

# Pervasive Pleo: Long-term Attachment with Artificial Pets

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## ABSTRACT

Playing with artificial pets is becoming a very popular activity. Artificial pets are present in a variety of forms and interaction styles, from online websites to video game consoles and, more recently, as social robots. However, some of these artificial creatures, in particular robotic pets, are not capable of engaging users for extended periods of time. Issues such as lack of perception capabilities or battery life sometimes break the playful experiences. To increase the attachment between artificial pets and their owners, and create more enjoyable experiences, we propose to extend the identity of a Pleo robot by creating a virtual representation of the robot in a mobile device. The user needs to take care of Pleo, and is able to do so by interacting either with the robot or with the mobile device. In this paper, we describe the work in progress of this system and discuss some future work directions.

## Categories and Subject Descriptors

H.5.2 [Information Interfaces and Presentation]: User Interfaces – *interaction styles*.

## General Terms

Design, Experimentation, Human Factors.

## Keywords

Interaction styles, artificial pets, handheld devices, attachment.

## 1. INTRODUCTION

Animals have been a source of companionship and entertainment to humans for many generations. Taking inspiration from human interaction with real pets, researchers and companies have been developing autonomous creatures with the purpose of entertaining and eliciting attachment from the user, commonly designated as artificial pets [1]. Some of the most successful examples are Tamagotchi, Nintendogs, Eyepet and online websites such as Neopets.

At the same time, the decreasing costs in electronics in the recent years enabled the appearance of commercial robotic artefacts for entertainment purposes, such as Furby, Sony's AIBO or Nabaztag. In the HRI field, researchers are focusing on how to make such robots more fun to interact [2], while others evaluate if robots can have therapeutic effect on elderly people [3] or autistic children [4].

One of the most popular animal-like robotic toys that recently entered the consumer market is Pleo, a robotic baby dinosaur designed to act like a real animal. Pleo is capable of conveying emotions, evolving over time and perceiving the environment through a set of touch sensors, IR-sensors for distance detection, a low resolution camera and two microphones. An analysis of blogs and web forums about Pleo [5] revealed that the majority of the blogs only contained a few posts concerning the initial stage of interaction, and after that people stop writing about the robot. Another user reported that after owning Pleo for five weeks, she only turns it on to show it to other people. This may happen because the perception and interaction capabilities of these robots are still limited, but there are also other relevant issues that might disrupt the interaction cycle. For example, Pleo's battery lasts for about one hour, and needs to charge during four hours.

Although the potential of Pleo and other pet-like robots seems promising due to the physicality of the interaction, most of these robots are not capable of engaging users for extended periods of time, especially when compared to the enormous success of virtual pets in video game consoles or online. What if users could always have the possibility of playing with his/her Pleo even when the battery is charging? What if they could carry it everywhere? Will the interaction become more enjoyable? Will users become more attached to it? To address these questions, we took inspiration from pervasive gaming technology [6], where gaming experiences benefit from a mixture of real and virtual game elements. We are extending the "identity" of a Pleo robot by creating a virtual representation of it in a mobile device. Users will then be able to interact with Pleo either in the mobile device or by directly interacting with the robot. The mobile device attempts to overcome some of the limitations of the robot, such as battery lifetime and the lack of communication, which makes it difficult for users to interpret the robot's internal state.

The paper is organized as follows. In the next section, we provide a brief overview on artificial pets. After that, we describe in more detail the interaction scenario that we are developing, with special emphasis on the mobile version. Finally, we draw some conclusions and future work.

## 2. RELATED WORK

In this section, we introduce some of the most successful commercial artificial pets and toys. When presenting the systems, we will focus on the interaction modalities between users and the artificial pets.

After the release of Tamagotchi in 1997, artificial pets have grown significantly in both toy and gaming industries.

Tamagotchi had the physical shape of an egg and its owners were able to feed, clean and play with it just like they would do with a normal pet. Some Tamagotchi owners became so attached to their pet that they even mourned its death (if the owner did not take care of it correctly, the pet would die) [7].

