Interactive tangible objects as play pieces in a digital tabletop game

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ABSTRACT
In this paper we present a new type of tangible interface for a digital tabletop game. This interface consists of an interactive tangible object; a play piece representing a bridge in the game 'Weathergods' [1]. The game players can not only physically change the appearance of the bridge to manipulate the digital world, the digital world in return can also affect the appearance of this play piece.

Categories and Subject Descriptors
[**Information Interfaces and Presentation (e.g. HCI)**]: User Interfaces - *Haptic I/O.* K.8.0 [**Personal Computing**]: General – *games*.

General Terms
Design and Human Factors.

Keywords
Interaction design, tabletop gaming, tangible user interfaces, pervasive games.

1. INTRODUCTION
The world of gaming has been shifting from physical board games to digital computer games over the past decades. Despite the advantages of computer games, they do not often support physical activity and social interaction. An upcoming gaming genre that is often referred to as pervasive gaming [5] can benefit from tangible play pieces, combining physical and digital. Many examples of pervasive games use tangible play pieces to support interaction. To classify tangible user interfaces, Van den Hoven and Eggen [3] have presented an extended framework including a division based on the appearance of tangible objects. In this division, objects can either be iconic, representing their association to digital information, or symbolic, having an appearance that does not represent this association.

As stated by Poupyrev et al. [6] tangible objects are usually static; they manipulate digital information, but the digital world has no effect on the physicality of the tangible interface. The type of tangible interface that physically reacts to the digital world is sometimes referred to as actuated interfaces [6], such as the Lumen shape display, or Push-Back tangibles [4], such as the PHANToM. These types of interfaces make changes in digital information physical. Rosenfeld et al. [7] present the Planar Manipulator Display, which uses interactive objects that can not only be moved by the computer to illustrate a digital change, but also by the user to manipulate digital information. In these examples however, the user input in the change of appearance of tangible objects is very limited.

In a study on differences between iconic and symbolic play pieces [1], a pervasive game was developed using several different tangible objects. One of the play pieces, the bridge, combines an actuated interface with meaningful user input. The appearance of the bridge can not only be changed by the digital world, but also by the user manipulating the physical world. This paper presents this tangible object as a new example of an interactive tangible.

2. THE WEATHERGODS GAME
The game that uses this new type of tangible object is implemented on the Entertaible gaming platform [2], created by Philips Research. This multi-player, turn-based game is called 'Weathergods' [1]. The board displays a map (see Figure 1.) that contains a canyon over which a physical bridge object is placed. Players can only cross the canyon via the bridge. By bribing the bridge keeper, the players can (physically) open the bridge and so keep other players from crossing the canyon. Two rounds later, the bridge is automatically (physically) closed by the game.

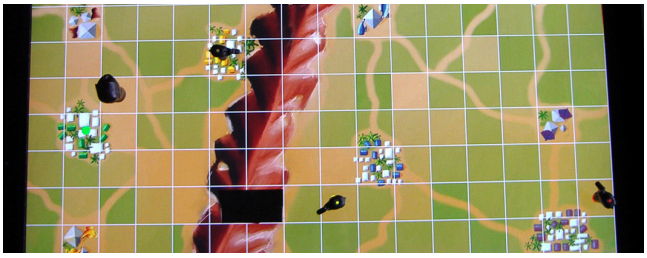

Figure 1. The 'board' on-screen of the Weathergods game.

3. THE INTERACTIVE BRIDGE
The bridge object is a dynamic and physical representation of the digital bridge in the game. It can either be open (meaning the canyon can not be crossed), if a player desires it to be, or closed

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(meaning the canyon can be crossed), which it is by default. Only players can open the bridge (manually); only the game can close it (automatically). How this is done is explained in Figure 2.

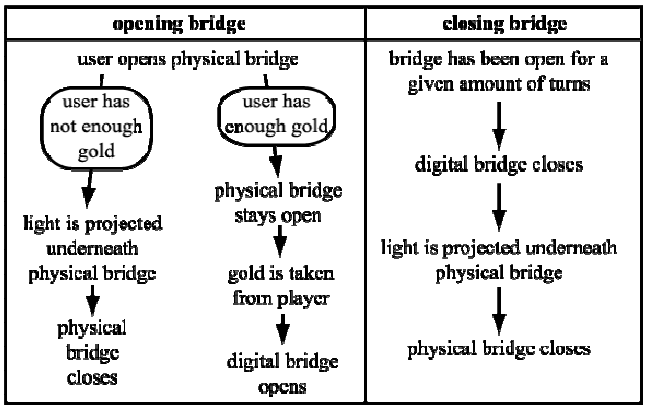

Figure 2. Ways of opening and closing the bridge in the game.

Since there were two sets of play pieces developed in this study, an iconic and a symbolic set, there were also two different versions of the bridge object. Both react to the game in a similar way, yet the interaction is totally different.

