The Woods: A Mixed-Reality Multiplayer Cooperative Game

Kyoung Swearingen(✉) and Scott Swearingen(✉)

The Ohio State University, Columbus, OH 43210, USA
{swearingen.75,swearingen.16}@osu.edu

Abstract. While loneliness in our real lives is increasingly recognized as having dire physical, mental and emotional consequences, cooperative games have also been shown to build empathy and provide positive social impact. In this paper, we present 'The Woods', a local cooperative mixed reality game that provides players with face-to-face interactions in pursuit of a shared goal using augmented reality and 4-channel audio spatialization panning. This paper discusses the technical aspects of the game, the design rationale and development process, and the resulting player experience. The goal of this research is to develop a narrative driven AR game that provides social benefits by prompting players to problem-solve collaboratively, and to leverage the physical and digital experience as fully as possible.

Keywords: Collaborative gaming · Mixed reality · Sonic experience

1 Introduction

'*The Woods*' is a mixed-reality multiplayer cooperative game that addresses the perils of social isolation by promoting connections between people and actively engaging them through play. Using Augmented Reality (AR) and 4-channel audio spatialization panning, players choreograph their movement in real-world space, while interacting with birds, clouds and other objects in virtual space. In pursuit of a shared goal, players experience an immersive sonic narrative of rumbling storm clouds and disconnected voices that culminate in stories of hope and reconciliation. '*The Woods*' provides positive social impact by illuminating our connections to one another and inspiring us to respond through collaboration [1, 2].

Since the 1980's the percentage of American adults who say they're lonely has doubled from 20% to 40%. Research has also indicated that an increase in mobile phone use and online networking (in contrast to face-to-face interactions) in general has had a negative impact on children's health, citing screen time, "phone addiction" and lack of physical activities as potential health-related challenges. These same challenges can be detrimental to a young person's mental and social wellbeing, lead to isolation and depression, cyberbullying, and even contribute to increased suicide rates. While loneliness in our real lives is increasingly recognized as having dire physical, mental and emotional consequences, our goal is to examine through creative inquiry how the same

X. Fang (Ed.): HCII 2021, LNCS 12790, pp. 388–397, 2021.
https://doi.org/10.1007/978-3-030-77414-1_28

technology can be reimagined to strengthen connections between isolated populations through play and collaboration, and to create a dialog at the intersection of the arts, humanities, and human-centered technology [3–5].

'The Woods' was designed to inspire a discourse of contemporary life and explore how technology can cultivate presence and promote positive societal change within it. It is expressive, playful, collaborative and physical. It is designed for people and illuminates our connections to one another. It communicates the importance of fostering mental health through face-to-face engagement, the power of the human voice, and purposefully "combines the strengths of different people from different perspectives" as it examines how technology that is often criticized for inducing isolation can be reimagined to mitigate it (Fig. 1).

Fig. 1. Playing 'The Woods' at Urban Arts Space Gallery, Columbus, OH., USA

2 Narrative

The narrative of 'The Woods' is built upon broken relationships and the hope for their reconciliation. The first narrative follows two adult brothers who have been separated and out of contact with each other for several years. One of the brothers, desperate to reach out and reconcile with the other, is heard leaving a voicemail in an attempt to reconnect. In the beginning, players hear only fragments and distorted chunks of the message, unable to decipher meaning or intent. As the game progresses through player collaboration, the message becomes clearer. Ultimately, players hear the message in its entirety, revealing that although the two brothers haven't spoken in years, there is a palpable yearning to mend their severed ties.

The second narrative follows an aging mother reaching out to her child whom she has not connected with for some time. Similar to the brothers, she also left a voicemail

describing her own struggles grappling with an aging parent who had become cognitively disabled. Like the first narrative, this too unfolds as players make progress in the game, concluding with a plea for connection.

These two narratives of reconciliation between these estranged brothers and a mother and a child echoes loudly through the mechanics of the game itself, as the players coordinate their efforts with one another in pursuit of a common goal. The game is designed in a way that it is not enough for one player to do all the work, but rather success can only be achieved through the work of all the players. As players engage one another and contribute to the goal together, the game rewards them with the unfolding narrative of the brothers reconnecting with one another. Furthermore, even if players fail to find success during the game, the mechanics reinforce that they are still connected.

