PicoPet: "Real World" Digital Pet on a Handheld Projector

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ABSTRACT

We created PicoPet, a digital pet game based on mobile handheld projectors. The player can project the pet into physical environments, and the pet behaves and evolves differently according to the physical surroundings. PicoPet creates a new form of gaming experience that is directly blended into the physical world, thus could become incorporated into the player's daily life as well as reflecting their lifestyle. Multiple pets projected by multiple players can also interact with each other, potentially triggering social interactions between players. In this paper, we present the design and implementation of PicoPet, as well as directions for future explorations.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

General terms: Design, Human Factors

Keywords: Game, digital pet, handheld projector.

INTRODUCTION

Handheld projectors (a.k.a. pico-projectors) start to attract more attention in the field of mobile gaming due to its high mobility and ability to project on almost any surface. For example, Cao and Balakrishnan [1] suggested that a handheld projector could be used to create a novel shooting game experience that leverages the geometry of the room, and MotionBeam [3] allows players to control a projected game character by moving the projector and supports some simple interactions with instrumented physical props. These games leverage a few simple physical characteristics to augment the experience, but the game design itself is still purely virtual and detached from the player's real life. However, with the vision that projectors will be embedded in every mobile device (e.g. cell phones) in near future, it is natural to consider how casual mobile games based on these devices may blend gaming experience and physical life.

We sought to explore a new form of handheld projector game experience that is tightly incorporated with the physical world and the player's daily life. We are inspired by the once very popular digital pet toy (a.k.a. Tamagotchi), where the player can interact with a virtual pet displayed on a handheld device using several buttons. Many players take their Tamagotchis with them all the time and interacting with the pet becomes part of their daily rhythm. Nonetheless, the pet lives entirely in the virtual realm and does not directly interact with the player's physical life. In comparison, EyePet [2] is a digital pet game based on the PSP mobile game console, in which the onscreen pet is displayed together with the real world scene captured by the onboard camera, and controlled using physical markers. This adds some physical realism to the game, however the experience is still confined to the mobile screen, and there is no real interaction between the pet and the physical environment. To create an experience that is truly integrated into the physical world, we created PicoPet, a digital pet game based on mobile handheld projectors. Instead of displayed on a mobile screen and operated with buttons, the pet is projected into the physical environment and behaves directly according to the physical surroundings. By doing this, we create the impression of a digital pet living in the physical realm, further blurring the boundary between the gaming experience and the player's daily life.

IMPLEMENTATION

Although our vision is to run PicoPet on mobile devices with embedded projectors, as a proof-of-concept prototype it is currently implemented by combining a standalone handheld projector, a webcam, and an Inertial Measurement Unit (IMU). These are all connected to a laptop PC which can be easily taken to various environments.

Figure 1: PicoPet prototype.

By analyzing the image from the camera using computer vision techniques, our prototype can recognize in real-time various colors, textures and objects in the physical environment where pet is projected, as well as presence of other pets nearby. The IMU measures the device's 3D orientations and accelerations. The pet behaves and evolves based on such information.

INTERACTION WITH THE ENVIRONMENT

The player simply points the handheld projector anywhere in the physical environment to place and move the pet. The pet interacts with the environment in two ways, by exhibiting transient behavior, and by evolving its form to adapt.

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Transient Behavior

The pet interprets background of different colors and textures around it as different "terrains", and behaves accordingly. For example, blue is interpreted as water, and the pet starts to swim; green implies grass for the pet to catch a butterfly (Figure 1); red indicates hot weather which lets the pet sweat; flowered background stands for a garden in which the pet starts to play with flowers (Figure 2a, b). We expect in the future more advanced computer vision techniques may allow us to recognize more specific physical material of the background beyond general color and texture. The orientation of the device also provides information to infer the terrain, e.g., when pointed up to the ceiling, the pet tries to fly; when pointed down to the floor, the pet rolls on the floor (Figure 2c).

