

Designing Collaborative Games on Handheld Computers

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1 Introduction

The availability of handheld computers with wireless networking, such as Pocket PCs, makes it possible to create new types of interactive games that simply could not be done on stationary PCs. For instance, what if in the middle of a game of PacMan your game character had to move to the screen of *another player's device* to successfully complete the game?!

Although gaming devices such as the *Cybiko* and Nintendo's *Gameboy* allow for competitive play via radio link or cable, there has not yet been a single commercial game released for handheld computers that can be played synchronously by two or more players over a wireless network connection. In a university course, we let students create networked games for handheld computers. Their brief was to design games where it would be necessary to collaborate to win. For instance, one game explored the possibility of combining the displays of handheld computers to form a larger play area, while another assigned each player a specific role, so that the players have to coordinate their actions to succeed.

2 Two Collaborative Games

PacMan Must Die (Figure 1) is a game for two or more players. In a reversal of the classic arcade-game *PacMan*, each player controls a ghost trying to re-capture the dots stolen by PacMan in an earlier adventure. To win the game, the player must collect all the dots matching the color of his or her ghost. But some of these dots are positioned on the displays of other players' devices! The player can enter another person's handheld computers by using doors at the edges of the map. When a player has entered the display of another computer she of course has to look at the other user's display to control her ghost. There are risks involved in entering the display of another player – for instance, the other person might run away! (see Figure 2) To be successful, a player should make sure to enter the display of another user's handheld only if the other player is prepared to collaborate – perhaps by in turn entering the display of the first player's device.

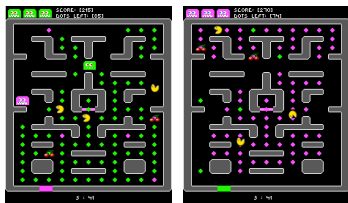


Figure 1. *PacMan Must Die* runs on two or more displays simultaneously.

Earth Defenders (Figure 3) is played with two to five players. The goal of the game is to defend the earth from an alien invasion. Each player in the game is given a unique role: Combat Strategy, Star Fighter (two players), Orbital Defense, and Opposition

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Figure 2. A player running away with another player's ghost, in a session of *PacMan Must Die*.

Commander. Each of these roles involves different responsibilities and limitations. For instance, Combat Strategy cannot engage the enemy by herself, but must coordinate player 2-4 by notifying them where and when to engage the enemy. The Orbital Defense player cannot move her unit, and will have to request support from other players when necessary. The Opposition Commander plays a different role: the enemy, who can position new enemy ships at regular intervals on the map. The players defending Earth must continuously discuss their plans and give verbal commands to each other – but they must be cautious not to let the player controlling the enemy forces listen in and get an unfair advantage!



Figure 3. *Earth Defenders*: (a) Combat Strategy, (b) Star Fighter, (c) Orbital Defense, and (d) Opposition Commander.

3 Implementation and Evaluation

These two games were implemented by five M. Sc. students during a period of five weeks, using Pocket PC handheld computers equipped with Wireless LAN expansion cards. The games use our graphics platform *GapiDraw* (www.gapidraw.com) and our networking platform *OpenTrek* (www.opentrek.com), both specifically designed to create collaborative games on handheld computers. The games can be freely downloaded from www.cafetrek.com.

A preliminary evaluation was performed at a local high school. Six handheld computers were given to students at a café. The students quickly grasped the game concepts, and also played the games differently based on experience. Beginners who played the game *PacMan Must Die* like an ordinary video game would quickly find their ghost captured by another player and lose. When players became more experienced they started to develop extensive collaborative strategies. It was obvious that all students found the games fun and enjoyable. Based on our experience, we believe that this type of collaborative games holds great promise.