The WebWall

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Abstract

A media and service independent framework for multi-user communication and interaction via public communication displays, WebWalls, has been developed to allow for a seamless WWW access for people in public areas via mobile phones or handheld devices. A software architecture is presented strictly separating wall access technologies (like HTTP, email, SMS, WAP, EMS, MMS or even simple paging protocols found on mobile phones) from the display technologies used and the presentation logic involved. The architecture integrates the most common and first truly ubiquitous wireless network (GSM), allowing a vast community of mobile phone users to access the WWW via public communication displays in an ad-hoc mode. A centralized backend infrastructure hosting content posted by users in a display independent format has been developed together with rendering engines exploiting the particular features of the respective physical output devices installed in public areas like airports, trainstations, public buildings, lecture halls, fun and leisure centres and even car navigation systems. A variety of different modular service classes has been developed to support the posting or pulling of WWW media elements ranging from simple sticky notes, opinion polls, auctions, image and video galleries to mobile phone controlled web browsing – all of them sharing common features like a defined display time and a set of commands for interaction.

Keywords: Public Messaging, Multi-User Awareness, Ubiquitous WWW Access, Wireless Networking, GSM, Ad-Hoc Communication, Team Collaboration.

1 Introduction

In this paper we explore the diffusion of digital artifacts into our physical world and how it enriches our perception of reality. Particularly, we are concerned with the fact that visual displays have played an important role in individual WWW usage, and the fact that very little research has been conducted to explore the potential of large, shared visual displays for group and community communication and interaction. While the use of visual displays and desktop projections is getting quite popular in group work settings (shared whiteboards, smartboards, etc.), their use in public spaces to allow for a ubiquitous WWW access for a broad, loosely related, non-determined and unstructured audience is only rudimentarily understood today.

With this work we address the potentials of ad-hoc communication in public spaces using a wall metaphor. We have developed a software framework, the WebWall framework, providing a seamless WWW access over visual displays in public spaces via a manifold of access technologies including HTTP and email, bust most importantly SMS and WAP. Partricularly the latter connect the first truly omnipresent and meanwhile most important public communication network, the GSM based mobile telephone network, to the WWW. After discussing related research concerned with visual displays in a wall metaphor based setting, we present the WebWall framework as a means to enrich public places with digital communication and interaction means for people to access their personal ‘multimedia memories’, to share information (e.g. notes, videos, pictures) with others or to interact with others (e.g. opinion polls, auctions, games) – all over the WWW and possibly all over their mobile phones.

2 Architecture

The WebWall base framework system architecture adheres a strict separation of access technologies, display technologies, services and accounting. The access logic layer as an open architecture supports any user side technologies for input and output to WebWalls. Service classes are managed by a backend system together with community data and usage accounting. The service instance or runtime layer of the architecture is responsible for the operation of WebWalls based on user requests. Requests are accepted after authentication and must adhere the syntax of predefined service classes. Upon request, service instances are drawn from the respective service classes in the backend system, and their output is rendered to the specific display technolgogies (see Figure 1). The three layer architecture of the WebWall framework thus allows to orthogonally develop different interactive services as well as to dynamically incorporate new I/O technologies (like EMS, MMS) in the future.

