MemoICON: Utilizing Everyday Objects as Physical Icons

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Abstract. Recently the multi-touch technique is quickly mature, and becomes prevalent. As we know that Microsoft's next operating system, Windows 7, also supports multi-touch mechanism. Therefore, we can easily predict the trend that multi-touch will become a common user interface, and expect that our computer will become a multi-touch table. Therefore, to increase the work productivity through the multi-touch table interaction, we propose a new interaction approach based on pattern recognition and multi-touch techniques by utilizing everyday objects on the table. Hence, the virtual tasks can be embodied as tangible ones with the everyday objects, which will become physical icons and also become physical reminders, so we call it MemoICON. The benefit of this new interaction approach is that we do not change users' behaviors. The users can easily learn how to use our system, because the iconifying process is similar to the scenario while using the post-it memo. Our primary innovation is to make everyday objects become a part of the operating system on the real desktop as real 3D icons while fully utilizing the everyday objects' affordance and semantic meaning.

VISION

From Virtual To Real

We envision this project may expand the interaction scope between human and computer. In traditional computer desktop environment, a user only uses some traditional input devices to manipulate the object in his or her screen. Hence, the traditional desktop restricts the dimension of the interaction scope. Nowadays, we may use the everyday objects around our working environment to represent and manipulate the digital information.

From Visible To Tangible

Digital objects are only visible or audible for us. Therefore, if we cannot see or hear the digital contents, we may easily forget or ignore them. Hence, the iconified everyday objects do not only improve the visibility of the digital objects, but also provide the tangible form. The tangible form allows the user to "feel" the information in the tactile way and able to manipulate the digital objects more directly.

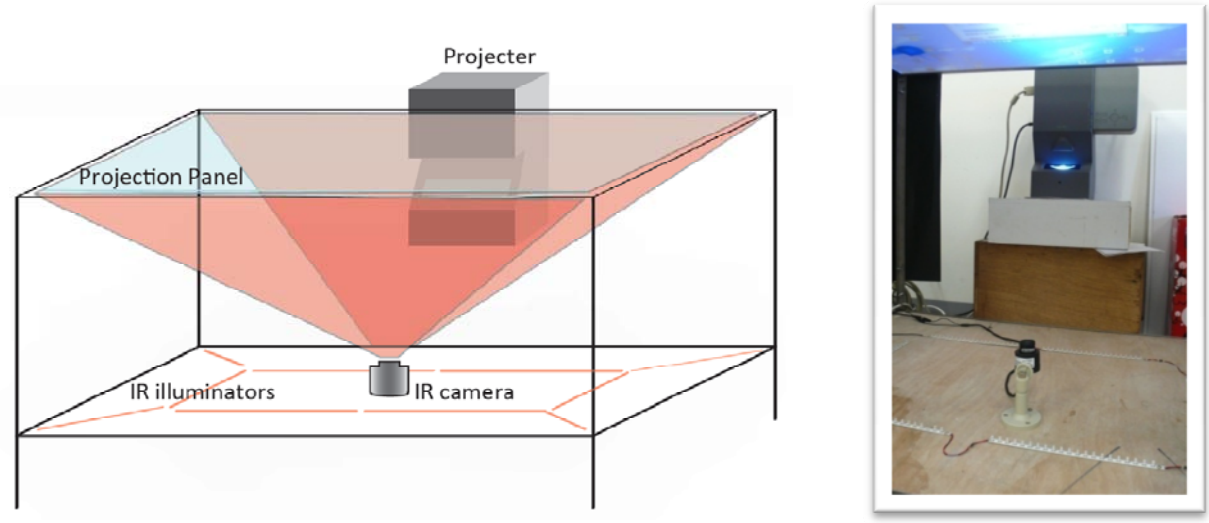
Everyday Objects vs. Specific Objects

Why do we choose to bind the information with everyday objects instead of specific-designed tokens or containers? The reason is that there are several advantages to utilize the everyday objects. First, everyday objects are personal. Each everyday object is related to the user's experience and hence suitable for personalized information. Second, each everyday object has its own semantic meaning. Once the user senses the appearance of the object, its own semantic meanings will remind him or her the inside digital contents. Third, each everyday object has its own affordance. The user can utilize the original affordance of the everyday object to do the manipulations.

