can be shot and also shoot the player. If a player shoots and hits a robot, it is destroyed. To survive, a player has to make sure not to run out of health. The amount of health a player has left is shown in a health bar. The robots shoot lasers at the players in order to lower a player's health to zero. When a player is hit or when a player steps off the path, the health of the player decreases. Shots can be dodged by physical movement.

Collaboration. As mentioned before, two players have to work together to destroy an energy core, which powers all robots, to win the game. The core has an energy shield protecting it, as seen in Figure 3. Each player has their own color and each piece of the shield has a color corresponding to a player, red or blue. Each piece has to be shot a number of times by the corresponding player to eventually destroy the whole shield and the core.

Player Perspective. A player can see the part of the scene where the head is pointed at through the HoloLens, as seen in Figure 1. When walking on the path, a player experiences a vertigo effect because the lava river appears to be a couple of meters below the path creating a void underneath the player. Because of the small field of view of the HoloLens, all game elements are kept on the floor or a little above to enable a player to see the path and avoid stepping in lava while also shooting at robots and the energy core.

There are separate health and energy bars which show how much health or energy is left. A player can see enemy robots in the direction they are looking at. However, when an enemy spawns out of the player's current field of view, a spatial sound indicates

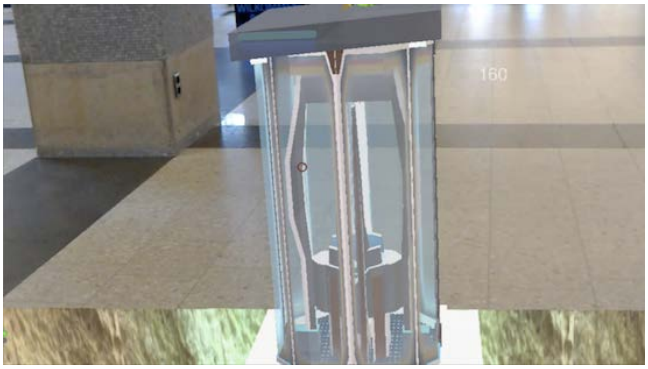

Figure 3: The energy core used in cooperative gameplay.

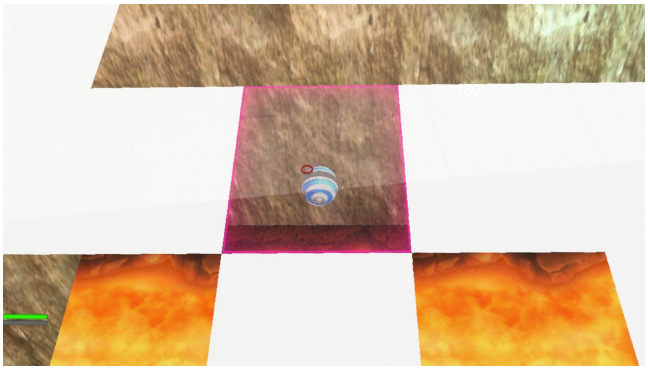

Figure 4: View of the player when looking down while the scanner is activated and an energy orb is found underneath the path

where the robot appeared in comparison to the player's current position. When the enemy shoots, a player sees a beam fly towards them. When a player shoots, a light-beam is fired from the position of the HoloLens (and therefore the player's head) when doing the tapping gesture. While looking down at the path when the scanner is activated, one tile of the path becomes transparent provided that tile is within a range of 2 meters. While scanning, if an energy orb is hidden underneath the transparent tile, it becomes visible to the player. Otherwise, a player only sees the lava below through the transparent part of the path.

The two HoloLenses are connected, which means that both players are able to see the core and the core's shield indicating which player should hit what part of the core. Each player has their own color, one blue and one red. This is visible in the laser beams that players shoot at enemies which will be red for one player and blue for the other.

