Prospero[*] – A "Visual Commons" Framework for Community-Aware Public Displays

I. Objective

Prospero is an infrastructure to enable public displays to reflect evolving public participation.

The objectives of the Prospero project arise from two primary motivations: one descriptive, the other normative. First, technologies that foster cooperation enhance our relationship to our surroundings [1]. Many of these technologies incorporate user feedback in real-time. Second, our team members believe that a society in which collective decision-making is based on participatory democracy and public resources should be allocated not by top-down or centrally-controlled mechanisms, but on the basis of the expressed desires and needs of participants. As cooperation increases, we have seen a resurgence of "the commons," i.e. that public sphere in which community values are expressed.

In our project, we shall explore this theme through its instantiation in the specific domain area of public displays. In much of modern life, public spaces, public media and public art are designed to send us messages that we passively receive, process and absorb. However, we believe that in a democracy, citizens must actively shape the public sphere. This necessitates "talking back" to the elements that constitute the public sphere. Public displays, that is, displays located in public spaces and accessible to a public, constitute an increasingly important element of the public sphere. We will develop an infrastructure for community-aware public displays that are controlled by users' expressed needs and preferences; we see our endeavor as part of an ongoing, democratic reclaiming, by citizens, of control over an increasing number of aspects of the public sphere in general.

Thus, by making a public display that is attentive to its community of users, a **Visual Commons**, it becomes possible for the community to escape the present hegemony of one-way communication, or "broadcast," of generic information (such as the time, or stock prices) or the barrage of mass-media advertising (such as occurs in New York City's Times Square). In effect, dynamic processing of community feedback regarding the contents of the display enables it to become *more than just a billboard*.

II. Introduction

Why is this system needed?

It is a truism that increasing sophistication of technology can deliver increasingly more powerful products. In the case of public displays, this has meant that displays have become increasingly cheap, fast and high-resolution. However, to maximize leverage such developments in technology, reliance on merely raw technological power is hardly sufficient; design shaped by creative thought that also takes social, cultural and political dimensions into account is called for. Our project will harness technology to meet not only instrumental or utilitarian needs, but also social and aesthetic human needs which, we believe, are currently going unmet, and which the creative use of public displays are able to address. The infrastructure that we will develop will meet three basic needs: (1) The utilitarian/instrumental need for more relevant and more specific information delivered by the display to the participant user; we address this need through the context-aware quality of the infrastructure we will develop. (2) The social need for group solidarity and bonding; we address this need by using the public display as a nodal point of a network of social interactions among participant users, and as a mediator of these social interactions. (3) The aesthetic need for a more fulfilling and more interactive experience, which leads to more user satisfaction as the participant user moves from a passive consumer of display content to an actor in a network of actors collaboratively shaping display content.

An Illustrative Scenario:

> It is Sunday, and there are ten students milling around Pierpont commons waiting for the next bus to arrive. Five students are hungry and would grab dinner if they knew they had time before the bus arrived, three students wonder if there are any music performances tonight, and some students want to know the current NFL scores. The large public display in the vicinity is unaware of their preferences, and so are the students unaware of the needs and preferences of each other. The display currently displays a notification that pool tables in the rec room are currently available, a piece of information that is not of much interest to the students currently near it. If an infrastructure existed (1) to make the public display aware of the preferences of the people in the environment, and (2) to make the people in the common shared space aware (to some extent) of the interests and preferences of each other, possibly via the display (aided by locative technology), then not only would the students' informational needs have been met more adequately and in a more targeted way, but new friendships might also be formed, common interests shared, and new interests cultivated potentially among these students, leading to the formation of a rich set of social networks -- some transient, and a few of them perhaps even of a permanent nature. Perhaps one of the students waiting for the football game would have become so sufficiently interested about the classical music concert, noting the other students' interest in it, that (s)he would have decided to check it out!

What are examples of current work in this area?

Whether it is called "collective intelligence"[2], "distributed cognition"[3], or "the wisdom of crowds"[4], the fact remains that sometimes "all of us" *is* "smarter than any of us." For example, wikipedia is an open-access encyclopedia, editable by anyone, that has demonstrated the value of leveraging individual contributions. Wikipedia is larger and more accurate than any encyclopedia ever created, and it works because it takes advantage of scale efficiencies unattainable by previous "closed" production methods [5]. Another website, Digg, allows

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[*] In Peter Greenaway's 1991 film "Prospero's Books," based on Shakespeare's "The Tempest," one of Prospero's possessions is described as "eighty shining mirrored pages; some opaque, some translucent [...] Some mirrors simply reflect the reader, some reflect the reader as he was three minutes previously, some reflect the reader as he will be in a year's time, as he would be if he were a child, a woman, a monster, an idea, a text or an angel. One mirror constantly lies, one mirror sees the world backwards, another upside down. One mirror holds on to its reflections as frozen moments infinitely recalled. One mirror simply reflects another mirror across a page. There are ten mirrors whose purpose Prospero has yet to define."

users to rate news items, and the system shows the highest rated items on the front page. Also, the most widely used computer operating system in the world, Linux, was entirely created by a global mass of volunteers contributing to the collective good [6]. While it would be frivolous to attempt to list all such systems herein, it is safe to say that the value of "crowdsourcing"[7] has been firmly established.