SYSTEM OVERVIEW

Hardware Requirements

A multi-touch table is required for performing our system. We built our multi-touch table with diffused illumination (DI) method (FIGURE 1), which is widely used for building multi-touch tables, like Microsoft Surface. The table is designed as assembled with size of 120 $\times$ 90 cm^2. We put IR illuminators and an IR camera inside the table. The surface of the table is designed as a projection panel, which is made with two layers, the upper layer is the glass, and the lower layer is the suitable projection material, which gives good scattering effects for avoiding the spotlight caused by the illuminators. This kind of projection panel can also be seen through. Therefore, the IR camera can check the pattern sheet attached under the everyday object. Finally, we need a projector to project the related content onto the projection panel. By touching on the surface, the IR light will be reflected back into the table and the reflected IR light can be detected by the IR camera and traced by our system.

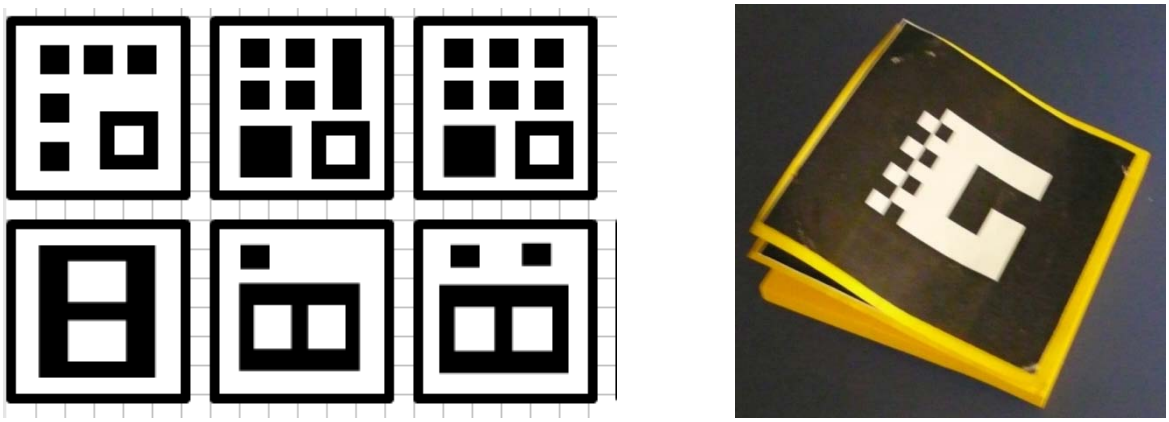


(a) (b)

FIGURE 1. (a) A sketch of our multi-touch table construction. (b) A photo of our implementation.

Software Requirements

We chose Touchlib as our software implementation. Touchlib, a well-developed open-source library framework proposed by NUI, is suitable for us to integrate the multi-touch technology into our installation. However, the Touchlib currently only supports finger/blob detections, and their fiduciary (FIGURE 2) recognition features have not developed yet. As a result, we used the pattern recognition engine from ARToolKit. We chose the ARToolKit engine because of its stability of pattern recognition and flexibility of pattern learning. To implement the interface, we used Flash and programmed with Actionscript 3 to design the visual effects and interactions. However, we found that Flash might have efficiency problem, and to make the interaction more fluently. Hence, we will port our system by using C++ and OpenGL in the near future.



(a) (b)

FIGURE **2**. (a) Some fiduciary patterns. (b) The memo pattern stickers.

INSTRUCTIONS

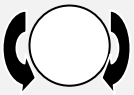
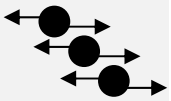
Gesture	Photo	Sketch
(a) Rotate		
(b) Select		
(c) Merge		
(d) Drag-out menu		
(e) Release		

TABLE 1. Our gesture designs. The white hollow circle represents the MemoICON, and the solid black circles stand for the finger blobs.

Basic Manipulations

Iconify: User can "iconize" an everyday object through the following procedures. At very first, the user needs to find an everyday object, then rips a memo pattern, pastes the pattern under the selected

everyday object, puts the everyday object on the table, drags any kind of digital content “into” the everyday object, and then the everyday object becomes an MemoICON. At the first initialization stage, the user also needs to choose a color for the halo. It is similar to define the icon name. The user can rotate (TABLE 1 (a)) the MemoICON to select the wanted color.

Move: There are two general methods for people to move physical objects on the surface: to drag along the surface, or simply to pick-up and put-down. Since we do not want to change user's common behaviors, both movements are allowed for moving the MemoICON. In the "drag" case, the halo would follow the trail of MemoICON's movements directly. In the "pick-up and put down" case, after the user picks-up the MemoICON, the content will be shown in the thumbnail form and while putting down the MemoICON, the halo will move toward to the new location.

Breathe Light: The MemoICON can exist ambiently without bothering the user. To show the significant difference from other “uniconized” objects, the MemoICON breathes light slowly.

