The Nexus: Computer Game Interfaces for the Real World

Jennica Falk

MediaLabEurope, Sugar House Lane, Bellevue, Dublin 8, Rep. of IRELAND
jennica@media.mit.edu

1 BACKGROUND/MOTIVATION

Most non-electronic games are designed for the physical world we live in and to make effective use of 'real world' properties, such as physical objects, our sense of space and spatial relations. Our sensory engagement in the world adds texture, context, and content to the game play. Computers inarguably offer exciting possibilities to the design of games but they also transform the way we play and interact within a game context. Perhaps most notably, they in some sense turn play into activities in which players are disengaged from the physical world rather than interacting within it. Computer games, while often designed to mimic the physicality of real world spaces and objects, typically do not allow for the same richness in interaction as offered by the real world.

It is sometimes argued that it is the game industry that pushes the development of new hardware technologies and software techniques (cf. Bushnell 1996). However, computer games, particularly those that are designed for personal computers, are nevertheless carried out on machines with interfaces optimized for office work, such as word processing. Despite the powerful machines that personal computers are, it is easy at hand to argue that an interface optimized for tasks such as word processing, compromises its suitability for gaming applications. Further, the PC is personal, and as such has been argued to effectively shield the user from the social and physical environment by demanding an excessive amount of foreground attention from the user. There are no reasons why this phenomenon does not apply to computer game applications, even in multi-player games where absorbing social realms can be created through the facilitation of a network. People are still primarily interacting with a computer rather than with other people, or engaging with the physical world. A compelling research task is to find alternative interfaces for computer games.

This paper describes the Nexus project, in which we research the design space of computer games that employ, as well as affect properties of the real world. The ultimate ambition is to create an out-of-the-box computer game, where the points of interaction are not confined solely to a virtual game world and the personal computer interface, but also has distributed and tangible interaction aspects that support the execution of the game. In other words, we envision future computer games that are experienced in physical and social environments where players to with the real world.
2 SIGNIFICANT RELATED WORK

Pirates! was implemented as a first effort to approach the design space of 'out-of-the-box' computer games (Björk et al. 2001). The primary goal was to design a computer game in such a way that the physical world and our engagement within it become meaningful to game play. Pirates! is a multi-player game, played with handheld clients that communicate with a central game server through a wireless network. Each client is fitted with a short-range radio transceiver, which functions as a sensor to detect the players' relative proximity to each other, as well as to a number of tagged locations in the physical environment. As this proximity information is used to trigger game events, Pirates! forces the players to roam a physical and social space when playing. As such, it is a computer game where the act of navigating a virtual world and encountering other players in the game, have been turned into actions in the physical world.

When designing 'out-of-the-box' computer games it is sensible to build on findings from established research fields that attempt to bridge the gap between the real and the virtual, even though they are not traditionally concerned with the design of computer games. Ubiquitous Computing (cf. Weiser 1991) is aimed specifically at taking computing beyond the dedicated work space, and ultimately turn it into a resource that is accessible 'anytime anywhere'. Of particular relevance, is the focus on providing seamless, even 'invisible' access to computation to users that engage in social and informal situations where attention is paid primarily to the interaction with other humans rather than with computers.

Context-aware computing (cf. Selker & Burleson 2000) is a field of research aimed at designing computers and applications that deliver task-relevant functionality tailored to the context of their users. By granting computer applications access to information such as a user's location, activity, social, or even biological state and matching that information against a set of predetermined rules and preferences, the ambition is to deliver timely and relevant information in an as seamless fashion as possible. Of specific relevance in the context-aware approach, is the notion of making the applications perceive and react to the user's actions in the physical world.

Tangible User Interfaces (Ishii & Ullmer 1997) aims at providing physical forms or embodiment to digital content and controls. In some sense, tangible media is the direct opposite of context-aware computing in that the concern is not about making the real world accessible to the computer but to make the digital world accessible to the user and the real world.

The currently predominant approach to novel modes of interaction in computer games is to give the application a perception system of sorts where various hardware peripherals are used to sense the player's actions or various states of the real world. Body- and eye tracking technologies are often employed as input mechanisms for a variety of gaming applications, mainly in the virtual reality domain, to infer a user's intention. Bio-signals, such as brainwaves, skin conductivity, or heart rate are beginning to appear in applications to monitor players physiological states and even as mechanisms to control the game world.

