Ambient Displays in Academic Settings: Avoiding their Underutilization

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ABSTRACT
This work reports the findings of a case study examining the use of ambient information displays in an indoor academic setting. Using a questionnaire-based survey, we collect experiences and expectations of the viewers who are based on different floors of the same building. Based on the survey feedback, we offer some design principles to avoid the underutilization of large displays and make the most of their potential in indoor environments.

Keywords
Ambient displays, indoor settings, community awareness, aesthetics, design principles

INTRODUCTION
Ambient information displays have emerged as an effective way of disseminating information in an unobtrusive and low effort manner. They have found their use in indoor (e.g. classrooms, workplaces [2,4,5]) as well as outdoor settings (e.g. shopping malls, city squares, airports, train stations [3]). In spite of their deployment and evaluation in various settings, a sound understanding of factors that may cause under-utilization of their potential remains lacking. Huang et al. [3] undertook a comprehensive case study of the use of ambient displays in public settings. However, there is no counterpart of this study for ambient displays in indoor academic environments.

This work investigates the current use of ambient displays in the Complex & Adaptive Systems Laboratory (CASL) [1] at University College Dublin (UCD), Ireland. At present, there are five large displays installed in the CASL, each of them showing, among others, the profiles of staff members, research images, and news feed in a repeated loop. We report on the results of a questionnaire-based survey that was conducted among 59 members who are based on different floors of the CASL building and work in various capacities. We explain the survey methodology, experiences and expectations of the viewers we collected from the survey. Based on the survey findings, we present some design guidelines that may help the designers tackle the factors responsible for under-utilization of ambient displays in an indoor setting.

AMBIENT DISPLAYS IN CASL
The Complex and Adaptive Systems Laboratory (CASL) is a collaborative research laboratory at University College Dublin, Ireland. It is situated in a five-story building and hosts members of various disciplines in differing capacities. These include academic staff, post-doctoral researchers, post-grad students as well as human resource staff. In addition, there are also undergraduate students based here for 3-months long internship during the summer.

CASL draws researchers and students from various disciplines including business, computer science, electrical engineering, mechanical engineering, geological sciences, and mathematics. Cross-disciplinary research is the focus of CASL's mission and large displays have been placed in CASL with the prime purpose of advertising research activities.

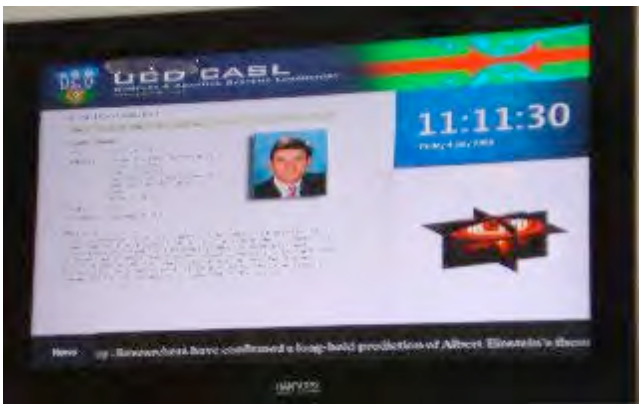

Fig. 1. Ambient Display in CASL

CASL has five large displays, LCD screens of size 32" as shown in Fig. 1, one on each floor. Each display shows the university research management system web-pages of academic and research staff in a repeated loop. The research images in the top and bottom right corners of the display are also repeatedly changed in a loop. The header contains the logos of UCD and CASL. There is a clock shown in the top right corner and a news ticker at the

bottom of the display. Fig 2. shows a schematic illustration of the design and layout of the display.

