

Design Criteria for Public Display User Interfaces

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Abstract. Recent technological advances have made large displays available on the mass market at affordable prices. We present a set of design criteria that support those who want to exploit such displays effectively to select the relevant content and present it in such a way to take into account the features of the specific devices and the context in which they are used. The discussion is exemplified with concrete example application of the design criteria.

Keywords: Public Displays, Guidelines and heuristics, Presentation design.

1 Introduction

Recent technological advances have made available on the mass market large displays in the range of 40 – 60 inches at affordable prices. Such displays can vary in terms of orientations and technologies used (LCD, plasma, various types of projectors, ...). Given the low cost such devices are being installed in great numbers in a variety of public places (train stations, airports, hospitals, public offices, museums, universities, shop centers, bars and restaurants, ...). Thus, their deployment can occur both in outdoor and indoor environments for providing various types of contents (informative, entertainment, advertisements, ...).

Unfortunately, often this widespread distribution has occurred without paying sufficient attention to how information is provided through such devices, thus diminishing their potential effectiveness. Indeed, some authors introduced the concept of display blindness [1] to indicate an effect similar to banner blindness on the Web: displays for which users expect uninteresting content (e.g. advertisements) are often ignored; an example taken from the Pisa (Italy) train station is shown in Figure 1.

Thus, it becomes important to think carefully about what information to provide through such screens and how to present it. Indeed, this work was stimulated by a project of a regional public authority in the health domain in which a number of large displays were bought for their deployment in various hospitals, first aid centers, and health offices and they needed to identify guidelines regarding information selection and presentation in such devices.

The purpose of this paper is to introduce a set of design criteria for public displays that can be installed in various contexts of use and indicate some examples of their application. We focus on public displays, which provide dynamic output but do not support the possibility of user interactions, since this is still the most common case of

their use and, even if technically possible, for various reasons organizations sometimes do not wish to allow interaction with them. The only interactive element that we have considered is the use of QR codes in public displays user interfaces since it is easy even for non-technologically expert users and content providers. Thus, its use can be recommended even if user interaction is not contemplated because it can be a simple mechanism to provide additional related information on the users' smartphones.



Fig. 1. Example of display blindness in a train station

In the paper, after discussing related work, we introduce the dimensions characterising the proposed set of design criteria, we then discuss how to apply them more in detail, and provide some example applications. Lastly, we draw some conclusions and provide indications for future work.

2 Related Work

Designing user interfaces for large displays has some differences with respect to the case for Web desktop applications, which are the most common applications. In desktop Web applications users usually access their applications alone, while sitting, and with the possibility of spending some time for searching and reading information, which can be located on any Web server, public displays are usually accessed in public areas, where people are on the move and have little time to observe them. Moreover, the information that is accessible in such displays is predefined, with limited or no possibility for users to select the content.

While many user interface guidelines exist for desktop and mobile devices, little has been proposed to capture the specific aspects of public displays. Nebelling et al. [2] addressed issues related to the overall use of the screen, the proportions between

different content elements and the readability of larger amounts of text but only in the context of news web sites accessed through large screens. They pointed out that Web sites made with older technologies or that are not designed from scratch with a view to adapting show various problems. Some common causes of problems are: the fixed vertical layout, i.e. with default columns width that cannot be modified and do not allow easily readable distribution of content in the space provided; poor layout with large centre or left areas, leaving large unused spaces; the intrinsic characteristics of texts and fonts used (weight, size, etc..) that, when set in absolute rather than relative terms, do not fit the browser window. The authors indicate possible solutions based on automatic font scaling, elements adaptation, use of CSS3 multi-column attributes, and automatic content pagination.

Muller et al. [3] found that the specific requirements for public displays are that they need to grab the attention of passers-by, motivate passers-by to interact with them, and deal with the issues of interaction in the public. Thus, they identified a taxonomy for existing display installations according to four possible ways (posters, window, mirror, and overlay) to use interactive public displays and briefly discuss the most suitable interaction modalities and interaction techniques for each of them without providing a set of concrete design criteria. Huang et al. [4] report on the findings of a field study examining the current use practises of large ambient information displays in public settings. They found that the technology and content being widely used was relatively simple. The set of public displays for ambient information that they found deployed consisted almost entirely of non-interactive vertical displays consisting of announcements for services, events, resources, “fun facts,” or products, as well as more abstract artistic content. From their analysis they derived some general recommendations that concern brevity of glances, positioning of displays, content formats and dynamics, catching the eyes, and display size. We have considered also them in elaborating our proposal with the aim to provide more concrete indications for user interface designers and developers. Alt et al. [5] have considered how to evaluate public displays rather than the design of their user interfaces: they identified five evaluation paradigms either used to inform the design of a prototype (ethnography, asking users) or to evaluate a prototype (lab study, field study, deployment-based research), and they ended up with some other general recommendations as well: choose your focus on internal, external, or ecological validity; consider the impact of the content; understand the users; and check for common problems.

