

Mediator and Medium:

Doors as Interruption Gateways and Aesthetic Displays

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Motivation

Doors are more than entrances to rooms, they are entrances to a person's time and attention. People can mediate access to themselves by choosing whether to leave their door open or closed when they are in their office. Doors also serve as a medium for communication, where people can exchange messages with passersby. These qualities make the door an excellent location for designing solutions that help people better manage their time and attention. In this work, we present a study of doors, derive design insights from the study, and realize these insights in implementations deployed in our workplace.

Door Observations

During our design studies we found many interesting artifacts. These are a few of the many we observed.



A partially transparent screen.



Is the return time accurate?



An eclectic display.



Put papers on the chair!



A clever message.

Design Studies

We observed the roles doors play in two dimensions:

1. As mediators of interruptions between visitors and inhabitants
2. As a medium for personalization and information

We did two observational studies of doors exploring their *objects* (e.g., signup sheets), *properties* (e.g., sizes and colors of posters taped to doors), *actions* (e.g., a person hovering outside an open door), and *relationships* (e.g., differences in interruptions based on social status).

Objects and Properties

We spent fifteen hours around our university examining the objects that people placed near their doors. We looked at hundreds of doors in different schools, such as business, fine arts, computer science, humanities, and engineering. These objects fell into the following categories:

- Information distribution (e.g., announcements)
- Information depository (e.g., sign-up sheets)
- Personal expression (e.g., aesthetic images)
- Instructional (e.g., "Joe, meet me at the concert")
- Temporal (e.g., "I'll be back in X minutes")

Actions and Relationships

We also spent ten hours observing the actions that take place around and "through" doors. Some actions we witnessed include:

- Glancing in doors while walking down a hall
- Knocking on a door gently, leaning in to listen for activity within the office, then leaving
- Sliding an assignment under the door
- Lifting a handout from a bin outside a door
- Reading a poster on a door
- Testing the doorknob to see if the door is unlocked
- Waiting outside a closed door
- Hovering outside a half-open door, traversing the visual field of a busy office inhabitant, apparently hoping to be seen but trying not to interrupt

From Observation To Design

In the second phase of our effort, we mined our observations for design insights. We found that our design effort might be applied in the following areas:

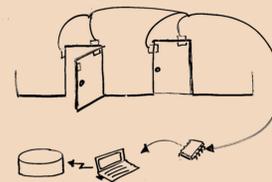
- Exploring the effort to interrupt
- Exploring the temporal communication between inhabitants and visitors (e.g., daily schedule)
- Augmenting aesthetic expression on doors
- Selectively publishing information (e.g., a professor's schedule is shown only to her students)
- Tracking exchanges between inhabitants and visitors
- Developing new affordances for interruption
- Aiding in the flow of information between inhabitants and visitors

Design Implementations

In the third phase, we put our design ideas to work in the implementation of two systems: Remote Door Awareness and the Door Projector. These systems work together to enhance awareness while providing new means for aesthetic expression on doors.

Remote Door Awareness

This system is comprised of three parts: sensors to measure the state of a door, a history database of door information, and a visualization system for communicating history to end users.



Door Sensors & History Database

We made our sensors using two magnetic contact switches positioned at different locations along the top edge of a door. This allowed us to sense three door states: *wide open*, *ajar*, and *closed*. Everytime a door's state changes, an entry is submitted over the Internet to our history database.



Abstract Visualizations

We created displays to explore ways of presenting the history data captured by the door sensors. The displays were intended to extend the range of awareness typically afforded by a physical door in aesthetically pleasing and novel ways, while also preserving privacy and being minimally disruptive.



Door Projector

We built a system using a door with a window and a data projector. Our goal was to change the unalterable two-way information channel of a window into two one-way information channels that could be manipulated by the office inhabitant. We implemented this system by covering the window with vellum and projecting onto the window and the door from the inside of the office. The projected area in the window was flipped, so it could be viewed correctly from the outside. This creates a public area on the window, and a private area on the inside of the door.

We installed this system on the door to an office containing fifteen Ph.D. students, and experimented with projecting the following elements onto the door:



Virtual Notes

We used a sticky notes program to leave virtual notes on our door. This allowed students to post announcements and remote visitors to leave messages. We also posted instructions for using the door system on the private side of the door.

Digital Art

The students were able to customize the door with web pages, graphics, and other elements. Microsoft's Active Desktop technology was used to embed graphics on the screen.



Awareness Information

We were able to display two kinds of awareness information on our door. Visualizations from the Remote Door Awareness system were displayed. We also built a system called StatusLight that allowed users to manually define their interruptability and display it on the door.

Future Work and Implications

Though our initial deployment of the Door Projector and Remote Door Awareness systems shows promise, it is clear that more work is needed. The following presents several areas that need to be addressed.

Implementation

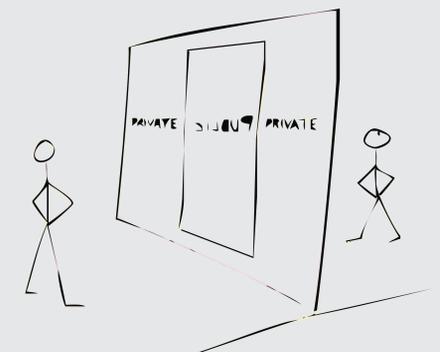
The Door Projector does not currently support interaction with the surface of the door. Instead, users must run software from personal machines in order to interact with the door. We would like to explore the use of computer vision techniques to recognize when a user touches the door. We believe that free-form interaction will improve the usability and utility of the door system.

Field Studies

The Remote Door Awareness visualizations need to be tested on larger groups. The current work has only investigated use with a handful of individuals. With additional members we can study how our system might affect social networking and group cohesion.

Outstanding Issues

Privacy issues are also an area of major interest. While the awareness systems provide knowledge to a wider audience, it is important to examine whether this affects the inhabitants (i.e., does it increase interruptions to the point where it is no longer useful).



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