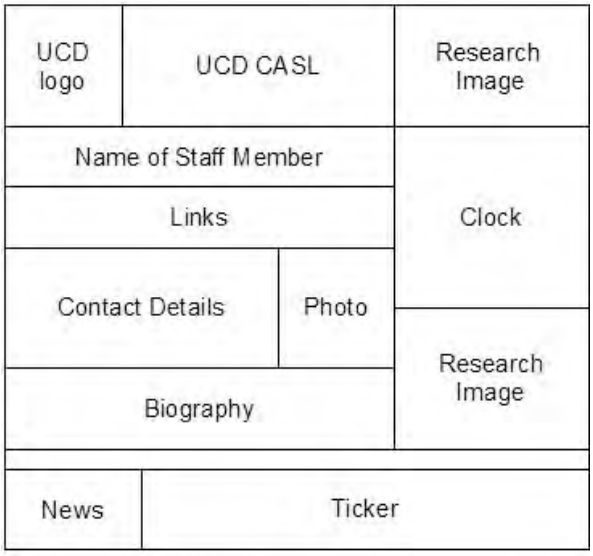

Fig. 2. Design and Layout of Ambient Display in CASL

SURVEY METHODOLOGY

We conducted a questionnaire-based survey to explore the manner in which CASL members are currently using the displays in the building. The survey involved 59 participants in the age group of 17-50 who were based on different floors of the building. Among the participants, 28 were post-grad students, 3 academics, 11 post-doctoral fellows, 8 undergrad students and 9 administration staff. Before filling the questionnaire, each participant was given an overview on the purpose of survey. The participants were first asked to draw the design and layout of the display from memory without looking at it akin to the diagram show in Fig. 2. The next section of questionnaire was aimed at collecting their current experiences with the displays followed by their expectations and suggestions for improving these experiences. After completing the questionnaire, the first author held a 5-10 minutes long discussion with each participant to get a better understanding of their views. On average, the first author spent 20-25 minutes with each participant. The survey lasted for seven days and all participants were given a candy as a gratuity.

It needs to be mentioned there is a trade-off when asking participants to remember things from memory, as opposed to observing them in context. Huang et al. [3] adopted the latter approach in their case study. In the former approach, the possibility of recall bias on the part of participants cannot be ruled out. At least two participants failed to draw some contents from the memory but after looking at the questions in the next section of the questionnaire, they immediately determined the contents on the display. However, using this approach, we are able to collect quantitative data about what and where people look at displays.

SURVEY FINDINGS: EXPERIENCES

The following section describes the experiences of participants with displays.

Drawing the Design & Layout of Display

Most participants were able to recall the photos and profile details of staff members on the display. In contrast to that, less than half could recall news feeds, research images, UCD and CASL logos, and the clock. The results of this exercise are shown in Table 1.

Table 1: Participants who recalled the contents on the display from memory

Contents on display	Participants who recalled
Staff member Photo	50 (85%)
Profile details	49 (83%)
News feed	28 (47%)
Peripheral research image	23 (39%)
CASL logo	20 (34%)
Clock	20 (34%)
UCD logo	14 (24%)
Top research image	7 (12%)

Surprisingly perhaps we did not encounter any correlation between the ability of participants to recall the contents of the display and the time duration for which they had been based in CASL. Moreover, while they were able to recall the profiles of staff members, very few participants were able to identify all the profile details (e.g. contact info, bio, links) on the displays. This concurs with the observation made by Huang et al. [3] that people pay very brief attention to the large displays and are rarely likely to stop and go through the whole content in detail.

Most useful contents on the displays

Among the contents currently being shown on displays, most participants regarded the profiles of academic and research staff to be the most useful information, followed by time and news feed. However, there was one participant who considered time to be the most useful content on the display near the reception desk while profiles of staff members on the display in the canteen.

Table 2 shows the results of what participants regarded to be the most useful contents on the display.

Table 2: Participants who considered the contents on display to be most useful

Contents	Participants who considered it most

	useful
Profiles	22 (37%)
Time and date	9 (15%)
News feed	8 (13.5%)
Time + profiles	6 (10%)
Profiles + news	3 (5%)
Time+ profiles + news	3 (5%)
Time + news	3 (5%)
Nothing	2 (3.3%)
News + research images	1 (1.7%)
Time+ profiles + news + research images	1 (1.7%)
Time at reception + profiles at canteen	1 (1.7%)

Places where they looked at the displays

We determined that participants were most likely to glance at the display in the canteen on the 4th floor, as shown in Table 3. The canteen is where most members of the CASL gather during their lunch break every weekday. Moreover, there is a weekly tea party there at 4pm every Thursday. In addition to that, other social events such as birthday, farewell, and graduation parties are also held there.

