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Why Do We Want to Interact With Electronic Billboards in Public Space?

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Abstract. Interactive large format displays have presently found their way into many places in public space. After a long phase of experimenting with prototypes only recently have technically mature applications been observed that are used in an increasing number of potential areas. This short paper examines the motivations behind the use of these applications. On the basis of an empirical investigation we present an experimental analysis of user-motivations in which motivational factors are determined from which design elements for interactive large format displays in public space can be derived.

Keywords. HCI, Ubiquitous Computing, Pervasive Computing, Situated Displays, User-Motivation, Public Space, Interactive Adverstising, Digital Signage

Introduction

Following a long phase of prototypal experimentation, interactive large format displays are now finding their way into public space. In the process it is sparking wide interest: commercial advertisers look for new ways to enter the dialogue with their clients, large-scale event organizers attract thousands of visitors with new interactive screens broadcasting sporting events, retail chains advertise with dynamic shop window displays that react to shifting bodily movements in grabbing the attention of passersby, and culture makers appeal to the community creating potential of interactive urban architecture, which promotes active public participation in the "Media-City" of the 21st century and creates new sites for urban encounters. [1]

The entry of interactive displays into public space is part of a greater tendency: computer usage is spreading into public life and no longer restricted to mere task fulfillment at the workplace. [2,3,4] While task oriented theories simply regard the "how" of an activity but not the "why", they leave questions concerning underlying motivations unanswered. In spite of its increasing significance in human-computer interaction, motivation has been only an isolated object for investigation. Up until now there exists a significant need for advancement in understanding the motivation behind the user's activity. [5] Particularly, only little is known about how the design of public displays will invite interaction. [6]

In-situ Research by Prototype-Design

We present an empirical investigation during which the installation Magical Mirrors with four interactive displays in Fig. 1 served as experimental prototype.

Fig. 1. *Passers-by interacting with the interactive displays of our experimental set-up*

The investigation is oriented around the research field of Ubiquitous Computing (UC), which takes the entry of computers into the physical environment as its starting point. In addition to the omnipresent linking of mobile technologies, large format displays are integrated into the urban environment. They become stationary components of UC and they do not therefore stand in the tradition of analogue advertising surfaces but in the tradition of interactive computer displays [11].

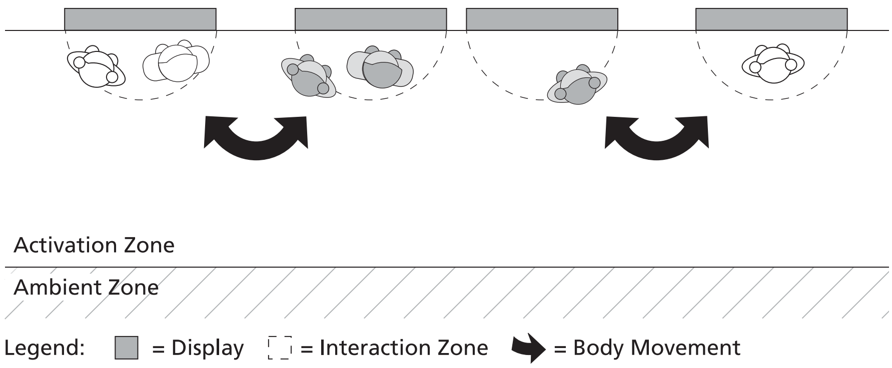

Fig. 2. Observed examples of body movements in front of the experimental set-up

As interaction with public displays takes places in both the digital and the real world, lab based user studies are no longer sufficient [7]; Instead by designing real-world settings, we become able to fully understand the process of public interaction as drafted in Fig. 2. [8,9] By altering the prototype-design in situ, we were able to observe resulting changes in real-world behavior. [10]

Within the scope of our experiments, a number of design elements shown in Fig. 3. were altered, e.g. the interface design, the number of displays operating, the design and reaction time of particular effects, and also the name-giving mirror-effect. The goal of this experimental approach was to examine what role the design of each variation played in motivating the usage of the prototype shown in Fig. 4.

