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# Control and Scheduling Interface for Public Displays

**Ivan Elhart**

University of Lugano (USI)  
Via Giuseppe Buffi 13  
6904 Lugano, Switzerland  
ivan.elhart@usi.ch

**Nemanja Memarovic**

University of Lugano (USI)  
Via Giuseppe Buffi 13  
6904 Lugano, Switzerland  
nemanja.memarovic@usi.ch

**Marc Langheinrich**

University of Lugano (USI)  
Via Giuseppe Buffi 13  
6904 Lugano, Switzerland  
marc.langheinrich@usi.ch

**Elisa Rubegni**

University of Lugano (USI)  
Via Giuseppe Buffi 13  
6904 Lugano, Switzerland  
elisa.rubegni@usi.ch

**Abstract**

Social media platforms such as Flickr, Twitter, Instagram, and Facebook have opened up new possibilities for providing content on large public displays. Integrating interactive elements in a public display, such as (virtual) Keyboards and Webcams, can additionally stimulate in-situ content production. Both social media content and such in-situ content are cheap to produce, always fresh, and potentially community sourced, thus increasing relevance for passersby. However, not all social media applications and content entries may be appropriate in a particular display setting and showing user contributed content on public displays requires new forms of content control and scheduling. In this demo we show: 1) a control interface for display owners to manage the overall behaviour of their displays, and 2) post-moderation mechanisms for controlling and removing potentially inappropriate user contributed content from public displays. The control interface and moderation mechanisms are designed for a university environment and were inspired by two short pilot test deployments and a focus group with the university officials.

**Author Keywords**

Public display applications, web-based display applications, user-contributed content, Arduino, RFID



**Figure 1:** A public display deployment at the University of Lugano



**Figure 2:** An example of a public display application that shows user-contributed photos from Instagram web service

## Introduction

Public displays are becoming a ubiquitous resource in the urban environment. However, in order to increase the overall utility of public displays and make them more attractive to passers-by [6], we envision the creation of large-scale networks of public displays and associated sensors that are open to applications and content from a wide range of sources and contributors - open display networks [1].

Opening public displays to many application and sources creates new challenges that involve the control, moderation, and scheduling of applications and content. Our main research question is: how can we open today's closed and isolated public displays to third party applications and user-contributed content, but still keep their owners in control?

We plan to open public display through interactive applications, in particular, ones that obtain and show user contributed content (in the form of Twitter posts, Instagram pictures, Facebook status updates, and on-site snapshots taken with a display mounted webcam, as shown in Figure 1 and Figure 2). While traditional signage systems tend to describe content in terms of media items (text and images), in open public display we focus on the more general concept of a display application. The transition to more abstract notion of the display application additionally complicates approaches to content control and scheduling [2]. Not only that display owners need to control applications in a more abstract way, but also, to schedule applications which content is potentially not known in advance and cannot be previewed before the final presentation.

In order to keep public display owners in the overall control we designed 1) a control interface for public

display owners that allows them to plan, manage, and control their screens; and 2) post-moderation mechanisms for removing potentially inappropriate user contributed content from their displays.

The initial version of our system was deployed at the University of Lugano for two short pilot tests. After the tests we organized a focus group with the university official to gather more insights and requirements for designing the control interface and moderation of inappropriate content for a university environment.

In this demo we show two things: 1) a control interface that allows display owners to register displays, select appropriate applications, schedule the applications in time and space on the displays, and instantiate and run their displays in a web browser; and 2) post-moderation content mechanisms that allow for a) remote and online monitoring and removing inappropriate content, and b) distributed walk-up removing of inappropriate content directly on the screens using an Arduino based RFID sensors and appropriate RFID tags.

## Control and Scheduling Interface

Today's digital signage systems typically show content items that have been scheduled well in advance and tightly controlled by their respective owners, i.e., companies or individuals who paid for and/or operate the public display. While open display networks and interactive applications that show user contributed content would make public displays more attractive, they have to provide appropriate interfaces and mechanisms to keep the owners in the overall control of their displays.

In our previous work we identified a number key challenges in controlling and scheduling applications on public displays, what we call the long-term scheduling [2]. Key

challenges in the long-term scheduling include, among others: introduction of new applications and content items, controlling relative and absolute application times, support for pre-emptive behaviours and priorities, support for display regions, support for orchestrated performance, and control over local sensors. In order to better understand these challenges, we designed a control and scheduling interface for display owners.

