

Peek-A-Drawer: Communication by Furniture

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ABSTRACT

Peek-A-Drawer is a new communication device that uses furniture to support lightweight communication between people. It provides virtual shared drawers that connect family members who are located at a distance. When a user puts something in the upper drawer and closes it, a photograph is taken automatically and the image appears in the lower drawer at a distant place. The operation is as simple as using a drawer, allowing even children to communicate with their grandparents. As the camera only takes pictures of objects inside the drawer, privacy is assured.

Keywords

Peek-A-Drawer, Digital Decor, ubiquitous computing, image communication, I/O device, drawers, furniture.

INTRODUCTION

The nature of our personal lives is changing. We no longer live in co-located extended families. Instead we have adopted economic mobility over geographic stability. Because of these decisions we frequently find ourselves living across the country from members of our extended family. Grandparents, though distant, still want to share a part of their living space and their lives with their grandchildren. They want to know about their grandchildren's favorite toys, their artwork, schoolwork and all those things that would be naturally shared if they lived close to one another.

While we can already share our lives using current electronic tools such as email, digital cameras, and video conference/telephone systems, these are lacking in two respects.

First, they are not as easy to use as many appliances that provide a single function and simple operations such as putting something in and pressing a button. Secondly, these electronic tools require a deliberate action to activate communication. They are not as lightweight as simply storing something away in a shared drawer in a home.



Figure 1. A prototype of a pair of Peek-A-Drawers. The contents of the upper drawer (left) are displayed in the lower drawer of the other chest (right).

PEEK-A-DRAWER

For this design we have chosen a drawer in a chest of drawers as a space to share with a distant person. A chest of drawers already functions as a storage unit and family members in a home often share its contents. For this reason, it seems like a natural choice to augment drawers to provide a virtual shared space for use by people in separate homes.

As shown in Figure 1, we have made a pair of the Peek-A-Drawer prototypes by using commercially available three-drawer chests (64cm height x 49cm width x 39cm depth). We have removed the top drawer to make chests of two drawers. We have equipped this space with a digital camera (Olympus D-360L), halogen lamps, a reed switch and electronic circuits, in place of the original top drawer. The digital camera faces downward to take a picture of the contents of the upper drawer. The reed switch detects the drawer-closed event of the upper drawer. In the lower drawer of each chest we have installed a computer (900MHz Celeron with Linux OS), a 15-inch LCD and buttons. The pictures taken by the camera are shared over an Internet connection between the computers in the two chests. The LCD in one chest displays pictures taken by the camera in the other chest and is placed, facing up, in the lower

drawer, providing an illusion that the user is looking into the distant drawer.

Mounted just under the top board of the chest, the digital camera is 30.8cm above the bottom of the target upper drawer. To be able to capture the entire contents of the target drawer, a wide-angle converter lens of 0.5X was placed in front of the digital camera. In order to make a natural-looking image for the display, software was written that compensates for the barrel distortion of this lens. To control the camera and extract the captured images, the camera is connected to the computer by a serial I/O port¹.

As it was technically difficult to synchronize slave flashes with the camera, we have installed two halogen lamps under the top board with the camera to illuminate objects without shadow. The power for these lamps, the camera and the reed switch is controlled through a parallel port.

The computers in each of the chests are running three software components; a picture-taking program, a WWW server, and a picture-browser. When a user closes the upper drawer, the picture-taking program detects the event, turns on the lamps and the camera, and takes a picture inside the drawer. After compensating for the barrel distortion, it assigns a unique name and places the image on the WWW server's file directory. The picture-browser in one chest periodically checks the WWW page in the other chest and gets a new picture file when it becomes available.

Simple picture navigation is also provided by the picture-browser through buttons, one located on the left and right of the display. When the button on the left (or right) is pushed the browser switches to an older (or newer) picture respectively.

DISCUSSIONS AND FUTURE WORK

Using a drawer

Technically, the same communication function could be realized by designing another configuration of a digital camera with automatic data transfer ability. We could adopt a mobile camera or a wall mounted camera to enhance variety by shooting objects outside drawers. But by constraining the camera's use to a closed, well defined, fixed space (inside a drawer) we believe our Peek-A-Drawer configuration addresses certain privacy and usability issues.

First, parents would be justifiably reluctant to give their children a hand-held device capable of transmitting images, viewable on the web, that could compromise the details of the intimate inner workings the family home.

Second, people expressed concerns about having an on-line camera device in their homes, even if they know that the camera does not take a photo until it is activated. For this reason we did not design a system that takes pictures in fixed, more open spaces such as a specified corner of a room, or of a table.

Third, novice camera users or children will benefit by a

¹ <http://photopc.sourceforge.net/protocol.html>

fixed camera, because the picture will be in focus, properly exposed, not blurred, white-balanced, and well composed. Additionally, equal-sized pictures in the equivalent drawers will help small children to understand the size and details of remote objects.

Digital Decor

In the near future, we will be using many single purpose information appliances equipped with ubiquitous, invisible computers [2]. Decor such as furniture, appliances, and small articles commonly found in homes are a good place to install invisible computers, because they also have single or, at most, a small number of functions, and have familiar simple operations. We can design decor enhanced with invisible computation, or "Digital Decor", drawing on the user's knowledge of original decor's functions and operations, just like we have been designing GUIs using real-world knowledge as metaphor. The challenge of designing digital decor is in the design of the interface between the activities of everyday life with the decor and the invisible digital world.

Peek-A-Drawer is currently designed in a manner that is completely symmetrical. Since the needs and capabilities of a grandchild are quite different than those of a grandparent we are currently extending this prototype to accommodate these differences.

RELATED WORK

Peek-A-Drawer addresses light weight human communication concerns similar to those addressed by the Digital Family Portrait [1].

HomeBox [3] is a set of drawers designed as a WWW content creation tool for people in the developing countries. Users can arrange the contents of the drawers and create their WWW page wherever a scanner and an Internet connection is available. Although the main purpose of this system is to realize efficient use of computer resources by batch processing, it also demonstrates the ease of use afforded by an everyday set of tool drawers. In contrast, Peek-A-Drawer focuses on one-to-one communication and has an onsite camera, server, and browser to support this interactive communication.

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