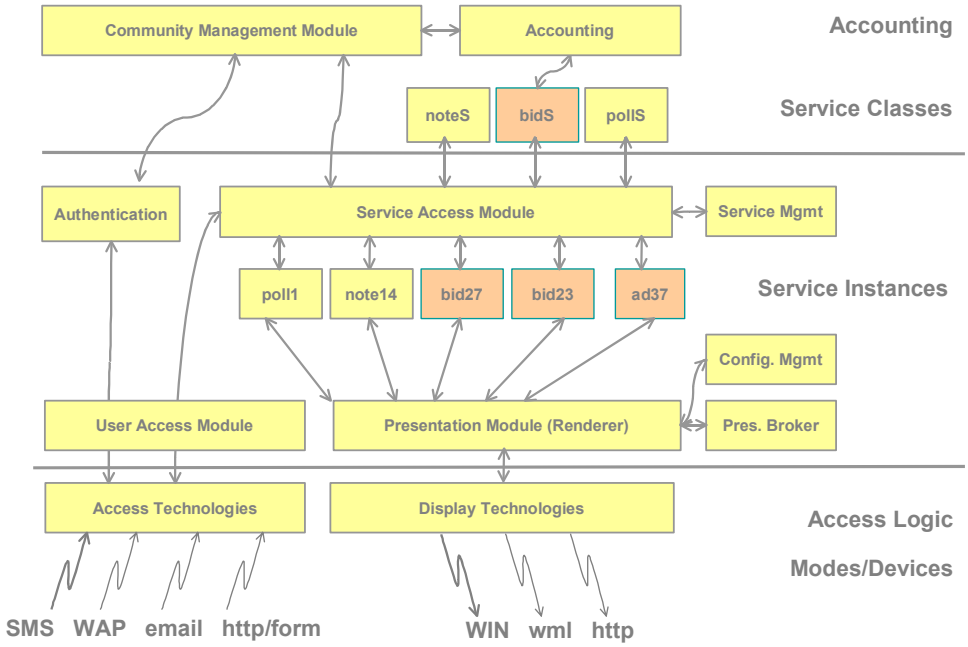

Figure 1: WebWall System Architecture

The integration of Internet- and mobile networking technologies demands for flexible and standardized access to a WebWall system which is granted via the representation of requests in a standardized format, irrespective of the access media (in this work we consider SMS, WAP, email, and HTTP as possible access technologies). The strict separation of request handling and display rendering provides extensibility by means of being able to integrate new technologies as they evolve. As for the physical presentation of WebWalls, various display technologies exist today (projectors, plasma screens, CRT, etc.), and further technologies will evolve (laser projection). The WebWall system therefore is designed to provide flexible support for the full range of exisiting and upcoming display technologies. A presentation module is responsible for arranging the service instances on the screen according to service type and priority. It uses a *renderer* for each service class that is responsible for translating the data into a displayable form, for example a HTML page of a given size. Users interact with the objects (i.e. service instances) on a WebWall by passing messages and/or commands through one of the access modules. The current implementation of a WebWall provides GSM, IEEE802.11b WLAN as well as standard LAN access to receive requests, which are then passed on to the service access module that is responsible for translating the text into requests to specific service instances or classes. Personal preferences, login information as well as pre-defined objects are managed by the backend system.

Users may create service instances not only by direct interaction with a WebWall, but also by accessing the backend system via a web-interface. This way, many service classes – like picture *galleries* or personal *videos* – can be costumized and saved for display on a WebWall at any later time. Besides the user related data, the backend system hosts the code for the service classes and the renderer classes that are downloaded to Java-based clients whenever they start up. It also handles configuration sets for individual clients that define the services that should run, as well as the display areas where individual instances may appear on a visual display. This central storage of configuration sets and class code enables application providers to implement new service classes and distribute them to a defined set of clients.

WebWall supports a range of service classes that differ in presentation as well as in functionality (see Figure 2). The most basic service is the one for posting notes (service class *Note*) to a WebWall that can be viewed by everyone in the spatial proximity of the (public) display. Replys to a note may be sent to a WebWall, which, depending on the reply mode, either display on the WebWall or are routed invisibly to the author of the referred note. After a defined lifetime, notes are removed from the WebWall. While notes may be posted instantly when viewing a WebWall, there are other service classes that are better defined first over the Web-client: *Video* and picture *galleries* (service class *Gallery*) can be used to display multimedia content by composing URLs of the media to display and save them under a userdefined names. *Polls* may be used to solicit the public opinion on local issues that may arise in the geographical vicinity of a WebWall, for example. Polls display an up-to-date view of the current collective opinion, thus providing an effective means for instant democracy. To allow for ad-hoc buy&sell applications and commercial advertising the framework provides two service classes: *Auction* and *Banner*. Banners work analogously to their WWW counterparts, but could be used to send vouchers to the interested reader upon request. Auctions lets users bid for an item on sale, with the highest bid being on display on the WebWall.