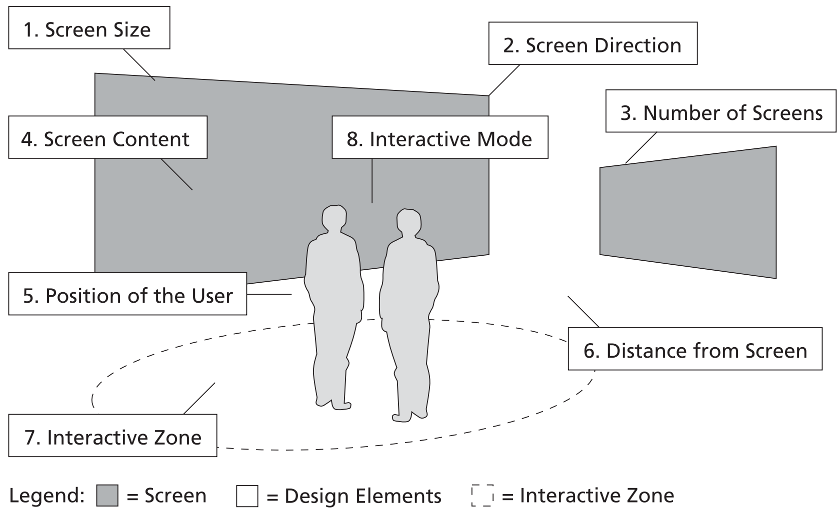

Fig. 3. *Design elements of public displays*

As a starting point for our investigation we developed intrinsically motivating design elements that were identified in the context of a motivation theory analysis and that should serve as the orientation point for the development of interactive applications in public space. Initial experience from these areas of application are providing valuable insight into design guidelines, usage behaviour and success factors for the future application of interactive displays in public space. [13]

According to previous research work and in consideration of the demands specific to interactive large format displays a number of motivational factors are determined. In the analysis of these factors a set of tools of fundamental motivations are identified from which design elements for interactive large format displays in public space can be derived. The findings of our analysis were subjected to an empirical examination. In 15 partial experiments the observed user behavior of a total of 4640 passersby is analyzed.

Results

The results of our empirical research clearly show central design elements that can influence awareness, perception and usage of interactive displays. Observation revealed that user-motivation is based on the five motivating factors in Table 1:

Building Blocks for Motivating Interaction in Public Space
Challenge and Control In interaction with public displays people strive for an optimal level of competency that allows them to master the challenges presented by the application. Viewing the consequence of one's own interactive behavior was described as the most important element for challenge as a motivating factor. In addition to this visibility, the presence of a goal to the interaction, in which a distinction between set and emerging goals can be made, also plays an important role. Whereas a set goal is established by cultural or social conventions, emerging goals arise from the interaction of the individual with his or her environment. Since emerging goals have a strong motivating effect, interactive environments should allow the designing of one's own emerging goals. Moreover, the intrinsic motivating challenge of an activity appears to increase if, in interacting with the environment, a clear and direct feedback follows from one's own behavior and the attaining of the goal. In order to turn an interaction into a challenge, the behavioral outcome should however be somewhat uncertain and the end result should remain unknown prior to being conducted. The motivating effect of control is based primarily on recognizing a cause and effect relationship, as well as on powerful effects and the freedom of choice in performing the interaction. For motivation the perception of control is more important than actual control.
Curiosity and Exploration Curiosity appears to belong to the most important characteristics of intrinsically motivating environments. In order to stimulate curiosity and to influence motivation, the interaction shouldn't be designed in a way that is either too complex or too trivial. Interactive elements should be novel and surprising, but not incomprehensible. On the basis of prior experiences the user should have initial expectations for how the interaction proceeds, but these should only be partially met. In reactive environments a motivating optimum of complexity is therefore also fostered through the interplay of surprising and constructive interaction. The desired behavior for the interaction can be initially activated by surprising elements and maintained through constructive elements. In contrast to perceptible changes that appeal to people's sensory curiosity, cognitive curiosity relates to anticipated changes. People are motivated in this way to optimize their cognitive structures. To increase motivation through curiosity, it appears at first sufficient to convey to the individual a sense of incompleteness, discrepancy or dissipation and to present through the interaction the possibility to abate these sensations. However during the interaction it should be made especially clear how to attain completeness.
Choice The offer or presence of interaction alternatives is the third motivating factor within interaction with public displays. Choice encourages the performing and maintaining of specific interactions. The existence of choice possibilities alone, however, doesn't always lead to a maximum of intrinsic motivations. Concrete