3.3 Movement and Activity

STAR encourages players to move in two different ways: by collecting energy orbs and avoiding enemy robots' attacks. Energy orbs are scattered all over the playing field. To find them, the players must scan the paths above the lava by walking or running around the field, without stepping off the path and falling into the lava pit. The scanner has a limited range so the players can only see through the path under their feet within a limited radius. This requires them to quickly traverse the path as fast as possible in order to collect energy orbs, which as previously mentioned are needed to win the game. The second way this game encourages movement is through the use of enemy robots that shoot at the players with the aim to decrease their health. In order to stay alive, the players have to avoid robot attacks by moving around to dodge their laser beams. This requires players to react and move fast and always be aware of their surroundings. Furthermore, the game incorporates elements which can be found in most team sports. It requires concentration, communication, and strategic insight to succeed as a team. If one player is failing to communicate or focus on the objective, the team will ultimately fail as it becomes impossible to complete the game successfully.

4 TECHNICAL CHALLENGES

During the design and implementation of the game, there were several technical challenges. This section discusses these challenges as well as the chosen solutions.

4.1 Map Design and Implementation

One of the most challenging aspects of the game was to create an environment that motivates players to move around while staying on the path. To do this, we motivate the player not to stray off the path. This was done by creating a vertigo effect using a difference in depth between the path and the lava below as well as using a red haze effect such as in the game Doom [4].

4.2 Limited Field of View

Another challenge comes from the limited field of view of the HoloLens [11]. We compensated for this issue by keeping the important components for the player close to the same height. That is, the heights of the core, the robot enemies and the path along with energy are relatively close to a horizontal plane of reference We feel this solution is more immersive and less cluttered than a small top-down view of the map in the player perspective or changing the viewing distance of the player.

4.3 Multiplayer Synchronization

The co-op aspect of the game poses a challenge of sharing and synchronizing the holograms of the scene between two players. In order to make the game playable in real-time without introducing latency between the two players (and therefore breaking immersion), we only share the enemy core and its status at all times between the two HoloLenses of the players. We used Windows Sharing Service [7], a spatial anchor [12] to the hologram of the core with respect to the real world, and message passing [9] to achieve this. While in most cases this is sufficient, the shared anchor's (core's) position does not always align between devices. This is due to the fact that the spatial anchors depend upon the points in an environment that HoloLens considers necessary to find that anchor. These are known as 'feature points' and in effect, we export the feature points when we export an anchor. If the exporting device didn't scan much of the world or both HoloLens did not start in the same position, then the exported list of features are insufficient

to find the same position from a different HoloLens. Thus, we also include a mandatory 'scan your environment' phase in STAR to map the surroundings for both players.

4.4 Speed of Movement

One of the more difficult aspects of designing this type of game is in making it as fast-paced as possible without compromising the experience. Unfortunately, using the HoloLens, the technology now limits the speed at which a player can move. This is primarily due to two reasons: the HoloLens is not designed to wear while sporting and fast movement can cause the HoloLens to drop frames.

We can expect that in the near future, the next generation of AR technology will allow players to move as fast as they can without compromising the in-game experience.

5 EXPERIMENTATION AND DISCUSSION

The purpose of STAR is to promote physical activity by imbuing players with superhuman abilities and having them compete in an augmented environment. Therefore, STAR should be an enjoyable game that also has people move around during gameplay. We determine the efficacy of STAR through a user test with ten volunteers, which contained both a play-testing questionnaire and quantitative movement data. For each participant, we described the game to them, and then allowed them to play through one round of the game until they either finished the game or did not want to continue. All participants played the game in the same environment which was a space of 5x5 meters.

5.1 Play Testing

After each participant tested our game, we asked them the open-ended questions and recorded the received feedback. The questions that we asked focused on the game's exergaming experience, and are specifically:

(1) What is your first impression of the game?
(2) Was the game too difficult or too easy?
  (a) Were there certain aspects of the game which made it too hard or too easy?
(3) Were there certain aspects of the game which annoyed you?
(4) Were there any aspects of the game which were not visually pleasing?
(5) Would you play the game again if you could?
  (a) What would you most like to change about the game to want to play it?
  (b) Would you recommend this game to your friends?
(6) Do you think the game asks for enough physical exertion by playing it?
(7) Do you have any further comments about the game?

