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# Herding Nerds on Your Table: NerdHerder, a Mobile Augmented Reality Game

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**Abstract**

In this paper, we introduce *NerdHerder*, a mobile game with an augmented reality interface. The game's premise is that you are hired as an IT manager, and your job is to use "management skills" to get the nerd employees back to work in their cubicles. The core game mechanic relies on the physical position and movement of the handheld device in relation to the physical-digital game world. *NerdHerder* creatively integrates puzzle-solving and motion-based action with a mobile Augmented Reality interface. This paper introduces the system implementation, design process and design rationales of the game. More information about the game can be found on [www.MicroNerd.net](http://www.MicroNerd.net).

**Keywords**

Augmented Reality; Physical Interface; Player experience; Design; Mobile game.

**ACM Classification Keywords**

K.8 [Personal computing]: Games.

**General Terms**

Design, Human Factors.

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## Introduction

A current trend in the game industry, exemplified by the success of *Nintendo Wii* [8] and *Microsoft Kinect* [5], is towards game interfaces that bridge the physical and digital divide by incorporating natural and intuitive physical/social interactions. Handheld Augmented Reality (HAR) interfaces, where the computer-generated content is registered with the player's view of the physical world in real time, put such capabilities into users' pockets [15]. Although HAR games do not currently have a large share of the market, Augmented Reality (AR) gaming is beginning to gain popularity with commercial consoles such as *Sony PSP* [13] and *Nintendo's 3DS* [7] supporting HAR interactions.

However, there are also skeptical voices, questioning whether AR is another gimmick exploited for marketing purposes, or if it truly creates novel and engaging gameplay. Some existing AR games (e.g., *the Eye of Judgment* [13]) inspired by traditional games (e.g., board/card games) were critiqued for not meaningfully leveraging AR. In *Eye of Judgment*, computer graphics render the game characters and animations when the cards are placed. But the game itself can be played without the complicated digital setup that includes a camera, a grid mat, and a PlayStation3.

This question of "why AR?" is a valid concern, and we have been asking ourselves that question for many years, leading up to and during the process of designing and iterating on *NerdHerder*, a mobile augmented reality game that leverages player position and movement around a tabletop game board. The goal of the game is to explore the relatively unexamined connection between interactive technologies, game design, and new types of play experiences.

*NerdHerder* creatively combines the genre of puzzle games with a mobile AR interface that tightly integrates the game world with player interactions in the physical world, a combination which has rarely been explored before. Previous AR games have focused on real-time actions, of which the most popular kind is point-and-shoot [4] [7] [10]. This research contributes to the diversity of game mechanics designed with the affordances and constraints of mobile AR in mind.

## Related Work

### *Mobile AR Games in Research*

Since researchers began experimenting with AR experiences on handheld devices (e.g., *Invisible Train* in 2004 [14]), mobile AR games have been designed and developed to test research hypothesis and advance the understanding of how mobile AR interfaces can be used in collaborative and competitive scenarios. In 2005, Henrysson et al. conducted a study on a mobile AR Table Tennis game to understand the role of face-to-face collaboration enabled by mobile AR interface [1]. The AR research community has studied a variety of topics through mobile AR games, including spatial navigation [6], social presence [16], tangible objects [2], and inter-personal distance [11].

In our design of *NerdHerder*, the research motivating our game design is the concept of distance in hybrid (physical, digital, and social) space, especially in natural settings of players. Compared to the existing studies conducted in lab environments with researchers' supervision, we plan to push the envelope further by releasing our game to the public to understand how mobile AR games are played in the wild. To make sure that the game itself is interesting and learnable, we have carefully designed tutorials,

balanced levels and polished the user interface in preparation for the release.