Table 3: Participants who are most likely to look at on display on different spots in CASL

Spots	**Participants who look at displays**
Canteen	32 (54%)
Canteen + Reception	8 (13.6%)
Floor where cubicle is	7 (12%)
Canteen + Floor where cubicle is	6 (10%)
Reception	4 (7%)
Photocopier (1st floor)	1 (1.7%)
Canteen + Reception + floor where cubicle is	1 (1.7%)

Perceived Purpose of displays

As part of a qualitative evaluation of the displays, we asked the participants what purpose, in their perception, these displays served in the CASL. From their responses, we determined the purposes of displays in CASL as follows:

Visual appeal

Most participants were of the opinion the displays served an aesthetic purpose and made the environment visually appealing. Some were of the opinion that the presence of displays gives the impression of working in a "technological environment".

Community awareness

The displays enabled the viewers to get to know staff members of the CASL. They were able to associate names with faces of members in an effortless manner i.e. without browsing the CASL or UCD website and visiting the web page of individual members.

Motivation

The displays show the research system web pages of academic and research staff members in a repeated loop. Undergraduate students who arrived few weeks before on summer internship found it quite motivating and inspirational. Here is how an undergrad internee remarked:

"I realized that it takes hard work and dedication to be on these displays."

Most participants were of the opinion the displays provided a good "sight-seeing opportunity" but their potential was not being fully utilized. At present, they act as nothing more than a research poster and wall-clock. There were complaints from participants that the news ticker was hard to read and was also not updated regularly.

Table 4 summarizes the experiences of CASL members with the displays in CASL.

Table 4: Summary of user experiences with displays in CASL

Issues	**Findings**
Memorable contents	• Photos of staff members (85%) • Profile of staff member (83%)
Useful contents	Profiles (37%)
Most likely place to loot at the displays	Canteen (54%)
Purpose of displays	• Visual appeal • Community awareness • Motivation

SURVEY FINDINGS: EXPECTATIONS

The final part of the questionnaire consisted of open-ended questions designed to provoke the participants to divulge what changes they expected to be brought about with the displays in the CASL. These included the questions about the type of information to be shown on displays, positioning of displays in the CASL, and changes in interaction mode with displays. The results of this section of questionnaire are explained below.

Content of displays

Participants in general were of the view that instead of profiles of staff members, news and events should be given more prominence on the display. They pointed out that the web-pages being were not tailored to public display. For example, it makes no sense to show the "Links" section of a web-page on a non-interactive public display.

Currently, news appear as a ticker at the bottom of the display. Many participants wanted this section of display to be made more prominent. Moreover, to their dismay, news displayed on display was quite static and not updated regularly.

Below are comments of some participants:

"There is a lack of information on displays, plus unsuitable display -- web page has not been altered for public display".

"The display in the canteen can be used for entertainment and that in reception to welcome guests."

"Along with news about upcoming conferences and seminars, it would also be better to display auxiliary information such as weather forecast, intermittent traffic."

Change in Position of displays

Participants wanted displays to be placed in the areas of building where most people linger. Some comments from participants are given below:

"2nd floor display should be outside the lift or besides the stairs. Most people currently do not pass or see the screen in its current location".

"It would be better in view of my desk or in places where people linger".

"Place them in more public areas e.g. seating areas."

"It would be better to have one in the elevator."

"Bring them all down to eye-level or for canteen, seated eye level."

Making the displays interactive

Most participants were apathetic to the possible option of making displays interactive and allowing participants to upload content of their choice. However, a few of them found the idea exciting. Although, they still preferred a moderated control over the user-uploaded content lest it undermine the professional look and feel of displays.

