

Storing digital contents references in physical objects

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1 Introduction

Managing digital content is one of daily activities of modern people. Locating relevant data in short time increases productivity but at the same time it could turn challenging when they are located in different sources. Even if symbolic links and short-cuts can be used, organizing those turns tiresome when the amount of links becomes too large and user might end up facing the same problem locating the links.

Regarding to this problem, we propose a solution based on Tangible User Interface [1], which supports quick access to digital contents by giving locating power to surrounding physical objects on user's real desktop and converting it to symbolic link containers. User can organize the references of related digital contents from different sources and map them into a single physical object, which can be used later to access them from the object. The idea is to take advantage of the accessibility and manipulation properties of the physical objects and combine them into the digital world to provide a novel interaction method.

2 Storing digital content into physical objects

We propose a novel method to organize and access digital information using physical objects as reference containers. An object can be mapped to one or more references. In our system, it does not contain physical memory nor be modified in any way. Instead, the system stores in the computer these associations. To store a reference into an object, the user places the object in front of the screen as shown in Figure 1(a) and drags the reference toward the direction of the object regarding to the coordinates system of the screen as shown in Figure 1(b).

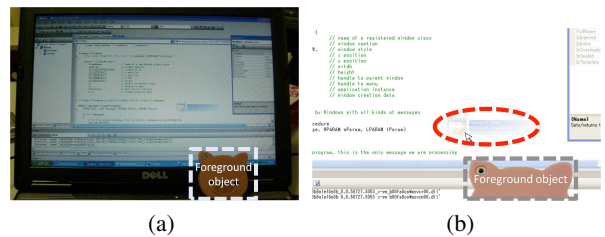


Figure 1: Association of a reference to an object: (a) the user places an object (enclosed within the white square) in front of the screen, (b) the user "drags" the current project reference (enclosed within the red ellipse) towards the object.

Next time when the same object is placed in the capturing area, the system automatically recover the list of references and display them on the screen next to the object as shown in Figure 2 so user can access these references by clicking on the link. Once the user finishes using the object, removes the object from the capturing area and the interface will close automatically .



Figure 2: Access to digital content stored in an object: when the object (enclosed within the white square) is detected again the associated references are shown in a semi transparent window (enclosed within the red circle).

3 System Architecture

3.1 Hardware specification

The hardware setting consists in a laptop computer and a web camera with a polarized filter to reduce background variation produce by the computer screen. We use computer vision approach to detect the presence and extract the features of the target object to avoid limiting interactive object to specific configuration. Additionally we defined implicitly the screen of the computer as capturing area to ensure that an object is captured by the camera when it is intended to be.

3.2 Object Detection

Our object detection and recognition is achieved by means of computer vision. Regarding to the image processing, we separate it into 3 steps. First we classify the pixels of an input image into either background pixels or foreground pixel. We use Approximated Median Filter [2] to model the background. This recursive technique is based on the estimation of median value of each pixel, which is incremented by one if the input pixel is larger than the estimate and decreased otherwise. This estimation eventually converges to a value that is the median for each pixel.

The resultant set of foreground pixels from background extraction is considered as raw representation of the object and it is transformed into a representation used by the system to model the object in 3 metrics: 1) average and covariance matrix of the color distribution (in HSV color space); 2) Color histogram on hue channel of the color image (in HSV color space) and 3) size proportion of the contour formed by the object image pixels. These 3 metrics will be used to compare an input object with those in the database to find to best match.

4 Related work

Ishii's Tangible User Interfaces[1] describes the possibility of interaction between human and digital information through physical objects. His work Tangible bits[1] proposes to give a physical form to digital information, which is more manipulable and perceptible by human natural abilities. Siio *et al.* Icon-Sticker [3] is a paper representation of a digital content which consists on transferring the icons from

computer screen to paper, so they can be handled in the real world and used to access directly to the digital content. Bernheim's AURA *et al.* [4] also uses barcode sticker to access digital online information.

5 Conclusions

We proposed a method to virtually "store" digital content references into physical objects. It enables user to access directly digital contents using any unmodified physical object, relieving the user from the burden of remembering long and complicated paths to access the target information. Additionally, the user interface is triggered by the presence or removal of an object avoiding explicit command from the user to open intermediate application to get to the target information.

References

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