Remind: When the tasks are idle for a long time, it might represent that the tasks are ignored. In this case, the MemoICON could act as an active reminder. Light ripples are used to attract user's attention.

Select: Once we want to bring the embodied information back to foreground, we can select the task inside the MemoICON by dragging it outside the halo. Here are the procedures: First, the user picks up the MemoICON and see the contents inside the halo. Without always hanging the object in the air, the user can activate the "select mode" (FIGURE 3) by putting his/her fingers into the halo (TABLE 1 (b)). Then while putting the object on to the table, the halo will not follow the object any more, and will be fixed in the original place. By dragging out the element outside the halo, it can recover the related task.

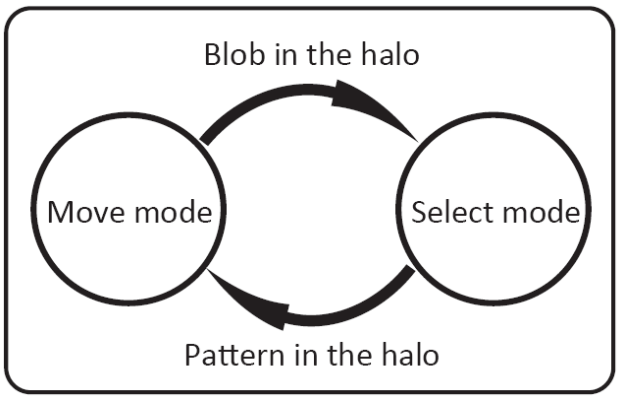


FIGURE 3. The state transition diagram of mode switching

Merge: Because the MemoICON can be treated as a container, therefore, users can freely manage the inside elements. The users can merge two sets of elements by putting the two everyday objects together, and there will pop out a button to ask them if they want to merge these two sets or not. They can also arrange the elements between the halos by dragging the element from one halo to another.

Release Info: When the embodied information is no longer needed, users can release the information inside the MemoICON by flushing it. The users can activate the release mode by drawing a "circle" gesture (TABLE 1 (e)) to summon the whirlpool on the right corner of the table. Then they can put the MemoICON onto the whirlpool to release whatever inside the MemoICON, or just drag one element to the whirlpool to release a specific digital content.

Advanced Features

Besides the basic manipulations, we also provide some advanced features, which are Time Machine, Resonance, and Ambient Tweet. Users can activate these features by dragging out the menu (TABLE 1 (d)) from the halo and select the function (FIGURE 4) by tap on the button.

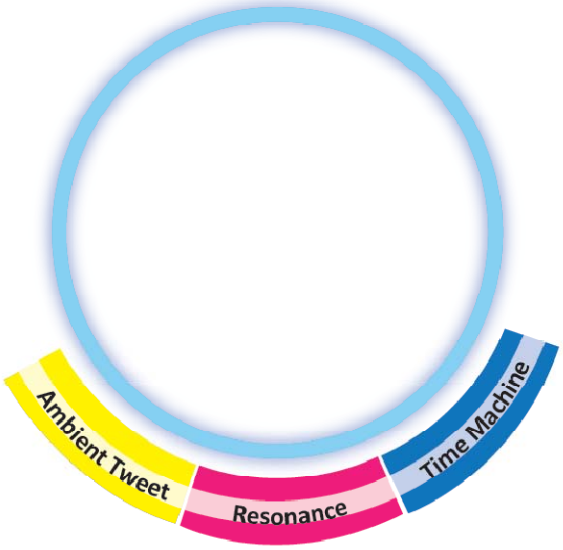


FIGURE 4. The dragged-out menu shows the options of advanced features: Ambient Tweet, Resonance, and Time Machine.

Time Machine: It is common for users to forget their previous manipulations, or need to undo their manipulations. For this reason, we designed a feature called Time Machine (FIGURE 5), which can let the user see the past moving trails of a MemoICON, and help him or her to remind the contents by

rewinding the whole life cycle of the MemoICON. To activate Time Machine, the user needs to drag out the menu and select the "Time Machine" option. Then he or she can scroll the timeline ring outside the halo to see the history of the MemoICON's previous locations and trails.

FIGURE 5. Time Machine

Resonance: Users may put some homogeneous tasks into different MemoICONs and have troubles finding these tasks. For this reason, we proposed the feature, Resonance (FIGURE 6), which can detect the contents between current and other MemoICONs on the desk, Any MemoICON containing the same file type of the task will emit ripples to help people find and classify homogeneous tasks. To activate/deactivate the resonance mechanism, the user can drag out the menu and select the "Resonance" option.

