Designing Interactive Transparent Exhibition Cases

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**ABSTRACT**

Interactive technologies in museums and galleries enhance on-site learning by providing information about the exhibitions and motivating collaboration and participation. In this paper we revisit the design of an existing exhibition medium – the transparent case – from a lifelong learning perspective. Transparent cases with interactive properties can complement other museum technologies and minimize their shortcomings (e.g. mobile devices isolate groups; public displays are disconnected from the objects). This paper focuses on the design of interactive transparent exhibition cases and makes three contributions. First, based on field observations and interviews we enumerate a list of requirements for interactive transparent cases. Second, we propose a design space for interactive cases with dimensions grouped around the themes of *hardware*, *interaction* and *information* design. Our design space suggests cases which present collocated information at increasing levels of detail, support different input modalities, facilitate social interaction and integrate with other technologies. Third, we present alternative interactive case designs and discuss their implications for different audiences and learning styles and enumerate technical challenges.

**Categories and Subject Descriptors**

H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

**General Terms**

Design, Human Factors.



Figure 1: Traditional acrylic exhibition case (non-interactive).

**Keywords**

Transparent Displays, Cultural Heritage, tCase, Exhibition, Transparent Case, Case Display, Museum Display

# INTRODUCTION

The museum visiting experience is evolving due to the emergence of novel interactive technologies [1]. Technologies such as audio guides, mobile applications and public displays allow museum visitors to access relevant information on-site [REF], to personalize this information [REF], and to collaborate with other visitors [REF]. This abundance of information and interaction opportunities redefines the traditional roles of museums: from institutions that deliver formal learning to spaces that facilitate open-ended explorations and alternative interpretations of artefacts [1].

Sharples [7] enumerates a set of goals for museum technologies such as portability, unobtrusiveness and intuitiveness. However, field studies show that current technologies, although fulfilling most of these design goals, might not be optimal for users as they present undesirable side-effects. For example, audio guides isolate people from the group hindering collaborative explorations. Mobile applications take the attention away from the exhibition to the device. Public displays are spatially detached from the objects and occupy space which could be dedicated to more artifacts.

Recent advances in transparent display technologies allow us to envision their usage in exhibition cases. In this paper we explore how to redesign exhibition cases as information appliances (using transparent displays). Exhibition cases are essential media for the showcase of volumetric artifacts which, unlike pictograms, should be explored from multiple angles (see Figure 1). The glass/acrylic helps protect the artefact from visitors and environmental conditions. Attached labels provide basic information such as the exhibit’s name, author, origin, material and year. Adding interactive capabilities can offer the necessary multi-angle exploration and protection while providing the benefits of interactive technologies for information delivery.

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To identify the challenges and opportunities for interactive cases we performed field observations in museums and galleries, and conducted interviews with relevant stakeholders. Based on our fieldwork we present requirements for interactive transparent cases including, for example, multi-side exploration, information scaffolding and open-ended exploration. Further, based on our own and others’ experiences designing museum and public display technologies we propose a design space for interactive exhibition cases and group its dimensions along the themes of *hardware*, *interaction* and *information* design. This design space highlights different possibilities for redesigning transparent cases while implementing the mentioned requirements. Finally, we present exemplary designs, including integrations with other museum technologies, and discuss their implications for different audiences and learning styles, and enumerate technical challenges.

# RELATED WORK [0.5P]

The arrival of tape recorded tours [1] and the Internet [3] marked the beginning of a new era in our relationship with museums where information technologies serve as alternatives and complements to the traditional ways of obtaining information about exhibitions such as books, exhibition booklets and expert guides. Over the years, other technologies have been introduced with ever more promising results. Digital audio guides allow visitors to navigate the audio contents interactively and in a non-sequential manner [6]. Mobile devices bring multi-media content to the hands of the visitor enabling collocated exploration [REF]. Head-worn displays provide context-sensitive information based on user’s location and gaze []. Public displays fostering group coordination and collaboration [].