Presence/leave information

As a way of enhancing collaboration, we proposed to the participants the option of displaying their presence/leave information. Most participants expressed strong opposition to the idea of displaying their presence/leave information on displays. They considered such information to be quite private and not something to be shared with other than their immediate colleagues. This proposal of displaying presence/leave information was inspired by applications such as In/Out Board [5] and Active Portrait [2]. However, in the case of aforementioned applications, the information was accessible to only the close colleagues rather than people from other research groups, not to mention non-academic staff e.g. human resource staff, as in the case of displays in the CASL.

Table 5 summarizes the expectations of CASL members with displays in CASL.

Table 5: Summary of user expectations with displays in CASL

Issues	Findings
Content of displays	• Focused on events, rather than personal information • Web pages to be tailored for public display
Positioning of displays	• Places where people linger • Bring them to eye level
Making displays interactive	Moderated control on user uploaded content
Presence/leave information	Breach of privacy. Only immediate colleagues should get to know about that information.

UTILIZE THE POTENTIAL TO FULLEST: DESIGN GUIDELINES

Based on the collected experiences and expectations of participants about displays in the CASL, we offer some design guidelines to utilize the full potential of ambient displays in academic setting.

Content type: "Core" and "Auxiliary" Contents

"Core contents" on ambient displays in academic setting should be focused on relevant event and news, rather than profiles of academic staff. It is more inspirational for the fellow colleagues to see events such as recent awards, patents and publications of members being shown on ambient displays.

People seem more interested in looking at dynamic and up-to-date content rather than static ones.

In addition to "core" contents, to further evoke the interest of viewers, some auxiliary contents may be added such as latest news about weather forecast, and intermittent traffic.

Contextualization of Content

Ambient displays should display information relevant to the different audience in different settings. In our case, most participants were of the view that the content on the display near reception desk should be more general and appealing to visitors. One administration staff member who joined CASL a few weeks ago was puzzled to see that the content on the display near the reception desk did not give new-comers any idea about the vision and activities of the CASL.

Positioning of Displays

Ambient displays should be placed considering the movement flow of people in the building. Before conducting the survey, we assumed that almost every member of CASL looked at the display near the reception desk. However, we found out that many people used the car park and entered the building using elevator from the underground basement to reach their floor, thus bypassing the reception desk on the ground floor.

Most people viewed the display in the canteen followed by the reception desk, and quite a few of them looked at them at the floor where their cubicles were. That indicates that 3 out of 5 displays in the building were hardly if ever being viewed by the occupants. Moreover, a place which was used by all members of CASL had no display i.e. the elevator.

Here is a comment from a participant:

"I view them only when I'm using the photocopier on the 1st floor. Better put them over printers, water-coolers, and in elevators… anywhere people are waiting."

Therefore, it is important to identify the *movement flow* of people and *congestion spots* within the building before positioning ambient displays.

Privacy concerns

Information displayed should not infringe upon the privacy of members. Considering the strong opposition to the public display of presence/leave information we encountered in the survey, designers of ambient display systems must be sensitive to privacy concerns of viewers. This issue becomes critical when, unlike the cases [2, 5], many viewers do not happen to be their immediate colleagues.

Table 6 gives a summary of design guidelines for ambient displays in the CASL.

Table 6: Summary of design guidelines for ambient displays in CASL

Issues	Guidelines
Content type	• Dynamic and up-to-date content • Content be made event-centric rather than profile-centric
Contextualization of content	Different contents for visitors and members
Positioning of displays	• Identification of flow of movement • Identification of congestion spots
Privacy concerns	Comprehension of privacy concerns in case information is viewed by the people other than immediate colleagues

CONCLUSIONS AND FUTURE WORKS

In this paper, we reported on the findings of a questionnaire-based survey of the current use of ambient displays in an indoor environment of a research lab. We collected the experiences and expectations of the viewers, along with highlighting the limitations of our survey methodology. Based on survey findings, we formulated some design principles to minimize the underutilization of ambient displays in indoor settings. We plan to implement the proposed changes in the design, layout and positioning of the displays in CASL and collect the subsequent feedback from the users.

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