The control interface has for functions: 1) allows display owners to register displays, 2) allows them to select appropriate applications, 3) schedule selected applications in time and space on their displays, and 4) instantiate and run their displays in a web browser.



**Figure 4:** A screenshot of the remote online monitoring interface

INTERACTIVE DISPLAY PLANNER					DISPALYS	LAYOUTS	APPLICATIONS
ui-display-1	inf-1f-west	lat:46.0109, long: 8.95825	layout:1-3-static	apps: 9,8			
ui-display-2	inf-1f-east	lat:46.0109, long: 8.95825	layout:1-3-static	apps: 9,8			
ui-display-3	inf-2f-north	lat:46.0109, long: 8.95825	layout:1-3-static	apps: 9,8			
ui-display-4	inf-2f-south	lat:46.0109, long: 8.95825	layout:1-3-static	apps: 9,8			
ui_display-test	not fixed	lat:0.0, long: 0.0	layout:1-3-static	apps: 1,8,3,4,5,6,7			

**Figure 3:** Control interface that lists registered displays

First, display owners can register new displays. A new display is added to their account and listed as shown in [Figure 3](#). Each display has unique id, name, short description, location data (latitude and longitude), orientation (e.g., facing north), and viewing radius (e.g., 10 meters). Also, the control interface shows the state of the display using three labels: red - indicating that the display is not running, yellow - display is running but there are some problems in its operation, and green - indicating normal state of operation. By only glancing to the interface display owners could tell whether their displays

are running properly. In addition, displays can be restarted and turned on and off as needed.

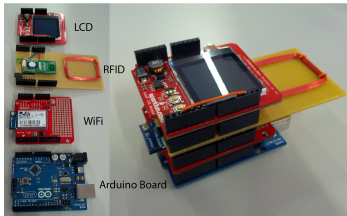
Second, the control interface allows for browsing and selecting appropriate applications for particular display setting. Each application is described by its name, the author, short description, an icon, a screenshot, ratings by other display owners, description of content it provides, and supported screen sizes.

Third, each display can be divided spatially in different screen regions by selecting a display layouts. Applications can be added to display regions and additionally arranged in a time sequence. The current version of the interface supports only layouts composed of three screen regions: fullscreen, sidebar, and tickertape.

Finally, display owners can instantiate and run registered displays directly through the interface. By selecting the run option, a new instance of the display is created in a new browser window.

## Remote and Distributed Post-moderation of User Contributed Content

The idea of using user contributed content on public displays is not novel and numerous previous projects have created networked public display applications that display it [\[4, 5\]](#). However, harvesting user contributed content from online social platforms requires new forms of content control and moderation. First, in open display networks the owners are concerned with the scheduling of applications and individual content items are not available in advance. Second, traditional pre-moderation techniques simply do not scale due to a large number of content items that have to be moderated before the final presentation. Finally, pre-moderation techniques introduce



**Figure 5:** An example of Arduino-based RFID sensor that allows administrators to unlock additional interface features and remove inappropriate content



**Figure 6:** A simple interface that allows administrators to remove inappropriate content from public displays

delays in posting/updating content and can negatively influence how the users interact with the applications.

A possible solution would be to use post-moderation content techniques. After two pilot deployments of our initial system and a short focus group with the university officials, we were able to gather requirements for two post-moderation techniques. The most desired interface for content monitoring and removal was through a dedicated web page [Figure 4](#). However, this requires a person constantly monitoring the web page. In contrast, distributing content moderation to a larger number of authorized people would make this process more easier. At the university the students and staff have RFID tags for accessing buildings and classrooms. The same RFID cards could be used to identify authorized staff at the display and allow them to directly remove inappropriate content on displays when such appears.

As a first prototype we implemented an Arduino based RFID sensor, as shown in [Figure 5](#), that the staff can use to unlock additional content removal features from the displays as shown in [Figure 6](#). Adding additional external sensors to public displays and display applications is one of the challenges for the long-term scheduling [2]. However, our applications have been developed using a web-based application template that supports a flexible integration of new sensors through a web socket connection [3].

## Conclusions and future work

Showing user contributed content on open public displays creates new challenges for application and content control and scheduling. In this demo we show 1) a control interface for display owners to manage the overall behaviour of their displays, and 2) post-moderation mechanisms for controlling and removing potentially

inappropriate user contributed content from public displays displays. In future work we plan to improve the control interface to include more sophisticated scheduling mechanisms as well as to evaluate the walk-up distributed post-moderation technique with display owners.

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