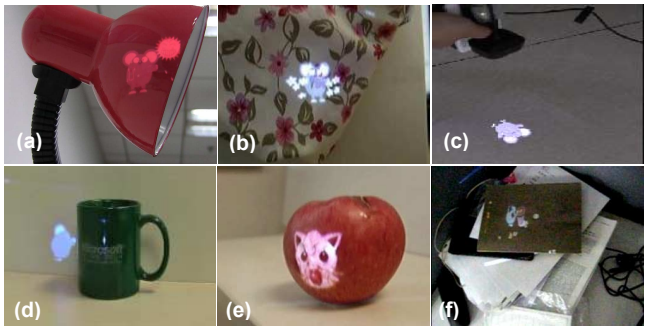

Figure 2: Examples of transient behavior: (a) Sweats on a red background. (b) Scatters flowers on a flowered background. (c) Rolls on the floor (d) Pushes a mug. (e) Feeds on an apple. (f) Bins rubbish on a messy desk.

The pet may also interact with physical objects nearby that it recognizes based on their visual appearance and shape. For example, when it sees a mug it tries to "push it away", while when it becomes hungry, the player needs to find an apple for it to feed on (Figure 2d, e).

In addition to behaving for itself, the pet may also prompt the player to do something to the physical environment. For example, when it is in a cluttered environment, it starts to put rubbish in a recycle bin to remind the player to clean it up (Figure 2f). This builds a connection between the pet's life and the player's life, and may serve as an interesting persuasive technology.

Longer-Term Evolvement

If the pet spends enough time in a certain terrain, it may start to evolve its form to adapt to the terrain, and eventually become a different species. For example, when the pet is put into "water", after swimming for a certain period, it starts to develop gills, and eventually will become a fish (Figure 3). Or if the pet is always put in messy environments, it will become a rat. Hybrid species are also possible for pets spending considerable time in multiple terrains. Such evolvement not only provides space for development and personalization in the game, but also means that the form of the pets may reflect the lifestyle and living environments of the players themselves, e.g. a sheep may suggests its owner loves outdoors and often takes it to play on meadows in parks.

INTERACTION BETWEEN MUTIPLE PETS

Multiple pets projected by multiple players may also interact with each other (Figure 4). Each pet is projected along with a special visual marker, which can be recognized and tracked by the camera on another PicoPet device. Thus, a pet can notice the presence of another pet in its proximity, and depending on the other pet's species, move towards or away from it to exhibit various relationships between the two pets. Apart from using visual makers, other technologies might also be employed to determine the presence and relative location of other pets, such as peer-to-peer wireless communication between the projectors. Such "social" interactions between pets may become triggers for the players themselves to start socializing in public settings, a phenomenon often observable in owners of real pets.

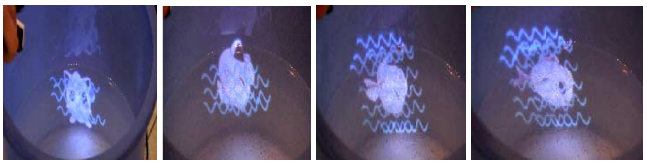

Figure 3: Pet evolvement (left to right in temporal order).

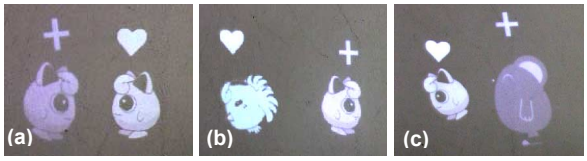

Figure 4: Interaction between two pets: (a) Mutually attractive - walk towards each other. (b) Mutually repelling - walk away from each other (c) One pet tries to catch the other pet, while the other runs away.

CONLUSION AND FUTURE WORK

PicoPet is a first exploration into a new form of gaming experience supported by handheld projectors, one that blends the virtual pet experience into players' real life environments. Such a digital pet might establish a close relationship with player's daily life, reflect the player's lifestyle, or even support social interaction between players. In the future, when the prototype becomes more technically mature, it may also be appropriated for purposes other than pure entertainment, e.g., educating young children about the world, or promoting social interactions between people. We would also like to explore the interactions to allow players to teach the pet about new environments and associate them with new pet behaviors. This would further enrich and personalize the game experience.

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