Existing public display research has focused primarily on designing interaction methods for public displays [8,9], exploring how public displays can encourage users to interact and socialize [10,11], using public displays to share and publish media content [12,13,14], and using public displays to aid collaboration [15,16]. Other public display research includes using locative technologies to customize the content of a display for an individual user [17] and to determine when new users have appeared in an environment [18].

Prospero will synthesize and integrate these two literatures to provide an example of the broader role of public displays in the commons.

How are we different?
The Prospero project provides a framework for allowing the public to participate in the definition and selection of content for public display. Other projects have allowed members of the public to contribute multimedia content to a shared bulletin board [12,13,14]; however they presented no mechanism for audience to participate passively in the selection of bulletin board content. Thus, users of the system who did not actively contribute or rearrange content had no role in determining the display. Locative and user identifying technologies have been used to change advertisements when a new user arrives near a display [18] and to identify individuals interacting with a display [17]. However, these approaches do not provide a method of aggregating multiple preferences to determine what a group of individuals is interested in, or a method of displaying interesting content to a group of individuals.

We let participant users (i.e. the "public" or "citizens") decide what they want; instead of forcing a predefined content upon them over which they have no control, the infrastructure that we will build will let users determine the *modality*, the *function*, as well as the *content* of the display. By "modality" we mean the particular way in which information is encoded for presentation. [19] For example, the information content requested by user(s) could use the modality of either space or of time, which would allocate display of content as a proportion of all available space or for a varying length of time, determined by the aggregated preferences of all users. By "function" we mean the category of information, i.e. the *kind* of information (e.g. about events, about the weather, about lectures). By "content" we mean *what* the information actually consists of -- for example, the content of information about "events" could be an event listing, or it could be samplings of streamed video from the events themselves). The "richness" of the display as media, would consist in its potential multi-*modality* and multi-*functionality*. All of these transform the typical understanding of a public display (which tend to deliver one-way, non-interactive broadcast communication) into a visual commons

III. Students and Faculty

Ben Congleton – Team Lead, Designer, and Developer
Ben Congleton is currently a 1st year PhD student in the School of Information. He has a B.S. in Computer Science, B.S. in Business Information Technology, and a M.S. in Computer Science with a specialization in Human Computer Interaction from Virginia Tech. He is interested in public displays, visualization, interaction design, photography, organizational memory, media spaces, CSCW, and using technology to foster communities. In 2005-2006 he helped lead a seven member interdisciplinary team to create a cyberart exhibit for Virginia Tech's Arts Fusion. He has also helped foster collaborations between assistive technology and computer science on the VT MEMEX project, and served as a president of the Nethernet Corporation. He serves as one of our team's designers, developers, and visionaries, and is the team leader for the Prospero project.

Paul B. Hartzog – Network Culture, Commons, Public Awareness
Paul B. Hartzog (http://www.PaulBHartzog.org) has a B.S. in Political Science with an emphasis on Global Commons, and an M.S. in Political Science. Paul is currently an IGERT recipient at the Center for the Study of Complex Systems at the University of Michigan, and is pursuing a Ph.D. in Political Theory. Paul's work on "The Success of Openness" has been published as "Open Scale" by The Institute for the Future (http://www.iftf.org) and used as a key piece in their annual Ten-Year-Forecast in April 2006. Paul blogs about social software, commons, technology, and cooperation on Many-to-Many, Smart Mobs, the Cooperation Commons, and On The Commons. He has lectured about "Commons and Collective Action" at Stanford University. Paul brings his knowledge, experience, and social ties to this project.

Sayan Bhattacharyya –Cultural Theory, Developer
Sayan Bhattacharyya is a doctoral student in the Program in Comparative Literature. He has a B.S. in Electrical Engineering (Jadavpur University, India), and an M.S. in Computer Science (U-M, Ann Arbor). He has worked as a programmer/analyst for Tata Consultancy Services, India (where he helped develop operations management software for the Indian tea industry), at the Ecole Nationale des Mines, France (where he helped develop pedagogical software), and at the Great Lakes Research Laboratory, Ann Arbor (where he developed software for ecological modeling). Having made a career switch from computer science to the humanities, he is currently interested in issues related to cultural theory. He will contribute his programming skills to the project and will use this project to gain hands-on experience in context-aware computing, which, he hopes, will nicely complement his theoretical understanding of how to work with novel cultural texts. Having grown up in the developing world, he also has an interest in the uses of visual media and rich media in low-literacy environments, and this is another interest area that he anticipates working on this project will help him explore.

