Wallet Games

Minxin, Ehud Sharlin
Interactions Laboratory, Department of Computer Science, University of Calgary
2500 University Drive NW, Calgary, Alberta, Canada, T2N 1N4; Phone: +1.403.210.9404
{xinm, ehud}@cpsc.ucalgary.ca

1. INTRODUCTION

Mobile games have become increasingly popular with the advancement of cell phones, portable computing devices and mobile gaming consoles such as the Nintendo DS and the Sony PlayStation Portable. However, one of the principal bottlenecks in mobile game design is the lack of display space and interface real estate. Navigating a rich and vast game environment on a limited display window often requires zooming and scrolling which can be cumbersome especially if the interface that supports them is unintuitive. Graphically-simple games with static overviews for the game environment can avoid these technical challenges but often at the cost of less immersive game play. Therefore, if the limitations of the small display area can be overcome with an intuitive navigation interface without sacrificing portability, immersive games involving rich and vast game environments can be more readily transferred onto mobile gaming platforms.

When we observe an environment in the physical world, zooming and scrolling are naturally achieved as simple movements of our head, our gaze, or the environment itself. Searching visually on a physical map is more efficient than on a digital map as we can easily control the speed and direction of the search by simple movements of our gaze or by moving the physical map. To achieve such natural interaction for mobile games, we propose a method for intuitive navigation of virtual game environments displayed within the physical environment using mixed reality. Our Wallet Games are played on a sheet of paper which can be easily folded into a pocket or a wallet and serves as a portable mixed reality game board for mobile games. With physical markers printed on the paper, the virtual game environment can be visually superimposed on top, giving it a direct reference in the physical environment. Then using handheld computing platforms such as camera phones, PDAs, tablet PCs, or mobile gaming consoles with cameras, players can easily navigate and interact within the virtual game environment anchored on top of the portable physical game board (Figure 1). The mobile handheld device essentially becomes a magic window through which players can visualize virtual game environments and entities displayed within the physical environment, and with touch screen capabilities, players can simply tap on game entities seen on the screen to manipulate and interact with them. This concept utilizes mixed reality to take advantage of the benefits of both regular physical board games and videogames. By placing the virtual videogame within the context of the physical environment, navigation and interaction are simplified while the rich graphics, animations, and game play are retained.

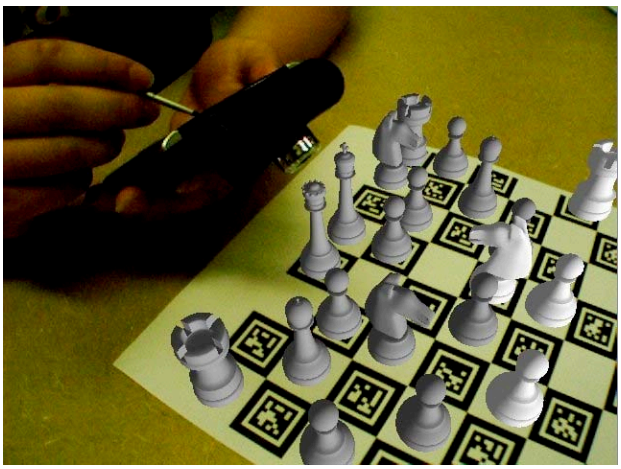

Figure 1. A wallet 3D chess game

2. RELATED WORK

Mixed reality as a visualization technique has many advantages. By allowing the superimposition of virtual entities in the physical environment, direct context is established for the virtual entities which allow players to perceive and interact with them more intuitively. Traditionally, mixed reality requires obtrusive and expensive equipment such as head-mounted displays or large handheld goggles attached to heavy computers and tracking apparatuses. Projects such as The Human Pacman [1] use mixed reality for large scale outdoor gaming but often require heavy equipment and tedious administration. Although entertaining, such an involved outdoor mixed reality game is still not practical for mobile gaming. However, with the increasing processing power of portable devices, camera phones and PDAs equipped with cameras are becoming inexpensive and practical platforms for handheld mixed reality, making it a promising technology for mobile games. The Invisible Train Project [2] uses a physical toy train track with surrounding markers to create a collaborative mixed reality experience where players attempt to prevent virtual trains from crashing on the physical train track. PDAs with cameras are used as standalone mixed reality devices from which the players can view the trains and control their speed by tapping on buttons onscreen. Navigation is natural as players simply move around the track and point their PDAs in corresponding directions. Collocated players can also readily collaborate within the shared physical environment which is another advantage of mixed reality games. However, although the track setup is elaborate, it is not portable. We propose extending the technique of handheld mixed reality and its advantages for mobile games to provide intuitive navigation, natural interaction, and collaborative game support without sacrificing portability.

