Designing Shared Virtual Reality Gaming Experiences in Local Multi-platform Games

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Abstract. Designing multiplayer virtual reality games is a challenging task since immersion is easily destroyed by real world influences. However, providing fun and social virtual reality experiences is inevitable for establishing virtual reality gaming as a convincing new medium. We propose a design approach to integrate social interactions into the game design while retaining immersion, and present design methods to implement this approach. Furthermore, we describe the game design of a collaborative local multi-player/platform virtual reality game to demonstrate the application and effectiveness of our methods.

Keywords: Virtual Reality Gaming, Multiplayer, Immersion, Presence, Game Design, Player Experience, Social Interaction

1 Make or Break: Social Interaction vs. Immersion

Virtual Reality (VR) games are able to create unique realistic experiences in fictional worlds to an extent that is out of reach for traditional gaming systems. One of the main contributing factors for a compelling virtual reality gaming experience (VRGX) is the system's ability to shift the user's perceptive and cognitive attention from the real to the virtual world to elicit *sensory* [14] and *cognitive* [13] immersion. Hence, any action or event happening in the real world might destroy this illusion. This holds for any interaction with other social entities, which make the real world become salient again. This is why VR is often perceived as being a solitary technology, which isolates a single individual in an artificial environment [4]. On the other hand, social interactions while gaming are considered a key factor for joyful gaming experiences [8]. Some authors are of the opinion that there is a contradiction between social interactions and cognitive immersion [15]. In contrast, Cairns et al. [2] state that without social interaction some games would not be fun at all. According to the authors, only such interactions which do not happen within the game's context are a potentially disruptive influence on cognitive immersion. This argument is supported

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by a study on the disruptive factors on presence (i.e. feeling of actually being in the virtual world [7]) by Slater and Steed [14]. One of the most reported reasons for breaks in presence was the hearing of background noises such as people talking. Then again some participants mentioned the wish to share their experience as a cause for the perceived break in presence. In line with these findings, it was found that players experience higher levels of cognitive immersion when playing with others [2]. To solve this issue, the other players must become part of the game in such way, that any interaction becomes an action intrinsic to the gameplay. We assume that cognitive immersion in digital games can be preserved and become a shared experience, if all interactions between players are expressed through game mechanics. Taking this as a design paradigm, we are able to design multiplayer VR games, which provide a rich social VRGX to all players without cutting down immersion.

2 Expanding the Game Space

Following the design paradigm set up in this paper, social interaction has to be integrated as a core mechanic of the game, meaning that it is essential for the game design to work. If game related social interaction takes place beyond the virtual game world, as this is the case in local multiplayer games, it is necessary to push the game's boundaries [11], [6] beyond the mere virtual game world. We call this approach the *expansion of the game space* . The systematic expansion of the game space is comparable to the basic idea of pervasive gaming and mixed reality gaming. These genres expand the *magic circle of play*, either socially, spatially or temporally [10] to combine natural world interactions with digital game elements [3]. Including player interactions in the physical world as a game mechanic makes the game happen in both worlds: the virtual and the real world. Hence, the game space is stretched out to allow all players to enter the game world, whether they access it using a head-mounted display (HMD) or any other gaming device. Applying this idea to VR gaming implicates that not only what happens in VR is part of the game, but also all related actions and events happening outside. It is possible that multiple players become part of the game and share the same gaming experience facilitated by the cognitive immersion stimulated by the game [2]. A shared cognitive immersion is the foundation of live action role-playing game or even traditional pen and paper role-playing games. The latter game genre demonstrates that sensory immersion is not crucial, although it can facilitate and enrich the experience (e.g. costumes, props). With regard to (partly) digital games, alternate reality games show that it is possible to create engaging games, which emerge to the physical world, blurring the line between reality and fiction. Popular examples are the location-based mobile games *Ingress*, and the recently in 2016 released *Pokémon GO* developed by Niantic Inc. The success of these games proves that highly immersive experiences depend more on factors like storytelling, and social interaction than on the technological characteristics of the medium itself.

2.1 Design Methods

The following methods and techniques help designers of VR games to implement our approach of the expansion of the game space.

Unification. Unification is a game design technique where in a first step a fitting and homogeneous theme for a game is identified [12]. In the second step, every detail of the game is designed along this theme. Thus, all elements of a game from interface to visuals and music must reinforce the game's theme. If possible, even the surrounding real world environment should be arranged and shaped accordingly. For VR games this is a promising approach since today's VR systems do not exhibit a level of sensory immersion high enough to make the necessary hardware components completely "invisible" to the user (i.e. "illusion of non-mediation" [9]). If the designer manages to find an explanation for these deficiencies which fits the game's theme and story, they may even facilitate the theme. Thus, instead of trying to make the player believe there is no VR system, explain its existence with the game's theme. It is then possible to strengthen cognitive immersion and to compensate lacks in sensory immersion.

Storytelling. Good storytelling establishes an emotional bonding with the virtual world and its inhabitants and involves the player in the unfolding story [6]. Storytelling evokes cognitive immersion on the player, because it gives meaning to the actions and events happening in the virtual world. For VR games, storytelling is important, because the main characteristic of VR games over traditional games is that the player can find herself literally in the middle of the story. Furthermore, it has been shown, that the ideas and emotions transported by the story are equally important for the experience of presence like the VR system's technical qualities [1]. Storytelling stimulates the human imagination while the individual properties of the transporting medium become subordinated. Because VR entertainment is a quite unexplored new medium yet, designers have to learn how to craft intriguing stories tailored for VR. Storytelling supports the unification of the game's theme by involving the player mentally and emotionally.