Charles Kaylor – Public Participation, eGovernance, Stakeholder Involvement
Charles Kaylor is a doctoral student in Urban and Regional Planning with an interest in how information and communication technologies are transforming the nature of public participation and governance. His dissertation project is focused on how community planning processes for broadband are providing an element of demand articulation to which telecommunications providers tend to be blind. Prior to this research, Charles devised the Municipality eGovernment Assessment Project as part of a research and consulting practice he devised in 2001. Through that work, Charles gained enormous experience in strategic planning and community-based planning. This experience is reflected in numerous publications and conference presentations on egovernance, planning, and public participation. As part of this team, Charles brings his theoretical interests in e-governance, e-democracy and technological change as well as his lengthy experience in project development, coalition development and stakeholder involvement. Charles has an MA in Political Science and an MUP in Urban Planning.

Advisory Committee

Primary Advisor**:** Paul Resnick – Professor, School of Information – Professor Resnick's research focuses on SocioTechnical Capital, productive social relations that are enabled by the ongoing use of information and communication technology. His current projects include analyzing and designing reputation systems, ride share coordination services, and applying principles from economics and social psychology to the design of on-line communities.

Advisory Committee: We have assembled an interdisciplinary advisory committee to help make the Prospero framework a reality. Dr. Malcolm McCullough from Architecture will help us better understand the place in which the displays are deployed and inform design for sustainable mobility; Erik Hofer from the SI Connection Project will serve as a resource for display hardware; and Scott Gifford from the EECS WhereFID project will help out team implement the RFID and locative aspects of our project.

IV. Project Activity

Synopsis

Because the Prospero project aims to launch an open information architecture to facilitate feedback between a **community of users** (social aspect) and a **public display infrastructure** (technical aspect), the Prospero team members will engage in two primary modes of project activity (these are elaborated in the following sections):
1. Conversations and design sessions revolving around the concept of "**Socially- and Culturally-Aware Design**."
2. Development and implementation of the **Prospero Framework**.

Socially and Culturally Aware Design

Our project will investigate the nature of community participation and how to use technology facilitate such participation. The infrastructure we describe in our proposal allows space for exploring this at two distinct levels: On the one hand, the open-source API that we will create will itself foster co-operation and collaboration within the community of interested software developers. In addition, at the level of the users of the infrastructure itself, that is, the casual or more long-term user participants of the communities that may be using such public displays, our infrastructure may function as a "technology for community-building" and the fostering of sociability and, ultimately, of good citizenship. We are hoping that the dynamic context-aware nature of the infrastructure we are hoping to create will make participation interesting and fun for anyone who chooses to use the public displays that our architecture will enable.

The Prospero Framework

The Prospero framework is the underlying architecture for the Prospero project. Three core elements make up the Prospero Framework:

Users: Users are defined as people in the environment who have elected to carry an RFID. Each user of the Prospero system can participate by contributing functionality to Prospero in the form of a widget (see below), and by electing to enter their attributes and preferences into the Prospero system.

Locations: Locations are places in the environment where a public display running the Prospero framework is deployed. Each location has a set of local attributes that helps determine which widget to show (e.g. A display closer to a bus stop might be more likely to display information about the arrival of buses,). Locations are responsible for scanning for Users in the environment, we currently envision doing this using RFID, but it could also be accomplished using Bluetooth, WIFI, or Computer Vision [15].

Widgets: Widgets are rich media objects that display content on a public display. Each widget has a set of attributes that are used to help determine when it should be displayed (e.g. Some widgets may be more relevant during live events, i.e. football scores, whereas others may be more relevant during a specific time of day, i.e. a lunch menu). Each widget also has a set of user specified preferences (e.g. a news widget might allow users to specify their interest in world news).

The Prospero framework consolidates information from its environment to determine which widgets should be displayed in each location. It is aware of the users detected at each location, each user's attributes and preferences, and the available widgets. It uses this information to determine both which widgets should be displayed and how the selected widgets should be arranged on the display. In short, the Prospero framework allows the public to both contribute functionality and content in the form of widgets, and control the widgets displayed on the public display though that participation in the Prospero system.

V. Resources

<u>Hardware:</u>
- Alien RFIDs and Reader provided by Scott Gifford and the WhereFID project.
- Public Displays provided by Paul Resnick's RideNow project and Dan Fessahazion in Design Lab one.
- A PC with a good graphics card to drive the Public Display.
- We may need to purchase additional Battery Assisted Passive (BAP) Rfid Tags to improve the reliability and range where we can read RFID tags.

<u>Software:</u>
- Opensource interface to RFID reader written by Scott Gifford
- An operating system for the PC (Linux, Windows)
- Processing.org, Flash, or HTML/JavaScript for Media Rich Widgets
- Ruby or Java for Prospero Framework and MySQL for data storage

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