3 Mechanics

What makes 'The Woods' unique is how it enables players to physically collaborate with their whole bodies. Using AR markers and the Master-Client architecture of the Photon Unity Network (PUN), we track the positions of players through their smartphones as they move about the 12x12-foot game space. By tracking the positions of the phones, we connect the players to one another by placing a virtual branch at their mid-point. As players move themselves and their phones through physical space, the branch moves in virtual space. As such, players must choreograph their movement (and the branch by extension) to provide the virtual birds a perch to land on. To accomplish this, the game checks for collisions between the branch and two other virtual objects. If a collision occurs between the branch and a bird, the bird will land on it and a fragment of the aforementioned voicemail will play. By contrast, if a collision occurs between the branch and a storm cloud, a crash of thunder erupts and any birds that were caught scatter and fly away. The mechanics are designed to echo the narrative of the isolated brothers navigating their own obstacles to reconnect with one another.

Players begin by launching the game on their iPhones (assuming a server has already been established on a server located on the same network). Both players/clients must select 'START' to begin the game. See Fig. 2. After doing so, a short cut scene plays that provides the players with an 'in-game' tutorial in the form of an animation. The beginning of the animation shows four birds perching upon a branch. Through secondary movement, we see gusts of wind causing the birds to rebalance themselves so as not to fall off the branch. Dark clouds soon follow as the birds quickly scatter away from the approaching path of the impending storm. At this point, the animation stops, and the game begins.

Fig. 2. Three frames from the intro animation

The animation (in-game tutorial) is important in that it reveals a few key points about the game. First, it shows the goal, or the object of the game: to get the birds in flight back onto the branch. Second, this also reveals the total number of birds that the players must catch: four. Third, we learn that storm clouds are objects meant to be avoided. If not, any birds that happen to be perched will scatter again and the players will have to start once more from the beginning.

Once both players have entered the game, they find their phones attached to either end of an (AR) branch, connected to it by a tether. As players move their phones throughout the gaming environment, the branch responds in turn. In a way, you can think of each player manipulating one of the end points of the branch. This actually provides the players with a high degree of freedom in how they interact with the branch and one another in real-time.

A virtual (AR) bird is then spawned into the game and begins flying to random waypoints that it picks throughout the environment. We designed the experience to have only one bird at a time to let the players fully experience each voicemail message that plays after the bird perches on the branch. As the players choreograph their movement to manipulate the branch which serves as a perch for the spawned bird, the game also introduces a virtual (AR) cloud, a threat that randomly moves across the game space. The cloud serves as an obstacle that the players must avoid as they pursue their shared goal – collect all four birds. If the branch with birds on it intersects this virtual cloud, the phones will vibrate, and the birds will scatter and fly away. If there are no birds on the branch, the phone will simply vibrate. See Fig. 3.

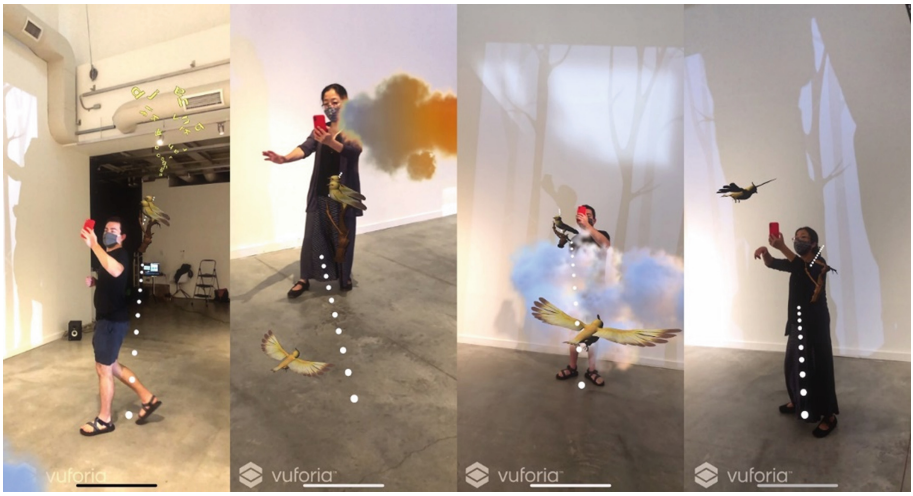

Fig. 3. In-game screenshots from both players' perspectives

4 Audio

While research has shown both physiological and emotional connections drawn through the power of the human voice, 'The Woods' employs it as a mechanism for expressing motivation and intention in its narrative. The immersive real-time audio of 'The Woods' is arrived at with 4-channel audio, using point-source spatialization and amplitude panning. We accomplish this with an embeddable version of the open-source graphical programming environment, Pure Data (PD), that we interface with Unity3D (our game engine). PD is installed on the computer where the server is located and is connected to speakers through an audio interface. We are using the MOTU M4. See Fig. 4 below.