interaction alternatives, in which a motivating effect was demonstrated in other areas, are for computer games for example, the possibility to select speed levels, camera settings, time limits or degree of difficulty. But alternative software features designed to correspond to one's own preferences could motivate in other areas as well, perhaps through the activation of flow. Moreover through the allocation of explicit choice possibilities the user can be provided with a greater control potential.
Fantasy and Metaphor In interacting with computers one of the initial user reactions is oftentimes the incitement of fantasy; the extent to which interactive environments incite fantasy determines their attractiveness and generates interest in the reception of the interaction. The use of metaphors allows inadequately concretized fantasy concepts to function. By employing metaphors fantasy elements can be directly integrated into the interaction process. Since they refer to physical or other systems metaphors can help the user to comprehend the interaction even prior to actual use, motivating him or her toward the reception of the interaction. Since the interaction bears resemblance to already known situations, it can be more easily grasped and utilized more efficiently. In so doing metaphors must not reproduce the real world in any way, since the abstract, conceptual or symbolic representation can prove equally as effective as true to life images. If new forms of interaction are linked to familiar traditions, it appears easier for users to carry over already established behaviors.
Collaboration In contrast to the first four motivating factors, collaboration is based on the interaction with other human beings. A condition for its motivating effect is the possibility that the individual can influence the interaction of other people. In addition to social interaction over the internet, the use of interactive large format displays increasingly plays an important role in collective interaction located in one place. The motivation to collaborate is increased for example through functionalities that make visible the effects of one's own behavior and group allegiance, whereby visibility as well as viewing the enacting is a result of the goal behavior as well as viewing the effects of the behavior.

Table 1. Building Blocks for Motivating Interaction

During the experiments the usage-motivation clearly depended on the impact the display design had on each of these motivating factors.

By providing a first list motivating factors our experiments aimed at collectively developing a better understanding of the design foundation of interaction with public displays and encouraging future research within the next couple of years. On the basis of our empirical investigation this paper presents a contribution to the understanding of the fundamental motivations behind the use of interactive large format displays in public space.

References

1. Mitchell, J.W., City of Bits, MIT Press, 1995

2. Ferscha, A., Resmerita, S., Holzmann, C. (2007), Human Computer Confluence, in: Stephanidis, C., Pieper, M., (Hrsg.) ERCIM UI4ALL Ws 2006, Berlin, Heidelberg, S.14-27

3. Fleisch, E., Mattern, F. (2005), Das Internet der Dinge, Berlin

4. Weiser, M. (1991), The Computer for the 21st Century, Scientific American, 265(3)

5. Adams, R., Russel, C. (2007), Lessons from Ambient Intelligence Prototypes for Universal Access and the User Experience, in: Stephanidis, C., Pieper, M., (Hrsg.) ERCIM UI4ALL Ws 2006, LNCS 4397, Berlin, Heidelberg, S. 229-243

6. Agamanolis, S. (2004), Designning Displays for Human Connectedness, in: O'Hara, K., Perry, M., Churchill, E. (Hrsg.), Public and Situated Displays: Social and Interactional Aspects of Shared Display Technologies (Cooperative Work, 2), Norwell, MA, USA,

7. Leikas, J., Stromberg, H., Ikonen, V., Suomela, R., Heinila, J. (2006), Multi-User Mobile Applications and a Public Display: Novel Ways for Social Interaction, PERCOM 06, Vol. 0, IEEE Computer Society, Washington, S. 66-70

8. Grasso, A., Muehlenbrock, M., Roulland, F., Snowdon, D. (2004), Supporting Communities of Practice With Large Screen Displays, in: O'Hara, K., Perry, M., Churchill, E. (Hrsg.), Public and Situated Displays, Kluwer Academic Publishers, Norwell, MA, USA, S. 261-282

9. Kortuem, G., Kray, C. (2005), HCI issues of dispersed public displays, in: Workshop on Distributed Display Environments at CHI 2005