3. SYSTEM

The following describes the implementation of Wallet Games, mobile 3D board games played with virtual game pieces on a physical paper game board, demonstrating the practical usage and advantages of mixed reality for mobile games. We chose to implement checkerboard-based games as our initial prototypes because of their simplicity and inherent need for a gaming environment. Strategy and role playing games like *WARCRAFT* and *FINAL FANTASY* have more complex gaming environments which we believe can also be implemented using our Wallet Games approach and further demonstrate the advantages of using mixed reality for mobile games.

Our first Wallet Game implementation uses a standard 8.5" X 11" sheet of paper with 32 small printed markers laid out in a checkerboard fashion (Figure 1) as the portable game board. This board can be easily printed, folded up and transported in a wallet or a pocket. The markers are from the mixed reality software library ARToolKitPlus [3] which are used for tracking and providing the correct transformation to translate and orient the virtual entities in the corresponding physical space. For the checkerboard-based games we present here, all virtual game pieces are placed on the planar physical game board, but with the correct transformation established, game entities can be placed almost anywhere in the 3D environment relative to the portable game board. The location, size, and number of the printed markers can be optimized to match varying game board sizes, viewing distances, and tracking stability.

Our mixed reality display is currently implemented using a tablet PC equipped with a camera which runs the game application and can be operated with two hands. However, our short term goal is to implement the game using a lightweight PDA equipped with a camera, allowing players to easily navigate the board by simply moving the PDA with one hand. Aside from the weight difference, the current prototype display is similar enough to the target PDA platform to demonstrate the concept.

Using the portable paper game board and looking through the portable display (Figure 1), players can visualize the virtual game pieces positioned on top of the physical game board. To control the view of this mixed physical and virtual game environment players can simply move the portable display around the paper game board or move the paper game board itself. This allows the players to freely observe the 3D game environment in any viewpoint desired. They can examine a detailed view of a particular area of the board or game pieces, or they can have an overview of the board with less detail; transitioning between any viewpoints is fast and intuitive as players perform these with natural physical movements of the board or the PDA.

Since in our current implementation all the virtual game pieces are planar to the paper game board, moving these pieces is intuitive as well. Using the stylus and the touch screen of the tablet PC, 2D cursor positions can be inverse projected into 3D positions relative to the transformation established by the markers. With the stylus and cursor, selection as well as drag and drop operations are implemented to allow players to simply click on a virtual game piece they see on the screen and drag it to the desired location on the physical paper game board. This direct "click where you want to go" interaction technique is simple and intuitive for 3D navigation even with perspective views of the game board.

When players decide to stop playing the game, they can simply fold up the paper game board and store it in their wallet or pocket. The state of the game is automatically saved, and the next time the game board is unfolded, the last game resumes with its previous configuration.

4. DISCUSSION

The presented techniques and concepts attempt to address some of the technical challenges of designing mobile games. Using a portable mixed reality marker along with a practical handheld computing device, we can intuitively navigate virtual game environments and directly interact with virtual game entities. The concept of our simple checkerboard-based games can extend to complex games like *WARCRAFT* where the transition is even more natural since strategy games originate from regular physical board games like Risk. Further, the actual paper game board with its markers can be physically textured and decorated to match the game being played. For example, there can be a set of different game boards, each decorated as a different *WARCRAFT* map. There is also flexibility in the mixed reality methodology: if a totally immersive virtual environment is required, the mixed reality device can only render the virtual environment, and the portable marker becomes an intuitive input device. However, mixing the virtual environment with the physical environment has the advantage of collocated collaboration. For example, two players sitting together playing a strategy game can naturally communicate with each other and manipulate virtual game entities simultaneously as they are having a discussion.

5. CONCLUSION

We presented a novel concept for designing mobile games. Using mixed reality, we are able to develop intuitive interaction techniques for navigating virtual game environments and interacting with virtual game entities. These techniques can be implemented inexpensively and deployed on practical portable platforms. Following our approach games restricted by small displays and limited interfaces can be more easily transferred to mobile gaming platforms, and new games taking advantage of the physical environment and potential for collocated collaboration can be developed.

6. REFERENCES

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