As the technologies evolve, the raison-d'etre of museum technologies has also changed. Starting from an initial focus on information access and online reach, new installations focus on interactive experiences, personalization and collaborative exploration. Interactive… Personalization… Collaborative…

Sharples [] generalizes from many of these experiences and argues that interactive technologies for museums should be X, Y, and Z. Researchers have started to look into augmented reality (AR) as an interaction paradigm that could fulfill most of Sharples’s ideals. Mobile augmented reality, as used in [REF Room One][][], augments objects by simply pointing a handheld device at them. Spatial AR, as in [][][], uses displays and projectors fixed on the space to augment objects. Although not mobile, spatial AR provides higher definition experiences which can be shared among users.

In this paper we depart from existing approaches to museum technologies, and investigate the re-design of an existing media, namely transparent exhibition cases. By appropriating an existing device, we expect to lower the entry barrier and, given its similarity to public displays, leverage its potential for social interaction. We also go beyond the proposed usage of transparent displays as mechanisms for spatial AR, which we cover as an alternative to *content alignment*. Besides AR being technically complex, our work shows that AR is just an option to the user-interface design and perhaps even secondary to design issues such as *attention attraction* and *personalization*. To the best of our knowledge, this work is the first to study exhibition cases as information appliances for museum and art galleries.

Paragraph about transparent displays covering types (projector-based, LCD, T-OLED), interactions, applications and limitations.

# ARTIFACTS ON DISPLAY

In order to understand the design and usage of transparent cases we conducted field observations at the [XXX] Museum and the [YYY] Art Gallery. We analyzed the location, orientation and physical layout of exhibition cases, and performed artefact-centered observations of interactions with and around them. We captured our observations in pictures, and later tagged them and aggregated the tags into general themes. We also interviewed museum personnel including two curators working mainly with sculptures and two administrative workers involved in their installation and maintenance. This section presents the results of our fieldwork and interviews as requirements for interactive cases (implicit in this list is their role as protection mechanisms).

The first requirement for an interactive transparent exhibition case is *to support exploration from as many angles as needed* by the artefact (**R1**). For example, Figure 2A shows a case for simple or planar objects which is “enough” to see from one side. On the contrary, Figure 1 and Figure 2B show cases where the objects are rich in details from multiple sides. The require number of transparent sides and the size of the object influences the location of the case. Single side cases are easily located against a wall (Figure 2A). Small all-around cases like in Figure 1 can be in the middle of a room (as far as possible from the walls in order to allow all around exploration), while the bigger case of Figure 2B is used to separate two different halls.



Figure 2: Planar and all-around transparent cases.

The second requirement is *to link information to objects in accessible ways* (**R2**). Exhibition space is scarce and curators optimize it by grouping several objects in a single case (Figure 2A), balancing the information they provide against the number of objects. This tension is often resolved by using small labels which limit the amount of information and affect its readability. More information is provided within the exhibition hand-outs or the didactic panels (i.e. poster or wall legend as see on the right side of Figure 2B), however this elements are separated from the objects and are often ignored (e.g. display blindness).

The third requirement, inspired by [7], is *to present information in unobtrusive and intuitive ways* and not stand on the way of exploring the artefacts (**R3**). This is evident in the current utilization of small labels (with their intrinsic problems) and side panels which, as highlight by admin personnel, presents a low entry barrier for the less tech-savvy visitors.

The fourth requirement is *to facilitate information scaffolding* around the notion of interpretation *layers* (**R4**). Interpretation layers connect the objects of an exhibition. One layer might be the thesis the exhibition presents and connects all of its objects (e.g. the oral tradition of a tribal group). Another layer might be the works by a particular artist or material. The latter types of layers connect only a subset of the objects on the collection. Layers might also scalate beyond the reaches of the physical collection. While some of the visitors might not be interested in any of the layers (e.g. tourists), others might be interested on the general thesis and more specialized visitors might follow particular layers (e.g. an artist). Moreover, making layers explicit provides context for the whole collection, even if other cases are not interactive.