The iconic bridge looks quite similar to a lift bridge (see Figure 3). The player opens the bridge by pushing the top bar down. A magnetic mechanism locks the bridge in the open position. The Entertaible will detect that the bridge has been opened and will notify the game. The bridge will stay open until the game gives a signal in the form of a light underneath the physical bridge. As the Entertaible detects the location of the bridge, small displacements of the bridge will not cause a problem in functioning. A light sensitive sensor in the bridge will react and cause the magnetic mechanism to unlock: the bridge will close automatically.

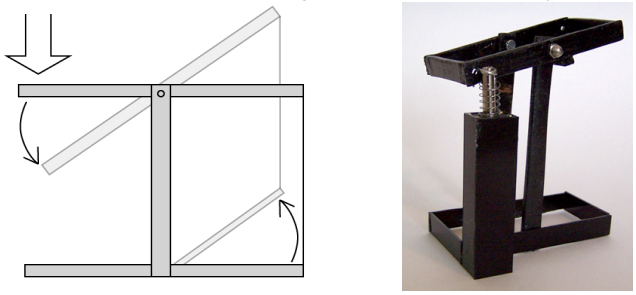

Figure 3. Iconic bridge, schematic (left) and prototype (right).

The symbolic version of the bridge should not look like a typical bridge and therefore needed a slightly more complicated mechanism. This bridge works with a folding principle (see Figure 4). The foldable part of the bridge is connected to a small electro motor with a thin wire. To open the bridge, the player needs to fold the 3 tiles on top of each other; this will cause the wire to unroll. When the 3 tiles are folded in a stack, the game will detect that the bridge has been opened. Similar to the iconic bridge, the symbolic bridge will react to a flash signal of the game. However, in this bridge, the light sensitive sensor's reaction will cause the electro motor to roll up the wire. Rolling up the wire will unfold the stacked tiles and thus close the bridge again.

These actuated objects enable the user to interact with them physically and receive feedback from the game in a physical way, despite the fact that the underlying game is digital.

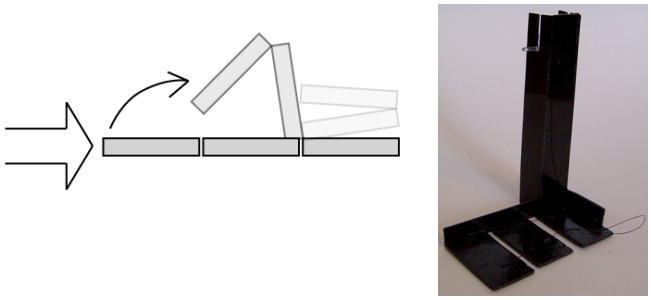

Figure 4. Symbolic bridge, schematic (left) and prototype (right).

4. CONCLUSION

We succeeded in reaching our main goal, to combine an actuated interface with meaningful user input in one interactive tangible object. The appearance of the bridge play piece in the Weathergods game can physically be changed by the user to manipulate the digital part of the game, and the digital part can react to this by changing the physical appearance of the play piece. Such an interactive tangible object creates a tactile reference to changing digital information, which could be very useful in presenting digital activity, but which also enables new types of game play.

5. REFERENCES

[1] Bakker, S., Vorstenbosch, D., Hoven E. van den, Hollemans, G., Bergman, T. (2007). Weathergods: tangible interaction in a digital tabletop game. In *Proceedings of the 1st international conference on Tangible and embedded interaction (TEI07)*, pp. 151-152.

[2] Hollemans, G., Wijdeven, S. van de, Bergman, T, and Loenen, E. van (2006). Entertaible. In Emile Aarts, Elmo Diederiks (Eds.) *Ambient Lifestyle. From Concept to Experience*, pp. 80-83.

[3] Hoven, E. van den and Eggen, B. (2004). Tangible Computing in Everyday Life: Extending the Current Frameworks for Tangible User Interfaces with Personal Objects. In *Proceedings of the European Symposium on Ambient Intelligence 2004 (EUSAI 2004)*, pp. 230-242.

[4] Koleva, B., Benford, S., Ng, K.H., and Rodden, T. (2003). A Framework for Tangible User Interfaces, Paper at the *Physical Interaction workshop of the Mobile HCI 2003*, Udine, Italy.

[5] Magerkurth C., Cheok A.D., Mandryk R.L., and Nilsen T. (2005). *Pervasive games: bringing computer entertainment back to the real world.* ACM Computers in Entertainment, Vol. 3, No. 3, July 2005, Article 4A.

[6] Poupyrev, I., Tatsushi, N., and Matoko, O. (2007). Actuation and Tangible User Interfaces: the Vaucanson Duch, Robots, and Shape Displays. In *Proceedings of the 1st international conference on Tangible and embedded interaction (TEI07)*, pp. 205-212

[7] Rosenfeld, D., Perlin, K., and Zawadzki, M. (2003). Planar Manipulator Display. in *SIGGRAPH 2003 Emerging Technologies*, San Diego, CA, July 2003.