#### Commercial AR Games

The first AR commercial game title, *the Eye of Judgment*, was launched on PlayStation3 by Sony Computer Entertainment in 2008. More recent mobile AR games, such as *Invizimals* (2009), *EyePet* (PSP version, 2010), and *Nintendo 3DS AR games* (2011) show the increase of interest in mobile AR interfaces from these leading game companies. Indie game developers have also created dozens of AR games, as summarized in [12]. Although AR has shown great promise in bringing in new gameplay, the vast majority of existing AR-based mechanics in these games are action-based, of which the most popular kind is “point-and-shoot”. We believe that AR has more potential than providing a virtual cursor in the physical world. *NerdHerder* is one of our experiments to explore the diversity of game mechanics with mobile AR interfaces. With the fast growth of smart phones and camera-based interfaces, we believe that mobile AR games are at the point of reaching a large audience.

Notice that there are also a large number of GPS based mobile AR games in the market now. However, this paper focuses on AR technologies that involve real-time tight registration between digital and physical objects, which can only be achieved using computer vision techniques.

#### NerdHerder

*Nerdherder* is a mobile AR game that takes advantage of the player’s physical presence in the hybrid game world. The player takes on the role of a newly hired IT manager, aka “nerdherder”, at the technology firm

MicroNerds. Using various nerdherding techniques, the player will learn to guide reluctant nerds back to their work space. The game levels involve both puzzle-solving and motion-based actions. We present the player with new high-level challenges to overcome as they manage their nerds on the lower level. The player must lead nerds away from distractions such as junk food and attractive secretaries, while also avoiding angry upper managers.

*Nerdherder* was developed using the Unity game engine combined with Qualcomm’s Augmented Reality SDK Unity plugin<sup>1</sup>. The game runs on android phones equipped with 1GHz snapdragon processors or better. It can also be deployed on newer iOS devices such as the iPhone 4S or the iPad2.

#### Process

*NerdHerder* has evolved from a class project, and gone through multiple iterations with frequent playtesting, over almost two years. The initial inspiration was to design a shoe-box-like environment that players can peek into and affect small living creatures.

#### Searching for Intuitive and Satisfying Interactions

The physical actions supported by a mobile AR interface are the basis for the core game mechanics. Through significant iteration and playtesting, we found the following two criteria are critical for physical action based games: 1) natural mapping between players’ physical movements and the responses that game characters and environment give; 2) continuously satisfying play. This second point turns out to be critical: because the core game mechanics exist

<sup>1</sup> <http://www.qualcomm.com/ar>



**Figure 1.** Game UI in *NerdHerder* (Iteration3, with fishing rod mechanic)

throughout the game, and physical actions can be tiring, it is critical to make sure the ongoing activities of the player are satisfying rather than repetitive or tedious. To achieve these goals, we evolved three different game mechanics.



**Figure 2:** NerdHerder iteration 1 (with push-and-pull mechanic)



**Figure 3:** NerdHerder iteration 2 (with the holodeck characters teleporting)

The first game mechanic we developed is a push-and-pull, directly using the camera position in relation to the game character (Figure 2). This interaction, referred to as “Hands-on Management style”, requires players to get within a certain distance to the game character to affect them. This mechanic was designed to encourage players to physically move around the board, and also move closer or further from the game board. However, we discovered two problems from playtesting. First, players do not know what to do when they first see the game (*gulf of execution* [9]). For example, players do not know that they need to get close enough to influence the Nerd characters. Second, this interaction becomes tedious because players tend to stay close to the board all the time and forget to draw back and get a bigger picture to solve the puzzles (and enjoy the aesthetics of the experience). While the first problem can be overcome through tutorials, the second problem is inherent in the mechanic: by allowing the player to affect the Nerds from further away, the player loses the ability to meaningfully control them.

The second technique we have tried is the “remote hologram” concept, where the player controls an imaginary hologram of the boss that is teleported into the office world by aiming at the game board and launching actions (Figure 3). This mechanic, referred to as “Art of Delegation”, allows players to precisely control the position of hologram characters. We found the following problems through playtesting. First,

players stop moving around in the physical world, and assume a viewpoint that allows them to see and control the entire game board. There is no motivation for them to move around the board. Second, this interaction is not particularly innovative: in practice, it feels very similar to the point-and-shoot mechanic that has been implemented in many existing mobile AR games.