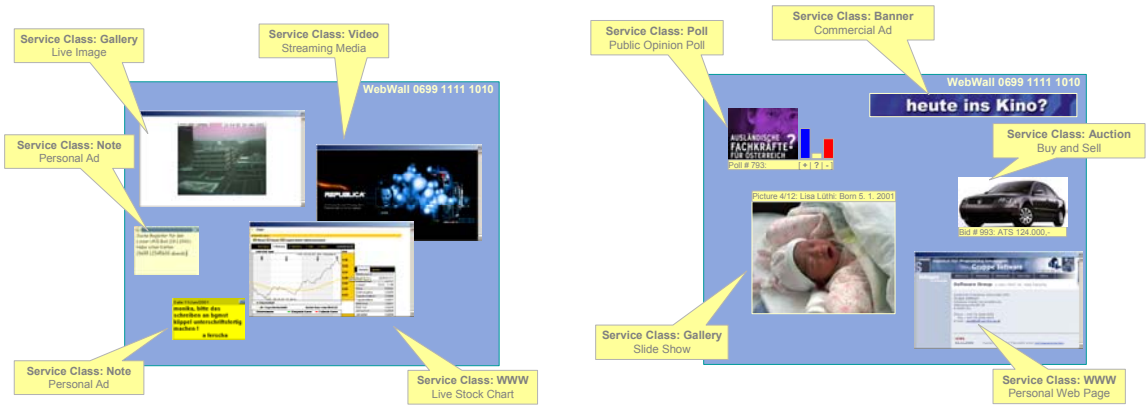

Figure 2: WebWall and Service Classes

2.1 Visual Components and Styles

A variety of different visual components have been created for the individual service classes, some of which are displayed below. For the video service class (Figure 2, upper left) the streaming video is displayed in the main frame. The service instance id is placed in the upper right header and can be used to stop, replay or removie the video. The gallery class (Figure 2, upper right) overlays image by image out of a collection of objects in img MIME type from the CMS. The auction class (Figure 2, lower left) displays an image and description text of an entity upon which an auction is set up in the public. New bids are posted by referring to the instance id, and once registered by the WebWall overwrite the current bid tag. An opionion poll like e.g. the evaluation of presentation by the audience accepts votes for one of the displayed alternatives (Figure 2, lower right), counts the votes, computes percentiles and displays the information in real time.

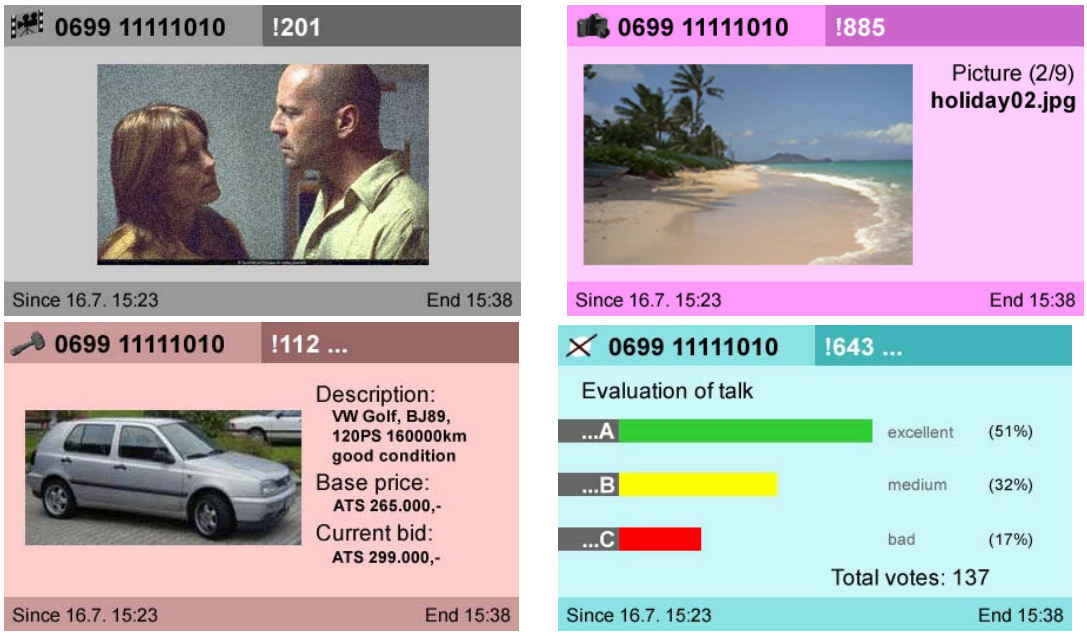

Figure 2: Service Class Visuals: Video, Gallery, Auction, Poll

The Table in Figure 3 summarizes wall computing projects and compares them with the WebWall approach. Most of the research projects presented deal with problems in display technology or CSCW-related issues, especially with closely coupled multiple users and appropriate interaction metaphors ([BCFS 98]).