We believe that tangible interfaces, ubiquitous computing, and context-aware computing can be applied to computer game design to create whole new types of gaming experiences. The challenge we are presented with is to design a computer game that takes focus away from interacting with a computer, and instead engages the player in
interaction with real world objects in a social environment. The lessons learned in these research fields will play an important role in resolving that challenge.

3 THE NEXUS GAME PROJECT

While location and co-location proved useful interaction mechanisms in Pirates! focus is now shifted to the potential of employing physical objects to facilitate the execution of a computer game. To research this design space we are constructing a computer game, Nexus, with the ambition to take some of the interaction between the player and the game out of the computer. To this end we are building tangible and context-sensitive interface-objects that will facilitate the execution of the game in a real world context. Through these physical interfaces, objects in the game world are extended to also exist in the physical world. Conversely, real world objects are immersed in a game world. In other words, the physical world is not only input to the game world, but provides the means for the game to manifest itself in the physical world. The result is a computer game environment where interaction is not confined entirely to a virtual world and a single personal computer interface, but also has distributed and tangible interaction aspects.

Nexus is based around a MUD gaming environment. A MUD, or a Multi-User Dungeon, is a network-accessible, multi-participant, virtual reality whose user interface is entirely text-based (Curtis 1992). Often set in fantasy or science fiction themes, they allow players to communicate with each other, engage in fantastic interactive text-based adventures, challenge each other, and explore vast areas of interconnected virtual 'rooms' populated by creatures and objects to interact with. Typical objectives for a player involve gaining experience and improving the skills and abilities of their digitalized personas (characters), but may also focus on participating in more or less extensive role-playing activities, evolving and sharing a story that takes place over time. There is no physicality to MUDs as is the case in non-electronic game play, and no graphics or sounds to add visual cues and similar context as in video games. The inspiration to Nexus came from the idea of introducing physicality to a MUD in such a way that it engages players in the real world in order to be played.

3.1 The Nexus system components

The Nexus game is made up of three components. Firstly, it is powered by a MUD server, which functions as a game engine of sorts. Secondly, hosted on the MUD server is a text-based game world; for the purpose of our current work it is a model of the lab space at MediaLabEurope in Ireland. The MUD version of the laboratory is created to provide as accurate a description (since it is created in text) of the real lab space as possible. The MUD world is populated by the same kind of object objects that exist in the real world, such as tables, desk lamps, books, computers, and persons. Thirdly, and what makes Nexus different from other MUDs is that it supports a number of tangible, physical interfaces that are 'wired' to virtual counterparts in the MUD world. These interfaces function as 'ligaments' between the domains of the computer game and the real world. The MUD server runs locally under the Linux operating system and via a
custom-made serial port hardware interface is capable of establishing communications links between these physical objects and their virtual counterparts. The connections between virtual and real objects can be bi-directional, as in the example described in the following section, allowing the interaction with the real world object affect the virtual object and the other way around. They can also be unidirectional in either direction between the real world and the virtual world. Objects that in this fashion exist both in the MUD world and the real world we refer to as nexus objects.

3.2 Interacting with Nexus

Playing Nexus is similar to playing any other text-based MUD. The player can wander around interconnected ‘rooms’ all of which are described in text. In addition to rooms, this virtual world hosts various objects with actions associated with them, e.g. buttons can be pressed, objects can be picked up or looked at, etc. Those actions are performed within the MUD itself by typing in commands to the game. It is the nexus objects that make playing Nexus different from the typical MUD. Nexus objects can both affect the behavior of their counterpart, i.e. interacting with the physical nexus object will affect its virtual counterpart, and interacting with the virtual nexus object will have some effect on the state of its physical counterpart.

To illustrate the interaction with Nexus, consider the most basic setup of a MUD room as described in Figure 1. The first 9 lines of text describe the room itself, what the exits are, and what objects are in it. This room contains one nexus object - a desk lamp and as the interaction shows the lamp has a button that the player can press to toggle the light. The virtual lamp object has been programmed to communicate with a lamp in the real world via the serial port interface in such a way that it is turned on and off by player commands. Conversely, pressing the button on the real lamp toggles the light on and off in the MUD world.