Figure 4, shows main.pd, an array of sound controls created in Pure Data, that was designed to correspond to the mechanics to reflect and magnify the experience of the overall gameplay through sound. In main.pd, 'Tension' blocks indicate there are three levels of intensity to the sound and illustrates that as more birds are collected, the intensity increases. To the left there are levels for 'Birds', 'Ambience', 'Rain' and 'Background'. Their current low levels correspond to the low tension above. As a second and third bird land on the branch, Unity sends messages of these state changes to Pure Data which responds by increasing the tension. Increases in tension are reflected in the 'Birds', 'Ambience', 'Rain' and 'Background' as their volume and intensity are programmed to increase in response. As birds on the branch are lost during gameplay, the tension and the levels of the corresponding sounds also drop. 'Flapping' is played whenever the branch (with birds or without) penetrates a cloud and represents the birds taking flight. 'CLOUD' is also played whenever the branch penetrates a cloud but emits a clap of thunder instead. 'Melody' and 'Notes' play during the intro and ending animations that bookend the entire experience.

At the bottom of Fig. 4, there are controls for 'All speakers and master level' which enables anyone sitting at the server to set the levels for all of the speakers independently,

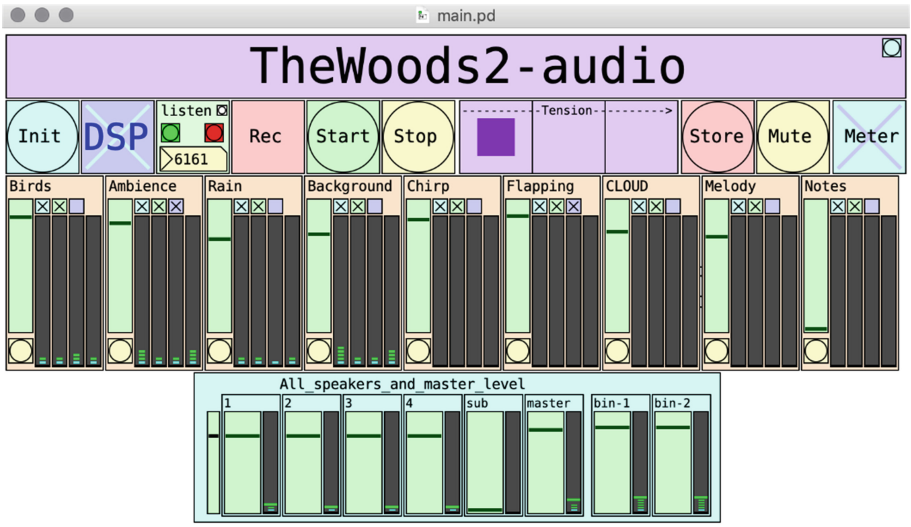

Fig. 4. Sound design using PD interface

in addition to a subwoofer (if connected). Using Pure Data in this way, in addition to all the individual controls above, allows our audio designer to have significantly more control over the experience, and the ability to fine-tune it in real-time on a per-user basis.

Our audio setup is designed to expand virtual space beyond the phone screen, making the storm clouds perceptible as sonic experiences as they drift by the players. As a metaphor, the storm clouds symbolize obstacles that make connecting with others difficult. In contrast to the global sounds of the storm, the voicemails (delivered by the birds after they have perched on the branch) is played only through the phones' speakers to provide a more intimate and private experience for the players.

While 'The Woods' speaks to concepts of isolation and loneliness in our own lives, the distinction made between global and local audio (i.e., the 4-speaker setup and the phones) motivated the creation of a juxtaposed sonic narrative for the players. The phone speakers provide a more intimate exchange simply by being a localized sonic experience compared to the 4-speaker surround sound setup. But it also takes the same device that the players are using to play the game and uses it as a multimodal device. In addition to expanding virtual space beyond the screen through the use of sound, our goal is also to encourage players to consider how the same technology that is so often criticized for isolating individuals can be reimagined to bring us closer together.