	NC	DATA Wall	LIDS	POWER Wall	HOLO Wall	DYNA Wall	SIW	SDW	Web Wall
Application area	CSCW	visualization	CSCW / CSCL	scientific visualization	ubiquitous computing	CSCW	CSCW	scientific visualization	Public communications, CSCW
Display	conventional monitor, rear projection device	proprietary projection device	rear projection screen, whiteboard digitiser	Rear projection (2x2 matrix) video projectors	rear projection (IR cut filter)	Rear projection whiteboards (SMART board)	rear projection board, tiled video projectors	tiled video projectors	independent of projection system, video projectors light emitting displays
Access	direct	passive	direct	Direct	Direct	direct	Direct	Direct	Direct
Interface	Windows GUI	None	Pen like interaction devices	touch screen	IR LED emitter, IR filtering camera with image processing techniques	touch screen, gesture techniques	LCD tablets, laser pointer trackers, microphone arrays, pan and tilt cameras	trackers	HTTP WAP SMS EMS MMS
Internet linkage	Yes	No	No	No	No	No	No	No	yes any MIMEtype
Scalability	high	single system	medium	single system	single system	single system	medium	single system	high
Extendibility	high	None	none	None	None	none	medium	none	high
Status quo	under development	Idle	prototype	Idle	research	commercial	under development	under development	fully functional

Figure 3: Comparison of related work

The Notification Collage is more related to the WebWall system than other wall computing projects, as it supports different media types that can be shared in a distributed setup. In contrast to WebWalls, it is closely coupled to a specific operating system for its providing its services, and lacks the possibility to access it via wireless phones (GSM) or other mobile devices – keyboard access is necessary to interact with the system. Furthermore, contents looks different on every screen, as users may arrange items at will, whereas a WebWall may be exported to different clients resulting in the same view on the data. The DataWall focuses on questions of abstracting logical from physical displays to construct larger interactive areas, and does not take into account any networking aspects, but could be used as an ouput medium for WebWalls. The POWER Wall as well as the InfinityWall deals only with high-performance data visualization problems and local multi-user interaction, networking is not taken into account. Likewise, the Scalable Display Wall focuses on clustered rendering of 3D content and uses networking only to distribute internal data sets. LIDS uses a whiteboard metaphor for user interaction so users need to have physical access to the wall and a pointing device, while WebWalls can be used from anywhere with a mobile phone or the Internet. Similarily, DYNA Wall allows access to networked data but needs direct interaction with the physical device, with binds the user to a specific location. SIW supports different pointing, input and output devices, but makes also heavy use of the room metaphor – only taking into consideration objects that are in a room. HOLOWall is a singular system that explores an alternative input technology and does not deal with networking, different service classes or other multi-user considerations.

There exist several notification services that transport information from the Internet or other data sources to mobile phones ([Woo 97]), like the various info services of GSM network operators. Another example of Internet/phone integration is iValet ([MDH 00]). It informs users of incoming emails and lets the user react to individual mails. These examples are a strict one to one type of communication, there is no ability to share information with others or even publically.

Current research efforts can therefore be summarized as concentrating on three major areas: Display technology research covers advanced uses of projection systems - often in combination with cameras for system feedback - to provide seamless output of multiple beamers on arbitrary surfaces, even deliberately integrating physical objects into the digital realm ([RWC 98]). Several architectures for the configuration, calibration and transparent access of a multi-display Wall have been proposed ([HH 99],[CWGL 02]). Projects focusing on groupware issues deal with the interaction of a known group of users on a shared display, using a variety of input devices. These efforts deal with the cooperative manipulation of artifacts on a shared display, dealing with privacy ([SI 01]). The size of the displays creates new problems for human computer interaction, as normal keyboard and mouse input becomes impractical (if not impossible). Therefore, new input devices have been proposed like laser-based pointing devices ([DC 02], [Wiss]).

The WebWall project, in contrast, makes use of a variety of dislocated displays to enable the ad-hoc communication and interaction of people with on another as with Internet-originated artifacts.It makes use of large displays as one possible output technology, but does not limit itself to this presentation medium. Instead it can be adapted to a wide variety of interfaces.

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