
Keyewai: Looking at Cooperation in a Holographic Projection Screen

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Abstract

Keyewai: Last Meal is an innovative two-player computer game for a holographic projection screen, using eye gaze and gamepad controllers as input. We explore the affordances given by our interaction setup by creating game mechanics (like controllable transparency and reversed instructions) that foster cooperation between players. This multi-modal co-located interaction scheme allows for a novel playing experience with face-to-face social interaction, allowing players to communicate with facial expressions and body movement to create a more immersive interaction environment.

Introduction

Eye tracking provides the opportunity to track the gaze of a user and has been mostly used in research context as a tool for providing insights of users' viewing behaviors. In the field of Human-Computer Interaction (HCI), eye tracking research has explored new interaction techniques, user experiences (UX) and usability insights, both in traditional and non-traditional environments [8,10]. However, its application to the field of gaming, more specifically, to Player-Computer Interaction (PCI) has been limited due to the availability and pricing of eye trackers. Advances in technology have allowed the commercialization of eye trackers and subsequently, an increase in research for gaze base interactions, predominantly research using a



Figure 1. Holographic projection screen with face-to-face social interaction.

single eye-tracking device. *Keyewai: Last Meal* is a novel interface mixing multiple eye trackers with a holographic projection screen, to form an immersive cooperation experience.

Related Works

Dorr et al. [3] created a paddle game controlled through eye gaze and an iteration with traditional controllers; comparing both prototypes, eye trackers improved player performance therefore accentuating the functionality of eye trackers in gaming. This game, as many others, explores the gaze point as their only input source. Other games explore more complex mechanics, allowing users to explore multi-modal [5] and eyes-only [1] navigation in virtual environments or to adapt the storyline to user's attention [6].

Transparent holographic screens are an emerging technology and there is little research on how they can be applied to real world situations. Heo et al. [4] explored properties and design guidelines in such installations while Chen et al. [2] used an identical installation setup (with multiple eye trackers) to explore the concept of tunnel vision in relationships and as a proof of concept for the setup itself.

Installation

For eye tracking, we used two Eye Tribe eye trackers [7], the smallest eye tracker available in the marketplace and released in 2013. The Eye Tribe device consists of one infrared (IR) camera and two IR light sources (located on each side of the camera). The IR light causes the pupil to appear in the IR camera as a

well-defined dark circle with two glints (reflection of IR light). By tracking the relative locations of the pupil and glints, previously calibrated based on known positions, the gaze can be accurately determined in real time.

For the projection surface (Figure 1), we used a freestanding projection screen, built using an aluminum, acrylic and 3M CLEAR transparent projection film. On each side of the projection screen, we set up an Eye Tribe (with tripod). Both Eye Tribes are connected to the same machine (Intel Core i5-2400 CPU @ 3.10 GHz, 4.00 GB RAM, running Windows 7), with the Eye Tribe servers in two USB 3.0 ports. To avoid that players are blinded by the projector light reflection, the projector - connected to the previous machine - is placed diagonally to the projection surface (Figure 1).

Two gamepad controllers were connected to the machine running the software and were placed on each side of the transparent surface. The game itself was built in the Unity game engine [9] and uses runtime projection mapping for size control of the projected image.

Design and Development

Keyewai: Last Meal was designed to explore the concept of cooperation in our unusual installation setup. The fact that users are playing front to front, unlike most games where players are side by side, inspired us to explore game mechanics involving communication, social interaction and cooperation, allowing players to share facial expressions and body movement.



Figure 2. Gaze is used to reduce the transparency of the screen and illuminate the virtual environment.

In the game, two players assume the role of a couple that survived a plane crash on a remote island. The couple explores the Island in search of radio pieces so they can assemble a radio, contact the outside world and get rescued while looking out for cannibals that roam the Island. The players can move their avatar through the gamepad controller. Each avatar has a flashlight that is controlled by the gaze position in relation to the avatar position. The holographic projection has controllable transparency depending on the graphical content (dark areas will appear transparent in the projection and bright areas will not); the flashlight allows you to see the surroundings in the direction you are looking at (Figure 2). The player has a limited vision of the world and there is a clear visual representation of your intentions (you only see the world in the direction you want to see).



Figure 3. Text elements are inverted to identify players and to promote cooperation in the dual-sided screen.

The game was developed in several iterations over a 5-week period. We ran several playtests throughout the development, with and without our installation setup. The first set of playtests, with only gamepad control input, was done to explore how players interacted with each other and the environment and the feedback acquired was incorporated into the game design. Several eye gaze game mechanics (e.g. players looked at their partner or at their avatar and were rewarded accordingly) were explored and tested in order to determine if they increased social interaction.

Mechanics

Scattered around the Island, cannibals patrol in search of the survivors. If a player shines his light on a cannibal, it is attracted to the player and pursues him. The only way to stop this chase is for both players to look at the cannibal at the same time (confusing it with

multiple light sources). This routine allows player to cooperate and depend on each other for survival. Players can also avoid being chased by closing their eyes, literally playing blind. In this situation, they have to depend on their partner to give them the correct directions to avoid the cannibal. Having the avatars stand closely is rewarded in the game by offering a higher level of security against cannibal attacks, while having them separated allows a better view of the world thanks to an adjustable camera zoom.

Given the transparent nature of the projection screen, text representation in the interface is problematic as only one person can easily read the text. Throughout the tutorial, we use this to our advantage by creating a cooperation spirit in the players; portions of instructions are reversed and to be understandable, players have to read them together (Figure 3). Throughout the game, we kept text elements to a minimum, relying on visual interfaces whenever possible. If text elements are necessary, these are inverted so that the corresponding player can read it.

Future Work

This novel interface is a flexible input setup and could be used for entertainment and non-entertainment goals. As it relates to this work, more playtests need to be done to evaluate the effectiveness of communication in the achievement of game goals, as well as changes in the relationship of players. Future work involves exploring new game mechanics afforded by our installation setup, namely abandoning traditional controllers and depending solely on eye gaze as input.

Conclusion

In the final set of playtests, 21 players tested the game and responded to an anonymous questionnaire.

Overall, the reaction was positive and the use of eye trackers was one of the most enjoyable aspects for players, who liked the power afforded by controlling gameplay through their eyes ("It was the first time using an eye tracker and it was really fun."). Another well-received feature of the game was cooperation between players (10 players named it a satisfying aspect of the game). When probed for examples of how they interacted in the game, players identified attacking cannibals, sharing items and communication (verbal and visual) when deciding their route. A observed factor that greatly influences cooperation is familiarity between players; those that knew each other were more verbal, willing to share items and more protective of each other; estranged players had difficulty navigating because they did not discuss their path. These results suggest that the game mechanics used were suitable if the players showed initiative to start cooperating.

"Keyewai: Last Meal" contributes to the field of Human-Computer Interaction, by exploring game mechanics in a face-to-face interface and how eye gaze can be used in such interfaces to promote cooperation and social interaction.

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