---

On the gray desk is a flat panel display hooked up to a computer that sits below on the floor. There is also a laptop computer, a white telephone, some books and lots of stray papers and notes. The desk is situated in the back of the lab, in one of the corners, and from here Jennica can see most of what is going on in the lab. Next to her on the left is Brendan’s desk, and in front of her is Konrad’s desk. A door behind the desk leads to the staircase.

There are three obvious exits: brendan, konrad and stairs.

Atop the desk is a lamp.
> look at lamp
It is a metal lamp. You can press a button to toggle it on and off.
The lamp is turned off.
> press button
You press the button on the lamp and turn it on.
> look at lamp
It is a metal lamp. You can press a button to turn it on and off.
The lamp provides a soft light.

---

**Fig. 1.** An example room as it is represented in the MUD world of the Nexus game. Interaction with the virtual lamp in the MUD toggles the light of a real world lamp.
3.3 A note on application

MUDs lend themselves very well to creating engaging game worlds and intricate plots and objectives. One of the great strengths of MUDs compared to graphical game environments is that they are easily customizable and expandable. Modifications can be done from within the MUD itself, and the flexibility and structure of the MUD driver cater for quick additions of new objects and rooms. Customizing them to specific needs, such as being responsive to, or able to affect some other entity, no matter virtual or real, is easily done. Secondly, because interaction within MUDs is purely textual it is very easy to infer (i.e. parse) the players' actions.

While the current functionality of our lamp may not appear interesting in the context of a computer game it is a powerful example of how tangible interfaces can be applied to the design of computer games. The lamp was the first object we implemented to illustrate how objects in the real world may be employed to not only manipulate but also to embody digital information. It also served as a thing with which to think about additional nexus objects that we are currently working with.

4 DISCUSSION AND FUTURE DIRECTIONS

Whereas our knowledge of the physical world and the skills with which we engage in the physical world are powerful facilitators to non-electronic game play, the virtual worlds generated for computer game play cater poorly for those skills. Clearly, computer game spaces do not allow for the same sophisticated engagement, mainly because our means for interacting with the real world (our perception of space, sensory input, and even the psychology of non-electronic games) are transformed into abstractions in computer games. As game context begins to push beyond the digital domain and become pervasive aspects of everyday social environments it will inarguably affect that space. By placing people with a specific mindset, in this case playing computer games, into an environment that has been instrumented specifically to support that mindset we might learn important lessons about how to design, and perhaps more importantly how we interact within a world in which computation is ubiquitous. In the light of this, the Nexus project is not only about researching the future of computer game play and design but also about interaction research.

We have thus far mentioned very little about a game plot, which obviously is important to develop as additional nexus objects are built. In terms of interfaces, a number of ideas are interesting to pursue next. Closest at hand is to distribute the interface over a larger area, and create a more immersive gaming experience. Our ambition is to design a wearable object, possibly in the shape of a necklace or badge that identifies each player as they roam a physical space. Equipped with either a radio, or infrared transceiver, such a device would allow for communications between it and the distributed interface to be established. A suitable application for such a ubiquitous game could for instance be a treasure hunt. Following that, we want to explore how the social protocol between people, both players and non-players, may be used as a game engine of sorts, an un-encoded driver of the game itself.

Finally, as a disclaimer, it should be emphasized that there are a number of things that make computer games very different from the real world. What happens when you
blur the line? For instance, laws of physics, and laws of society may be abandoned in a
counter game world, which is what makes it entirely possible to fly, sustain as well
as inflict serious bodily damage and turn violence into an encouraged activity. We are
obviously not trying to blur the line between what is possible in a computer game and
what is allowed in society. Nevertheless, we believe that future computer games will
move out of the computer, not only to become aware of the real world but also to liter-
ally inhabit it.

5 ACKNOWLEDGEMENTS

Very special thanks to Boltthrower of STYX for much-appreciated help tweaking the
MUD server (*dlove*). Thanks to colleagues at MLE, especially Chris Lucas and
Brian McDonald for help resolving hardware issues. To Glorianna Davenport, Carol
Strohecker for the advice and the encouragement, and to Hiroshi Ishii for the drills J.

6 REFERENCES

   as a Game Board, In Proceedings of INTERACT '01, 9-13 July, Tokyo, Japan.
dia, From Wagner to Virtual Reality, Packer, R. and Jordan, K (ed.). W.W. Norton & Com-
pany.
4. Ishii, H., and Ullmer, B. (1997). Tangible Bits: Towards Seamless Interfaces between Peo-
   94-104.