The most common issue that was reported was sudden frame drops while playing the game. The underlying cause of these frame drops was the network quality and the sharing services used. We concluded that, to play such a co-op game on HoloLenses requires careful calibration in terms of starting positions of two players and a stable environment with uniform flooring and lighting conditions. In addition to that, the players have to scan the area comprehensively and the already cached spaces in memory of the HoloLens should be deleted for the best experience. We also found that seven out of the ten participants were satisfied with the level of physical exertion. Eight out of ten people reported that they would like more levels of play and would recommend the game to their friends.

5.2 Physical Testing

In addition to the play testing we also examined the number of steps and distance travelled by the player during the gameplay. We do this to measure the amount of *safe physical activity* possible within the time limit of the Superhuman Sports competition. We define safe physical activity as the amount of activity that is possible without injuring the player or damaging and degrading the HoloLens environment.

Results: We tracked the movements of the players in our co-operative game using two Mi Band 2. The number of footsteps averaged 452 per 5 minutes which is slightly less than the brisk pace of walking. There were moments in the game in which the players walked faster than the average speed, especially when they were low on the energy. This is within the technical abilities of the HoloLens, as walking too fast deteriorates the gameplay experience by making the holograms shake or jitter. Future updates to the HoloLens and network setup may remove this technical limitation.

5.3 Discussion

The goal of the game was to create a Superhuman Sports game which provides an immersive experience and promotes physical activity while augmenting superhuman abilities. Play testing shows that the game is more immersive than initially expected given the technical limitations of the HoloLens. The limited field of view the hardware provides was not found to be an issue during play testing with the users. The most important requirement of STAR is to promote physical activity. Even though the game is not as physically exerting as for example football, it does motivate the user to work in a team and constantly keep moving around. As mentioned before in section 4.4, the amount of physical activity could be increased when technology is not the limiting factor. Increasing the size of the field and putting more time constraints on the objective could increase the amount of physical activity during the game. However, the game has to keep a delicate balance between the movement speed of the user and the technological limitations of the HoloLens.

Based on these two aspects, we believe that STAR is a sport that will encourage people to be physically active while playing a game. However, a large-scale testing will be required in the future, to better ground our current findings.

6 CONCLUSIONS AND FUTURE WORK

STAR represents a complete demo of a Superhuman sports game in augmented reality that promotes physical activity by letting people do and experience things they could not do in the real world. The game design was focused on a game that motivates players to engage in physical activity while involving superhuman elements. We found that the HoloLens is an excellent and advanced platform at this point in time for augmented reality game development which fits the criteria of doing physical activity while playing such games. At the moment, it poses some technical challenges in terms of its affordability, sharing experiences over the network, how fast one can move and supported gestures. Nevertheless, the HoloLens is

a quickly evolving piece of technology and we believe that future versions of this device will make Superhuman Sports experiences smoother and better. Despite the current technical difficulties, our tests showed that the game successfully achieves what it was designed for.

In the future, we would like to make STAR bigger and better to utilize to the fullest the current capabilities of the HoloLens. In particular, we would like to add richer game levels and mechanics. For example, we would like to add different energy orbs for each player and power-ups. Each player would be assigned a color of energy orbs. If a player encounters an orb of the opposite color while scanning, instead of collecting it, the player could put it on top of the path, which helps the other player with finding their energy.

Similarly, enhancements can be made to better promote cooperative play. For example, power-ups could be added in which both players would have to work together to obtain it. This could be done by presenting to the player a token with a countdown clock. If the player could collect the token before the time runs out, then a token would appear for the other player; if both players collect their token before the time runs out, both players would receive a power-up. These power-ups could e.g. increase the damage range of the laser or slow down time.

We believe that this Superhuman Sports game is a step in the right direction for the future of Superhuman Sports. It aligns with the philosophy of the Superhuman Sports Design Challenge that wants Superhuman Sports to develop fast enough to a level that they can be included in the 2020 Summer Olympics in Japan[1].

REFERENCES

[1] Tom Baranowski, Richard Buday, Debbe I Thompson, and Janice Baranowski. 2008. Playing for real: video games and stories for health-related behavior change. American journal of preventive medicine 34, 1 (2008), 74–82.

