Highly Integratable Large-Scale Displays for Public Spaces

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ABSTRACT
The use of large visual displays in public space has become increasingly popular. However, it is still difficult to install new displays in already existing buildings because of the large and rigid hardware associated with such displays. In this paper, we describe a highly integratable, easily and quickly installable, and lightweight display system for use in existing public buildings. We describe the technical design and implementation of the display system and describe an application of the display for public audiences.

Author Keywords
Public display, urban display, information visualization, digital public art.

ACM Classification Keywords
H.5.m Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Human Factors.

INTRODUCTION

In recent years, the use of large displays in buildings and pubic spaces has become increasingly popular. Some notable examples of the emerging applications of visual displays are public art and architectural interior and exterior displays. Out of the white cube in a museum, public art is site-specific and cannot be removed from the context of its site. Large displays that are deeply embedded in such spaces have great potential in the field of public art. We developed a highly integratable, easily installable, and lightweight display system for a public building (Figure 1). In this paper, the requirements and design principles, technical implementation, and applications of our proposed display are described.

LARGE-SCALE DISPLAYS IN PUBLIC SPACES

A number of research projects and artworks use display technology for their artistic expressions. Façade displays [1] are built-in displays for the building exterior. Although they are desirable for a united visual expression, they are difficult to install after the building is built. Commercial companies provide large-matrix LED displays for architectural façades and concerts [2]. Video projectors are used mainly for short-term events. The setup is easy and can have an interesting *augmented* expression. However occlusion may occur and the projector must be set in front of the screen. The structure and solid rectangular display edges result in making the display split-off from the environment and the context. Emergent display systems enabling an arbitrary pixel arrangement with 2908 wired mono-color LEDs [3] and 100 wireless full-color LEDs [4] have been reported.

Figure 1. "Constellation of Departure" installed at Tokyo International Airport, Japan, October 2009.

DESIGN AND IMPLEMENTATION

We have designed and developed a large-scale display system suitable for public buildings. The display is used for a public art installation on the ceiling of an airport departure lounge to visualize airplanes departing from the airport. The display area is approximately 323 m^2. The ceiling is covered with meshed metal panels, and a roof space is provided over the panels.

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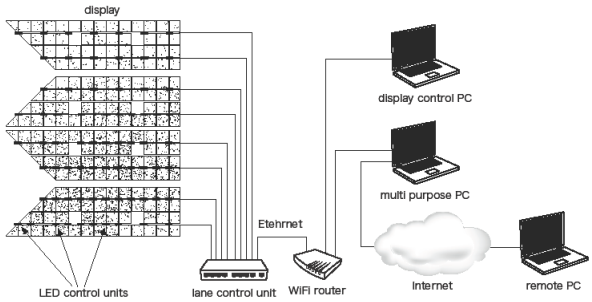

Figure 2. Display system diagram.

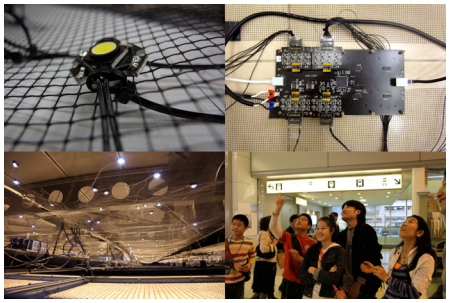

Figure 3. LED on a plastic net, LED controller board, display in situ, and viewers at the airport (from top left to bottom right).

Application

Airplane silhouettes consisting of stars move across the ceiling, scattering the other stars that are displayed (Figure 1). The display is interlinked with the airport's departure timetable: when appropriate, the display presents an airplane silhouette that moves in the direction of the flight's destination. Three thousand LEDs were arranged to match the actual positions of stars when the terminal building started its operation. The arrangement of stars is a memento of the site and is lost forever; this work has enabled the airport to "restore" its original starry sky. The twinkling and sparkling of the stars on the ceiling are intended to raise the travelers' anticipation and excitement of going on a trip. The stars transform the airport lobby into a vibrant place that feels more free and open. The turned-off pixels must show *true darkness*, and the frame of the rectangular display should not be perceivable.

System Architecture

The density distribution of the LEDs varies by location because the arrangement of the LEDs is determined by the star catalog; the distribution ranges from a minimum of 1 LED to a maximum of 46 LEDs per 1.3 × 1.3 m^2 grid. Therefore, the composition of the physical structure is designed to be flexible. The system architecture of our display is shown in Figure 2. Display data are generated by the display control PC and transmitted to each LED pixel through the Ethernet, one lane control unit, and 71 LED control units (Figure 3). Each lane contains 6–11 LED control units; each LED control unit has 1–8 LED drive sub-board(s); and each LED drive sub-board can drive 1–8 LEDs. This hierarchical structure allows us to provide a flexible arrangement of LEDs with a varied density distribution. The coordinates of pixels are given because this arrangement is fixed by the star catalog.

Physical Design and Implementation

As ambient light illuminance of the site is 500–1,000 lux, we set the current of the LEDs to a maximum value of 350 mA. White LEDs pre-mounted on aluminum core PCBs for heat liberation and easy handling are used. Black plastic nets (pitch: 6 mm; width: 1.3 m) were used as the structure of the display. LEDs were attached to the plastic nets with two cable ties (Figure 3) and wired to the LED drive units. The plastic nets are tied to steel wires stretched on the roof top and are secured with cable ties. Their lightness and flexibility are suitable for easy handling. The total weight of the display was 0.36 kg/m^2, while a conventional lightweight display weighs 26.4 kg/m^2 [3].

DISCUSSION AND FUTURE WORKS

We introduced a design of large-scale displays for use in public spaces and described the design principles and technical implementation. The proposed display system is better than conventional public display systems in terms of its integratability; the turned-off pixels and frames of the display are not visible, enabling a sophisticated and harmonized expression in a public space. It has an easy and quick installation/removal process (pre-arranged pixels on plastic nets) and results in a completely restorable installation. Its success as a visual display method is proven by the positive results obtained from an experiment with public audiences during a three-month exhibition at the airport (Figure 3).

A future task is to generalize the architecture of the display system so that it can be placed in buildings of any shape. An approach with wireless pixels is an ambitious goal but would be very powerful in terms of enabling savings on structure costs and installation costs.

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