The fifth requirement is *to support collaborative explorations* (**R5**). Transparent cases, similar to public displays, allow visitors to concentrate on an artefact and share interpretations. In a formal setting visitors stand around the case and a guide indicates the points of interest of a given object. Informal groups stand around the case, explore and pointing at the artefact freely, changing positions and collaboratively sharing interpretations.

The final requirement is *to enable open-ended explorations* (**R6**). While the static nature of existing exhibition cases easily supports a museum experience where curators provide interpretations of the works, novel technologies should enable the creation and sharing of alternative interpretations.

# DESIGNING INTERACTIVE CASES

Designing interactive cases to meet the requirements previously outlined can happen in many ways. Moreover, previous works on museum [RE] and public display [RE] technologies suggest important design problems which cannot be observed in with non-interactive cases (e.g. attention attraction and inciting interaction). In this section we propose a design space for interactive cases aimed at meeting both the requirements presented in the previous section, and the challenges derived from previous experiences. We group the design space categories around three themes: *hardware*, *interaction* and *information* design.

## Hardware Design

These dimensions are concerned with the physical design of the interactive case with a focus on information access. For the sake of completeness we remind the reader that the hardware design also contemplates the protective and security role that exhibition cases offer, which is out of our scope. Transparent cases should not only prevent theft and unwanted manipulation of delicate artefacts, but in cases should also maintain the environmental conditions for the preservation of objects [9].

### Transparent Display Technology

A transparent optical[[1]](#footnote-1) see-through display can additive (such as projector-based or T-OLED) or subtractive (such as LCD). To use one or another technology should consider the space availability, light resistance and required transparency (**R3**). Projector-based displays use diffusive films or half mirrors, require space for locating the projector and image key-stoning, and provide high levels of transparency. T-OLED displays are self-contained but, to date, present low color capacity and are the least transparent [8]. LCD displays require extra room for the backlight and are not completely transparent; their usage is limited to artefacts that can resist bright illumination.

### Display Coverage

Display coverage refers to the percentage of the transparent surface that is a display. Given that transparent displays are not yet fully transparent they blur the exhibition, obstructing its exploration (**R3**). Moreover, interactive displays are often “owned” by the active user, creating the honey pot effect [1] and keeping others from coming closer and examining the object. Limited display coverage provides fully transparent non-interactive areas for clear and people-free exploration. In the case of single-sided cases (e.g. Figure 2A) proximity could alleviate the obstruction problem.

### Input Mechanism

Input mechanisms have different physical demands depending on the desired interaction. For example, a depth sensor supports mid-air (gestures, gaze tracking, virtual arms) or touch interactions depending on its placement (front facing or parallel to the display surface respectively). IR camera-based touch can be implemented by embedding cameras inside the case. Camera-based and capacitive touch frames attach to the display requiring little extra space (note that binocular parallax affects touch interactions in transparent displays and require alternative cursors [5]). Tangibles can be used as interaction surrogates “select” areas of interest [4]. Finally, traditional input mechanisms can be used (e.g. keyboard, mouse, touchpads, trackballs, etc.) in order to support less tech-savvy visitors (**R3**).

## Interaction Design

### Content Alignment

Plain content

Augmented Reality

### Visitor Attraction

Bring people closer to the exhibition

Video/Showcase, playing with transparency (saliency, display blindness)

Physical movement

Attention tracking and adaptation

### Communicate and Provoke Interaction

Communicate that the case is interactive

Unobtrusive interface in case the person does not want to use it

## Information Scope

### Personalization

None (sequential)

Content exploration

User-types (predefined, includes formal curricula)

Adaptive (created user-models)

### Information Source

Object

Exhibition

Institution

Online

### Device Integration

Solo

Local (current room or exhibition)

Full-site (complete museum)

Online

Mobile (such as in TIDE)

### Learning Approach

One-way

User-creation

Collaboration

# DESIGN EXPLORATION [0.5P]

We present three possible designs in

1. Single-sided, touch-enabled
2. Single-sided, back display
3. All-around, multi-sided
4. All around, single-side

# CONCLUSIONS [0.25P]

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1. Video see-through displays are not transparent and therefore we do not include them in our analysis. [↑](#footnote-ref-1)