A mini game belonging to the Sonic Adventure game [ref] consists of raising little pet creatures called *Chao*. The interesting feature that Sonic Adventure introduced was the fact that the user can take a Chao with him/her anywhere, using the Dreamcast Virtual Memory Unit (VMU), a removable storage device that works as a basic handheld video console. In the VMU, the user can play small games that improve Chao's abilities, pet it, feed it or even mate by connecting it to another VMU. The user can bring Chao back to the Sonic Adventure game by plugging the VMU into the main console again. If the user treats the Chao well, it will like the user's avatar in the game, running to the avatar when it sees it and rubbing against its legs like a cat. On the other hand, if the user treats the Chao badly, it will show negative reactions, like struggling to get free when the user tries to hug it.

The appearance of new types of technology enabled new forms of interaction with artificial pets that were not possible before. For example, by using the touch screen of Nintendo DS, Nintendogs' users are able to touch their pets. Even if the feelings is different from touching a real animal (lack of fur, etc.), it increases the odds of bonding and attaching to it. In one of the few studies that analyses the interaction with commercial artificial pets, Chesney [8] argues that users interacting with Nintendogs feel a companionship relation with their artificial pets, yet in a smaller degree than users that interacted with real pets.

EyePet's Playstation 3 game also brought an innovative way of interacting with artificial pets. In this game, users own a pet that looks like a monkey and inhabits an augmented reality environment. Users can interact with EyePet using real objects and body gestures (a video camera is used to capture the user's environment). The pet reacts by exhibiting different behaviours such as chasing the user around or showing its emotional state. Players can also personalize their EyePet by changing its clothes or by using new toys to play with it. One of the drawbacks of EyePet is that users claim that, after some time, the novelty effect of interacting with new virtual pets wears off. This may happen because all the actions remain the same over time and pet's reactions do not progress much over the interactions. Another contributing factor to the decrease of enjoyment and believability in these games is the fact that there is no player recognition and thus the notion of ownership is missing.

Nowadays, children are drawn away from traditional toys at a younger age and tend towards playing computer games. Pervasive Gaming may reverse these trends, as it can bring similar levels of interactivity that are available in computer games to traditional toys. The shape of a toy alone suggests the way it should be played, but contrary to games, they are not bound by rules or limitations [9]. If we integrate computer technology into toys while preserving their natural ease of use, we can extract principles of user interaction which will allow us to learn new gaming experiences that might emerge. Taking into account advantages and drawbacks of existing commercial and research system, in the next section we will explain how we can contribute

to this type of games by designing new kinds of interaction modalities with virtual pets.

### 3. PERVASIVE PLEO

In [10], Kaplan discusses the nature of the relation established between users and artificial robotic companions, arguing that existing robots are not designed to establish a meaningful relationship with their "owners". Inspired by a well-known test used to evaluate attachment in psychology and ethology (Ainsworth's Strange Situation test), he proposes a set of guidelines for building artificial creatures that may eventually pass this test. First, the robot needs to recognize the presence of the attachment figure (i.e., the user), and eventually express positive emotions when this happens and display separation distress behaviours when the user moves away. Also, the robot should be able to perform some sort of self-reinforcement activity that requires many interactions with the user.

Following these guidelines, Pleo's internal state will be regulated by internal self-preserving needs inspired on PSI Theory [11], which will ultimately influence the pet's need for affiliation/attachment. Some of the needs can be satisfied when users interact with the Pleo robot and others when they interact with the handheld device. If the user is able to maintain Pleo's needs stable and devotes time interacting with it, the attachment that Pleo "feels" towards the user increases. We intend to develop a complete scenario where we can make use of both the robot and the virtual pet on the mobile phone.



Figure 1. Game interface of Pleo's mobile version.

#### 3.1 Playing with the mobile Pleo

We have developed a prototype version for the iPhone where the user can take care of a virtual Pleo through several different actions with the final purpose of establishing and maintaining a bond between them.

In the attempt to make the user emotionally involved with the pet since the creation process, he/she is allowed to select the pet's

name and gender. As reported in [5], these are practices that people usually do when their Pleo robot arrives.

After the pet's creation, the user has visual access to the current state of Pleo's needs and to a set of interaction buttons (see Figure 1). Using the touch screen, the user can pet, feed, bathe or send the pet to sleep, and also keep the environment around Pleo clean from its droppings. These interactions will affect the pet's needs, which then contribute to Pleo's attachment towards the owner.

### 3.1.1 Game Interface

The currently modelled needs are Energy, Hygiene, Social and Food, represented by bars on the top part of the screen. There is also a representation of the attachment to its owner, illustrated by the hearts bar in the lower left corner of the screen. There are four interaction buttons (feed, bathe, clean the environment and sending the pet to sleep), followed by the options button where the user can create a new pet if wanted.