Stimulated Communication. Verbal communication is a common form of social interaction found in many games. Provoking game-related chat while the game is actually running can reciprocally amplify unification. Thus, the storytelling should provide a common vocabulary to the players. Then again, if all player communication is consistent with the theme, this supports the occurrence of a unified or homogeneous gaming experience. A recent example for a local multiplayer (VR) game, which stimulates verbal communication between the players is the award-winning *Keep Talking and Nobody Explodes* developed and published by Steel Crate Games in 2015. The VR player has to defuse a bomb with the instructions given by a second player, who is outside the VR and cannot see the bomb. Real-world communication is the main mechanic in this game, therefore it is impossible to leave it out without breaking the game.

Player Roles and Mutual Dependencies. Assigning identifiable roles to certain players allows the game designer to equip each individual player with special abilities, tasks and objectives, information about the current game state, and views on the virtual game world. This is a prerequisite to establish mutual dependencies between all players. Depending on the structure of interaction between the players and the game system [6] this asymmetric distribution of abilities and information can force players either to collaborate or to compete. The result are complex and dynamic game-related interactions, which make the shared gaming experience unique. Giving players the opportunity to choose roles that fit their individual play styles enhances the gaming experience and strengthens the player's involvement.

Combination of Multiple Platforms. Using diverse game controllers and displays can support the game's theme and establishing player roles. Further, to date it is unlikely to find more than one HMD per household. Hence, game concepts which consider one player wearing a HMD and others participating in the game with alternative hardware are preferable. This technological setup can be used to implement the aforementioned design elements *mutual dependencies* and *player roles*. However, complexity and implementation efforts might increase. The advantage of private input and output devices lies in the possibility to provide each player with individual abilities, views on the game world, or an asymmetric information distribution [5].

3 Social VR Game Case Study: Lunar Escape

As a case study, we designed the collocated multiplatform VR game *Lunar Escape*, using the design methods presented before. In this collaborative game, one player wears an *Oculus Rift DK2*, while two others play on tablet PCs. Verbal communication between all players is essential to achieve the goal. The players have to find all parts of their broken space ship on a foreign planet to fix it.

3.1 Player Roles and Game Mechanics

Lunar Escape is playable with three active players. Each player has to choose a distinct role, which is associated with unique abilities, tasks, and perspectives on the game world, as well as a certain input and output device.

Mech-Operator. The Mech is a robot remotely controlled by the VR player by using a *Razer Hydra* motion and orientation detection game controller. This special controller was integrated to provide a natural and intuitive VR interface and to support the game's futuristic theme. Any movement of the player's arms is mapped to the arms of the Mech (Figure 1). The Mech is armed with shields and different weapons to defend against enemies. It can carry things and use a tool to repair the shipwreck. The Mech-Operator is not able to change weapons or tools

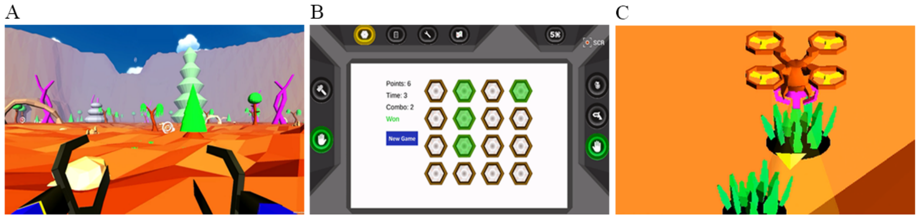

Fig. 1. ***(A)*** View of the Mech-Operator with tools for carrying things selected. ***(B)*** The Copilot interacts with a GUI on a tablet PC to gain energy from minerals. ***(C)*** The scout views the drone he's steering and has to collect the green minerals.

on her own. Therefore, she has to communicate with the Copilot. Additionally, shields, walking, and firing needs energy, which has to be produced and managed by the Copilot. The Mech-Operator's main objective is to find and collect all the wreckage to repair the space ship. The player has no other information about the game state (i.e. energy status, navigational information).

Copilot. The Copilot manages the internal systems of the Mech using a tablet PC. He is not able to interact with the virtual world directly. However, the Copilot has the most information about the current game state, such as energy and ammunition level, available Scout drones, as well as a minimap of the virtual world, which is updated with new information gathered by the Scout. The player has to provide necessary information to her teammates by direct communication. A major task of the Copilot is to select the weapons or tools as called by the Mech-Operator. Further, the Copilot has to gain energy from minerals for the Mech to walk and shoot, or for repairs. To do this, she has to repeat increasingly difficult visual patterns displayed on the tablet PC in time (Figure 1).

Scout. The Scout steers an unmanned reconnaissance drone to discover the planet. The player uses a tablet PC as input and output device and has an isometric view on the drone and the world below (Figure 1). The drone is controlled by tilting the tablet, e.g. by tilting the tablet PC forward, the drone moves in the same direction. The player can use a grappler to collect minerals from the ground. In addition, the Scout can launch fireworks to distract enemies from itself or the Mech. Further, the Scout has to explore and discover the planet in search of the lost wreckage and enemy hordes. As soon as the Scout spotted a part of the ship, the position is shown on the Copilot's minimap.

4 Conclusion

With the design of the social multi-platform VR game *Lunar Escape*, we have proven our design approach to include social interaction in the real and the virtual world as an intrinsic game design feature. Playtest sessions were characterized by vivid game-related communication and deeply focused, engaged play. We assume that the players experienced high levels of immersion and social presence and an overall positive shared VRGX. Encouraged by these results, we believe that the expansion of the game space allows designers to create compelling VR games that are social, immersive, and fun.

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