FIGURE 6. Resonance

Ambient Tweet: The MemoICON cannot only store the static information, but also the active information source, for instance, Twitter. While dragging a RSS feed of the Twitter item into the MemoICON, the object will start tweet (FIGURE 7). If the user thinks that it is too noisy, he or she can switch to the ambient mode by dragging out the menu and select the "Ambient Tweet" option to make tweeted information as ambient radar. The ambient radar will expand and glow while receiving new information.

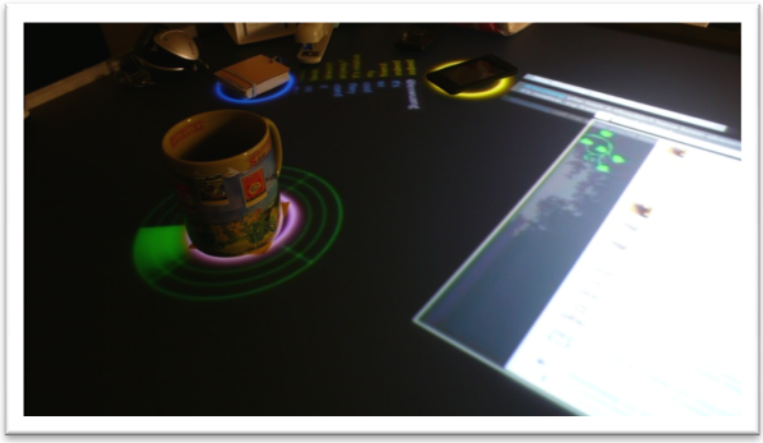


FIGURE 7. Active Tweet and Ambient Tweet

FURTHER APPLICATIONS

After we embodied the foreground activities into background, we may want to manipulate the background tasks without paying too much attention. For this reason, we propose some ways to manipulate the background tasks (e.g. music, timer, new message notifications in instant messaging, etc.) without bringing them back to foreground. Users can utilize each everyday object's original affordance to do the manipulations of background activities. Some example scenarios are shown as the follows:

Playlist Controller: Once the user drags a song into the MemoICON, the MemoICON becomes a playlist controller (FIGURE 8). The user can switch the songs on the playlist by simply rotating the icon to choose the previous or next song. Moreover, he or she can also drag the other songs into the MemoICON.

FIGURE 8. The Playlist Controller

Chat Switcher: People are used to hang on the instant messenger service as their background activities. While multiple new message notifications coming from different people at the same time, the user can simply rotate the MemoICON to switch between different chat windows (FIGURE 9).

FIGURE 9. The Chat Switcher

Event Reminder: When the user has some time-intensive tasks, the MemoICON can be used as an event reminder. To activate the reminder mode, he or she can drag the tasks into the halo. After triggering the reminder mode (FIGURE 10), there will be a timer scale instead of the halo. The user can freely decide the time-to-remind period by rotating the MemoICON. While time out, the MemoICON will emit ripples to remind him or her.

FIGURE 10. The Event Reminder

RELATED WORK

The idea of this project was inspired from several related work. In [1], three of the prototypes mentioned by Ishii and Ullmer highly influence on our working directions, and they are Bricks, Marble answering machine, and metaDESK. In "Bricks" [6], they shown the possibility of attaching virtual objects to the physical ones, and therefore, they made virtual objects physically graspable. In the work of marble answering machine [1], they used marbles to stand for the incoming voice messages. As a result, the user can grasp the physical objects (marble) and drop it into an indentation area to play the message. In the metaDESK [4] design, they have tried to push back from GUIs into the real world by physically embodying many of the metaphorical devices, such as windows, icons, handles, etc.

Related Researches

BumpTop [3] is an enhanced desktop environment designed to simulate a real-world working scenario. To achieve the goal, they brought some physically effects into their 3D desktop environments. Moreover, they also provided some well-defined gestures to give people more realistic experiences.

Mir:ror [7] is a product developed by Violet. By attaching the RFID onto the everyday object, they bind specific information with the object, like photos, weather condition, etc.

Rubber Shark as User Interface [5] is a simple and low-cost way to tag real world physical objects with digital information and functions by utilizing the uniqueness of weight to identify physical objects.

SLAP Widgets [2] are cast from silicone or made of acrylic, making the widgets combine the flexibility of virtual objects with physical affordances. Moreover, the widgets can be recognized by the surface and tracked locations by their patterns below.

Our work is to store the "task" in the MemoICON by using everyday objects, and let users interact with it directly on the multi-touch environment. To our best knowledge, there is no similar work with our project.

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