To solve the above problems, we created a third mechanic: a virtual fishing rod. By attaching a fishing pole to the camera, we allow players to repel or attract the players depending on the objects they use on the hook (Figure 1). This mechanic, referred to as “Carrot-and-Stick”, leverages physical movements by hovering on top of the game board. It solves the problem of players not knowing what to do by rendering the player’s real-time position in relation to the board by the fishing rod and the shadow it projects. It also requires players to move around the board rather than simply tilting their device. We have submitted seven game levels designed for this mechanic.

#### *Novice vs. Expert Users*

We have demonstrated different versions of the game repeatedly over the past two years, most recently to over 50 users at the International Symposium of Mixed and Augmented Reality (ISMAR’11) and at Georgia Tech’s Future Media 2011. During the demos, we encouraged players to experiment with the game and observed differences between novice and expert AR interface users, as well as people who consider themselves as gamers and non-games.

Novice AR interface users tend to hold the device still and sometimes even get stiff. They are more comfortable using existing interaction conventions on

mobile phones, such as touch screen. In the submission, we include a tutorial for players unfamiliar with AR interfaces. When testing with users who consider themselves gamers, sometimes their expectations do not work to our advantage. For example, one user did not understand the concept of “the player is the controller”, but instead believed that the characters (nerds) were his avatar(s). To solve this problem, we also provide tutorials that scaffold the learning of AR-based game mechanics. These tutorials were designed through a combination of usability inspection methods and storyboarding used in discussions with Augmented Reality experts, as well as analysis of game testers.

### **Design Rationales**

#### *Physical Presence in the Digital Game World*

In *NerdHerder*, we create game mechanics that reinforce the feeling that players are part of the game world. With the constant representation of the fishing rod as part of the game UI, players receive visual and visceral feedback when their physical movements are reflected on the fishing line, consequently influencing game characters. The fishing line and lure are dangling from the fishing rod, giving players imprecise control. This control is a fun challenge on its own [3] and ties itself with the real-world physics of how a fishing line is expected to work.

We also realize a unique opportunity that the mobile AR interface provides—combining first-person and third-person presence conventions. With the top-down view encouraged by the trackable boards placed on a table surface, we allow players to act as a “god” in the game. At the same time, players are part of the game; their movement is directly mapped to the change of game

state, which is a first-person game convention. The persistent fishing rod is also a reminder of the first-person presence. By leveraging mobile AR interfaces, we seamlessly integrate first-person and third-person presence in the game.

#### *Combining Puzzles Elements and Physical Actions*

In *NerdHerder*, we combine puzzles with physical actions. The two genres of game play are synthesized in a hybrid physical-digital game space that requires different cognitive skills. To solve the puzzles, players need to closely observe the whole game world, plan ahead, and often use trial-and-error strategies. But this is not enough; players also need to be able to turn thoughts into physical actions, they need to keep their hands stable while the clock is ticking, understand the importance of combining high level views with low-level interactions. Timing is also critical for getting through the levels. By demanding players’ cognitive resources, such as attention, planning, and reflexes, we believe that *NerdHerder* creates an engaging adventure in a mundane office environment.

#### *Embodied Metaphors*

Learning a new game with a new interface is challenging. Due to the fact that AR games are still new to many players, the conventions of this medium have not been well established. We believe that embodied metaphors are one effective way to solve this problem. Besides the tutorials we designed for novice AR players, we also use embodied metaphors to guide players’ actions by suggesting that the handheld device functions as a familiar object from everyday life. The metaphors, such as the “fishing rod” (“carrot-and-stick” management skills) not only make sense of the game mechanics within the game theme, but also create a

mental reminder to the actions available and upcoming responses. This metaphor also matches to the practical constraints of the AR interface, in which fast physical movements may cause the computer-vision based tracking to break. The delay effect from the fishing rod motion to the fishing line reaction slows down the player naturally, maintaining the smoothness of the gameplay.

### Summary

*NerdHerder* is a fun, casual mobile AR game in which players solve puzzles by physically moving around and strategically placing their characters. This game contributes to the design and development community of mobile AR games by providing more diversity to the game control mechanics. We also refined our design to support both novice and expert AR players.

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