5 Benefits of Collaborative Play

The strength of cooperative games is that they promote social interaction and improve personal relationships by encouraging players to work together to achieve a common goal [9]. And while loneliness in our real lives is increasingly recognized as having dire physical, mental and emotional consequences, cooperative games have also been shown to build empathy and provide positive social impact [10].

Shared activities with peers provide players of all ages with opportunities to learn, practice, and develop their communicative, interactive, and social skills. Because working with a peer can motivate players to attempt difficult and intimidating problems and provide new knowledge about problems and problem-solving strategies by observing one another and imitating their actions. Additionally, cooperative problem solving allows players to discuss their perspectives on a problem, which often leads to conflict, negotiation, and co-construction [3–5].

Computer gaming has often been considered a social affair, and in recent years many video game titles have been accompanied by multiplayer modes to extend their lifecycles in the hands of the consumer. However, multiplayer modes on PC and console games are typically confined to onscreen interactions and lack any real physical collaboration. By contrast, the collaboration that exists in tabletop gaming promotes deep social interactions that stem from verbal communication, and face-to-face problem solving that amplify social connections between the players. *'The Woods'* was designed to provide players with a similar sense of community building and promote social connections with their partners as they accomplish a variety of tasks throughout the game as they collaborate with one another.

6 Benefits of Merging Digital and Physical Play

While the social aspects of traditional tabletop games render them interesting enough in their own right, the static nature of their physical media limits the scope of realizable games. Complimentarily, many claim that the drawback to traditional computer games is the lack of social interaction in a face-to-face setting, which tabletop games provide. Therefore, it is only a natural evolution to combine the benefits of computer and tabletop games to provide new and engaging gaming experiences [6].

Physical play offers many opportunities to enhance and stimulate face-to-face interactions and promote active lifestyles that can benefit everyone's quality of life. The innovative mechanics of pervasive games (games that mix the real and virtual worlds) can further motivate its players, both young and old, to increase their levels of social interaction and physical activity. While there are several definitions of pervasive games, in general, their mechanics (or rules) blur aspects of the real world with the 'world of the game'. As an example, since the Global Positioning System (GPS) became available for public use in 2000, many pervasive games have incorporated physical location into their mechanics. 'Pokémon Go!' being one of the most popular [7, 8]. For '*The Woods*', it is the physical, collaborative and inclusive affordances of analog games existing in the real world that has inspired it in so many ways.

7 Comparison to Other Cooperative AR Games

The benefits of pervasive games (and especially cooperative ones) are far-reaching as they anchor themselves to physicality, mobility and social interaction. Despite all of its successes, 'Pokémon Go!'s greatest critique was how it suffered from its lack of social interaction, forcing its developer, Niantic, to release a multiplayer version which unfortunately did little to stimulate social interaction between players in the real world – it's most valuable asset! 'The Woods', on the other hand, cannot be played without a real-life partner to choreograph your moves with in-person, and most definitely cannot be won without collaborating with them.

What makes 'The Woods' unique as a cooperative AR game is that it promotes face-to-face interactions over screen-based interactions. While games like 'Codename Neon' and the more recent 'Secret Oops!' have helped to redefine AR games as physical experiences, interactions with other players are still primarily on-screen.

Other games like 'Swift Shot' and 'Real Tag' do support team dynamics, but at the same time lack any narrative component that would otherwise expand Huizinga's 'magic circle' and create space for more meaningful social interactions [11]. By contrast, 'The Woods' was designed as an examination of human connectivity through the lens of contemporary technology. It doesn't come with a non-AR mode, and cannot be played alone. It requires a real, physical coordinated effort between its players which echoes loudly throughout its narrative of reconciliation.

8 Conclusion

The strength of cooperative games is that they promote social interaction, build empathy and improve personal relationships by encouraging players to work together to achieve a common goal. '*The Woods*' further expands upon this by promoting real-world physical interactions over screen-based interactions that are made possible through our unique design of AR and audio spatialization. Much of what inspired the digital/analog play that we see in 'The Woods' were observations made of more traditional tabletop and physical games in general. In addition to the affordances of their physical characteristics and the benefits of having real face-to-face interactions with others, there is also an inclusive quality to analog games that is defined by the 'table' that they are played around, and its timeless ability of binding those seated around it in a shared, group activity. By highlighting the importance of physical interaction told through a digital narrative, our goal is to provide positive social impact by illuminating our connections to one another and provoking us to respond through collaboration (Fig. 5 and 6).

Fig. 5. Players collaborating with one another in-game

Fig. 6. POV of a player in-game

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