### 3.1.2 Needs

The Energy bar represents Pleo's need for sleep (empty being extremely tired and full being rested), the Hygiene bar decreases if Pleo and its surrounding environment is not clean, the Social bar represents Pleo's need for interaction with the user (empty being lonely and full being socially satisfied), and the Hunger bar indicates if Pleo is hungry or not. All the need values decay over time, even if the user is not playing with Pleo (i.e., if the application is not running).

At the moment the user can satisfy all Pleo's needs by interacting with the mobile device. However, we are integrating the mobile version with the robot in a way that some of the needs can only be fulfilled when the user interacts with the robot. For example, the social need might increase when the user plays with the robotic Pleo, rather than touching the virtual character on the screen.

### 3.1.3 Attachment

In our application, attachment is derived by the average, over time, of the pet's visible needs, each with its own weight (e.g., Social need has more weight than Hygiene). When the attachment is low, Pleo will look emotionally distant, whereas when the attachment is high, the pet will be eager to interact with the user.

If the user does not take good care of Pleo for a long time, attachment will eventually reach to zero and the pet will run away from the screen. This behaviour draws the user to devote time taking care of Pleo, as it happens with real pets, trying to avoid losing all of his/her investment in taking care of the pet.

### 3.1.4 Interactions

So far in this prototype we have implemented some interactions that allow the user to take care of Pleo. The user can pet Pleo by rubbing the pet's model on the screen, an action that increases Pleo's social need. By touching on the food button, the user can feed Pleo. To wash the pet, users can touch the bathe button and scrub their pet with a sponge, which results in an increase in Pleo's hygiene. Droppings on the screen will also cap the hygiene, so the user has also to keep the environment clean, by touching on the bucket button to pick up its droppings. Finally, sending the pet to sleep will increase its energy.

## 3.2 Playing with the Pleo robot

Regarding the development of the physical version of the pet, we have added an electronic component to the Pleo robot, giving it the ability to communicate through Bluetooth. With this addition, a mobile phone is able to communicate with Pleo. We already performed some tests using a mobile phone to retrieve data from the robot's sensors and control it (e.g. perform certain movements or emitting sounds). The robot can sense certain stimuli, such as the user petting it, and it can provide appropriate reactions, like wagging its tail. Another feature that we are able to provide using Bluetooth is to detect when a user gets near Pleo (one of the important behaviours that demonstrate attachment), based on the connection established with the mobile phone. In such a situation, Pleo reacts similarly to a pet, becoming more active and trying to engage the user in an interaction.

The pet will use the robot to interact with the user whenever it is in range, disappearing from the mobile phone's screen. When the robot becomes out of range, the pet will return to the user's mobile phone. The pet will respond to the presence or absence of the user in resemblance of a dog, becoming more excited or sad according to the situation. The values of the needs will be updated on the mobile phone so the result of the interaction with the physical version is reflected in the mobile version.



Figure 2. Integration of a Bluetooth module inside Pleo's body.

## 4. CONCLUSIONS AND FUTURE WORK

In this paper, we presented the work in progress towards developing Pervasive Pleo, a setting where users can play with an artificial pet using two different interaction modalities: a robot and a virtual representation of the robot in a mobile device. Despite the two different embodiments, the "identity" of the pet is the same, which means that the state of its internal needs is transferred from one embodiment to another. This way, users can spend more time interacting with their artificial pet, and possibly establish a stronger attachment relationship with it.

In this pervasive setting, there are still some open issues about the pet's identity that need to be carefully considered. For example, to create the sense of identity and uniqueness of the pet, if the Pleo robot is "on", the virtual Pleo in the handheld device should disappear from the screen. But who should decide when the pet

should migrate over the devices? Should the user be the one to decide, or should the pet also have some autonomy in this matter? For instance, if Pleo robot is running out of battery, should the pet autonomously migrate to the mobile version?

After the implementation of Pleo's behaviours is finished in both embodiments (mobile device and robot), we are planning to evaluate if users perceive the two agents as the same entity. Also, we intend to evaluate if users feel more attached to an artificial pet by interacting with this pervasive setting, rather than interacting solely with a robot or with a virtual pet in a handheld device.

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