Examples of interesting applications in the public displays area are reported in [6, 7]. In particular, [6] reports on the design, development, and deployment of Digifieds (derived from digital classified), digital public notice area, and the findings from its evaluation: the preferred content is events, sales, and community-based information; both the mobile and the display client could be easily used, preferences depend on the user’s situation and privacy concerns. The other application [7], Agora2.0, is a system that aims to foster the dialog between citizens and their political representatives and administrators, composed of two equally relevant features: an online system for voting ideas and an interactive public display deployed in a public space that is relevant to the community, a public relations office. However, a set of structured guidelines for designing user interfaces for public displays has not emerged from such works either.

3 The Design Space

Based on our experiences and discussions with target users and domain experts, and the analysis of previous work in the area of public displays, we have identified nine aspects that are relevant when designing user interfaces for public displays.

They can be grouped according to three main dimensions: the context of use in which the public display is deployed and accessed, how to select and organise the content to provide through it, and how to present the content in such a way to allow effective and efficient access to it.

In particular, the most relevant contextual aspects are:

- **Position:** where the display is located has an impact on the choice of the most suitable type of information and presentation, some locations are suitable for longer information access while others are places of transit and thus users dedicate rapid limited attention;
- **Time:** different contents can be more relevant depending on the time they are shown, for example if the display is located in places where new events occur frequently, then it is useful to exploit such changing events and immediately indicate those happening in the upcoming relevant time period;

The content-related aspects are:

- **Type:** it is important to carefully select the type of information, the source channel and media used to communicate, this depends on the environment in which the display is located, the target users, and its purpose;
- **Number of information items:** refers to the number of information topics presented with a specific style. Usually, the public display user interface is structured in a number of distinct areas, each of them presenting information associated with a specific topic. Overall, the screen should be exploited in its entirety without becoming too cluttered;
- **Text:** it refers to what various textual styles to adopt, how to structure them, the number of words associated with each of them, and how they should be presented.

The presentation-related aspects are:

- **Layout:** The visual structure of the user interface should consider the screen dimensions and exploit them in terms of number of internal areas, associated with the various information topic addressed, their positions, and dimensions;
- **Colour:** the choice of the colours for the user interface elements should facilitate visual interpretation for users viewing from distances greater than desktop users (usually between 1 and three meters instead of less than half meter);
- **Font:** the most suitable font attributes for the textual content in this type of display;
- **Dynamicity:** how the content presentations change over time and how their transitions should be represented.

4 How to Consider the Design Space

In this section we detail and discuss how to address the various dimensions of the proposed design space, and which aspects to consider for each of them.

For the context of use we have identified the position and the time as two important factors. Regarding the position, the choice of the place where to locate the display is fundamental: it should be accessible, visible, in a heavily trafficked place, at eye level or above. It can be indoor or outdoor (e.g. streets, train stations, ...). Some typical indoor locations are entrances, waiting rooms, hallways, shop windows, counter of an information point, ... Depending on the position various aspects can vary: the information displayed, the dynamicity of the information, the structure of the layout, timing, For example, a display at the entrance can show various screens with essential information repeated periodically, while a display in a waiting room can show various, more detailed, pieces of information at the same time, available for longer time. In a street it can be useful to have some multimedia elements with animations in order to draw the attention.

The scheduling is another important aspect as well: the type of content should be well suited to the time of its display in order to highlight useful information for the next hours. Such information can be general or specific to the context in which the public display is located. For example, in the morning it can be useful to show weather forecast for the day or the timing for public opening, while in the afternoon it can be useful to indicate events that occur in the evening nearby, while in the evening it can be useful to show the weather forecast and meetings that are scheduled for the day after.

Regarding the content types, in order to make them more visible and pleasant they should be multimedia, by integrating various types of texts with images, videos, maps, ... but they should also simple to ease their interpretation. QR codes can be useful to provide related additional information directly in the users' smartphones. The sources of the contents can be heterogeneous, some of them can be static and others dynamic, provided by external sources, which can be local or remote. The important point is that external content should be filtered and structured in order to be included consistently in the public display user interface. The use of content derived from social networks depends on the application domain considered. For example, in the project about deployment of large displays in the health sector we discussed the use of Twitter as a source of information. However, this possibility was discarded since in some cases the information provided needs to be first carefully checked, and may even have some legal implications. While in the same domain the display of content derived from news channels was considered useful in order to provide up-to-date information on a variety of subjects and does not suffer from such drawbacks.

The number of information items to provide depends on the purpose of the display, the user interface structure and where it is located. For example, if the purpose of the display is informative then greater amount of information is expected, even provided dynamically through multiple presentations. The location is relevant since it determines how long people can look at the screen, and consequently the number of topics that can be considered: waiting rooms or public offices imply the possibility of

standing for longer time than entrances and corridors where people have to move and so the texts should be read quickly. Each topic is associated with an area in the public display, usually we have a range from 3 to 6 informative areas.