[2] John Bolton, Mike Lambert, Denis Lirette, and Ben Unsworth. 2014. PaperDude: a virtual reality cycling exergame. In CHI'14 Extended Abstracts on Human Factors in Computing Systems. ACM, 475–478.

[3] Adrian David Cheok, Kok Hwee Goh, Wei Liu, Farzam Farbiz, Siew Wan Fong, Sze Lee Teo, Yu Li, and Xubo Yang. 2004. Human Pacman: a mobile, wide-area entertainment system based on physical, social, and ubiquitous computing. Personal and ubiquitous computing 8, 2 (2004), 71–81.

[4] DOOM. 2018. Berserk. http://doom.wikia.com/wiki/Berserk/. (2018). [Online; accessed 28-February-2018].

[5] Samantha Finkelstein, Andrea Nickel, Zachary Lipps, Tiffany Barnes, Zachary Wartell, and Evan A Suma. 2011. Astrojumper: Motivating exercise with an immersive virtual reality exergame. Presence: Teleoperators and Virtual Environments 20, 1 (2011), 78–92.

[6] Harmonix. 2010. Dance Central. http://bit.ly/2CPki6Q. (2010). [Online; accessed 28-February-2018].

[7] Microsoft Joe van den Heuvel. 2018. HoloToolkit.Sharing. https://bit.ly/2L5oJzC. (2018). [Online; accessed 28-February-2018].

[8] K. Kunze, K. Minamizawa, S. Lukosch, M. Inami, and J. Rekimoto. 2017. Superhuman Sports: Applying Human Augmentation to Physical Exercise. IEEE Pervasive Computing 16, 2 (April 2017), 14–17.

[9] Microsoft Kurtis. 2018. Holograms 240 - Shared Holograms, a Microsoft tutorial. https://github.com/Microsoft/HolographicAcademy/find/Holograms-240-SharedHolograms. (2018). [Online; accessed 22-February-2018].

[10] R. W. Lindeman, Gun Lee, L. Beattie, H. Gamper, R. Pathinarupothi, and A. Akhilesh. 2012. GeoBoids: A mobile AR application for exergaming. In 2012 IEEE International Symposium on Mixed and Augmented Reality - Arts, Media, and Humanities (ISMAR-AMH). 93–94.

[11] Microsoft. 2018. Hololens Hardware. https://www.microsoft.com/nl-nl/hololens/hardware. (2018). [Online; accessed 28-February-2018].

[12] Microsoft. 2018. Spatial Anchors. https://bit.ly/2IKF8eA. (2018). [Online; accessed 28-February-2018].

[13] Niantic. 2016. PokÃĪmon GO. https://www.pokemongo.com/. (2016). [Online; accessed 10-January-2018].

[14] Nintendo. 2006. Wii Sports. http://bit.ly/2FHI87E. (2006). [Online; accessed 28-February-2018].

[15] Nintendo. 2014. Wii Fit U. http://bit.ly/2GWeafE. (2014). [Online; accessed 28-February-2018].

[16] Yoonsin Oh and Stephen Yang. 2010. Defining exergames & exergaming. Proceedings of Meaningful Play (2010), 1–17.

[17] Wayne Piekarski and Bruce Thomas. 2002. ARQuake: the outdoor augmented reality gaming system. Commun. ACM 45, 1 (2002), 36–38.

[18] Peter Vorderer, Tilo Hartmann, and Christoph Klimmt. 2003. Explaining the enjoyment of playing video games: the role of competition. In Proceedings of the second international conference on Entertainment computing. Carnegie Mellon University, 1–9.

[19] Joonas Westlin and Teemu H Laine. 2014. Short paper: calory battle AR: an extensible mobile augmented reality exergame platform. In Internet of Things (WF-IoT), 2014 IEEE World Forum on. IEEE, 171–172.

[20] X-Company. 2018. Google Glass Enterprise Edition. http://www.x.company/glass/. (2018). [Online; accessed 28-February-2018].

[1] superhuman-sports.org/delft