Regarding the text, usually it should be communicated with short clear expressions, in very few lines, left or centre aligned, sometimes using bulleted lists. In the design of digital signage slides, some authors [8] indicate that, in order to provide clean, simple, attractive, and appropriate content, the main message should be communicated with a few, clear, and simple words (from 2/3 to 5/6 words), and a limited number of rows (from 1/2 to 6/7 rows). Titles should be with at most 22 characters, texts with at most 27-30 words, verbs used in active form, describing actions and stimulating involvement by using key words. In any case, secondary information can be structured in longer and more discursive paragraphs with the goal to provide additional information to the main message and stimulate the viewers' reading and deepening.

For the presentation, various aspects should be considered. The layout should be organised in such a way to capture the users' attention and drive their visual scan. It should be composed of three to five areas associated with the main information topics whose space depends on their importance. The resulting structure should be regular and easy to interpret. In general, there is one main area in the central part, which should attract the user's attention and provide the most important information, and some secondary areas with various spaces. Thus, symmetric layouts where two or more main areas have similar size do not seem to provide a useful hierarchy for driving the user view.

The public displays often should grab attention and communicate a message quickly and effectively. When too many colours are used, our eyes do not know where to look first. Thus, the classical 7 ± 2 colours can be applied. Indeed, by simplifying the colour number it will be possible to more effectively guide viewers. Contrast is a key element in colour choice in order to make sure that the message is easily readable. The choice of the colour should also consider the type of lighting available in the location where the public display is deployed.

The font should be simple and readable in order to better support the communication. It is better to avoid the use of fanciful or small fonts, which can be difficult to read. The titles should have a font size larger than texts with a ratio that can go from 1 : 1,5 up to 1 : 2 (for example, titles with 40 pts and text body with 24 pts or titles with 72 pts and body text with 36 pts) [8].

There are two types of dynamic behaviours in public displays: one is related to animated content often used to attract user's attention and one is more oriented to provide pleasant effects during the transition between showing two different pieces of information. Usually the interaction between the user and the display is short and casual. The user's full attention is usually limited to 2-3 seconds. Then, before deciding whether reading carefully or moving the gaze somewhere else the content is looked for 10-15 seconds. The overall average observation time depends on the purpose of the display and its location and is usually between 3 and 7 minutes. In an entrance or hallway it can be 2-3 minutes while in a waiting room it can be 7-8 minutes. In the case of various pieces of information that are shown in a cyclic way then the average time for each presentation should be around 3-5 minutes with some variations depending on the location [9].

5 Three Example Applications

We have considered three example applications for our guidelines for public displays: a hospital waiting room, a museum, and a research centre. Such contexts are different and thus determine the communication of different types of information in a different way.

In a museum context using a public display to show static information such as fares and opening time would have limited effectiveness, while exploiting the large screen in order to show dynamic content that supplements the static descriptions accompanying the various artworks could improve the user experience. For example, in a museum showing sculptures, it can be used to show where the quarries from which the material for such sculptures was extracted are located, the techniques used to extract such material, where the artists processed them, other artworks made by the same artists or similar artworks that are located in other museums.

Hospital waiting rooms are destined for use by people who often have to wait for long times, and thus may be willing to read more elaborated content. Health organizations can take this opportunity to provide users with information regarding the current services situation and how to access them (waiting list, expected duration, booking modalities, services currently available) but also for stimulating interest on how to improve personal behaviour and health or for some prevention and awareness campaign. For example, they can use them also for some campaign against smoking or alcoholism or for suggesting better diets and physical exercises. They can also be exploited for advertising events such as donor days. In order to enrich the informative content some information not strictly health related can be provided, such as local and national news, weather forecast, photo galleries of the sights of the area.

In the case of a research centre, an example is shown in Figure 2, public display represents a tool that can be exploited for providing students and visitors with overviews on the most recent research results and activities, also through images and videos showing some engaging demos, in order to stimulate interest in them. Such content can be accompanied by some general information regarding the town and weather forecast, and news related to the relevant research areas (such as forthcoming conferences, recently published papers by other groups, ...).



Fig. 2. Example of public display in a research context

6 Conclusions

We have presented a set of design criteria for public display user interfaces in order to support organizations that have to deploy them in their environments. In this work we have focused on how to provide output information through such devices. For this purpose we have identified a set of relevant dimensions and discussed how to consider them through a number of related design aspects. We also discuss their use in three specific application domains.

We plan to further detail such design criteria in order to obtain a set of guidelines that can also be supported by an authoring environment able to implement them when selecting content and designing user interfaces for specific public displays. A further planned extension is to supplement the guidelines with indications on how to interact with such user interfaces, when possible. Such refinements will also be obtained through a number of user tests that will be carried out in order to empirically validate the final guidelines set.

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