10. Laurel, B. (2003), Design Research – Methods and Perspectives, Cambridge, Mass.

11. McCullough, M. (2005), Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing, Cambridge, MA

12. D. Michelis, F. Resatsch. Unlocking the Interactive Capabilities of Large Outdoor Displays, Information Display 3/2007

13. D. Michelis (2009), Interaktive Großbildschirme im öffentlichen Raum: Nutzungsmotive und Gestaltungsregeln, Gabler, forthcoming

14. Harry Brignull & Yvonne Rogers (2003), Enticing People to Interact with Large Public Displays in Public Spaces, INTERACT’03

Towards Pervasively Adapting Display Networks

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Abstract. In this paper we describe our vision of pervasive advertising in the context of pervasively adapting display networks. We believe that future display networks will consist of large, geo-localized and heterogeneous displays that adapt to nearby users by targeting content to their preferences, providing personalized and interactive services, as well as being sensitive to the display context. We think that the success of such display-enhanced environments will heavily depend on two important factors: First, what programming abstractions must be provided for a flexible and evolvable display system? And second, how is user's privacy being protected? First steps towards answering these questions have been made by showing a demonstrator at a major exhibition.

1 2034 – The End of Pervasive Advertising ?

Today in 2034, we do not talk about pervasive advertising anymore. In a world where technology seamlessly blends with the physical environment, even the word *display* has lost its meaning. With the ability to turn virtually every surface into an *active surface*, we have little limitations on where, how, and what can be visualized. We have also learned a lot about human cognition, and new possibilities and limitations of sensing so that the system can make intelligent choices about what content should be presented when and to whom to maximize its impact. Advertising was the first important business driver for pervasively presenting visual content and people had no small concerns. But it helped a lot to progress the technology and it seems as we have just made it: advertisement is highly targeted and blends unobtrusively with the information requests we make every day. The physical world has become a programmatically addressable space, delivering us the sensor information we need and a place that we can use to show any content: multimedia, advertisement, and any kind of applications and services that smart developers provide. But although we have made great progress in protecting privacy, not everybody feels comfortable about the information that is gathered.

2 From Digital Signage to Pervasive Display Networks

Digital Signage (DS) is a fast growing market for products replacing traditional paper-bound posters with electronic *public displays*. DS owes it success to the reduction of costs associated with printing and updating the printed signs. Especially advertising content is already ubiquitous and constitutes an important driver for investing in DS solutions.

In contrast, researchers have long explored the potential of public displays, investigating social, interactional, and technological implications in many novel directions [1]. While professional DS solutions (e.g. [4]) are capable of networking thousands of displays, research in truly pervasive advertising systems is only beginning now [5]. Increasingly commercial companies are beginning to exploit the new medium and its capabilities, experimenting with various forms of external triggers (contextual sensing, user input, RFID, video processing etc.) and interaction, thus picking up results from research.

Thus both the DS industry and academic researchers are ultimately concerned with the same question: *"How to get the right content to the right people at the right time?* And: *Can we achieve* ***true*** *targeted advertisement?"* We think that this question needs to be addressed by a middleware for a *Pervasive Display Network* (PDN), i.e. an intelligent collection of heterogeneous, geo-localized networked displays that are able to adapt their content to groups of nearby users, their attention, location and context. By its own nature such a middleware will need to be a distributed system, a system we refer to as *Pervasive Display System* (PDS).

A successful PDS will (1) provide high level programming abstractions that allows the distribution of content to the whole network rather than addressing individual displays and (2) accurately track users in a privacy preserving way. We believe that addressing the challenge of programming display networks will be of crucial importance for their long term success. More importantly, open APIs are required to enable a fast growing market for display services and applications. Likewise privacy preserving tracking technologies will be crucial for the acceptance of the system.

In the remainder of this paper we present a prototype that we have developed to identify functionalities that are required for a pervasive display system. This prototype has been demonstrated for three days at a major exhibition for Digital Signage solutions and audio video systems [6].

3 The Prototype

The main purpose of our prototype was (1) to identify the short and long term research questions associated with a middleware for Pervasive Display Systems and (2) we were aiming at developing an experimental system that had the potential for fast commercialization. Based on previous research and commercial interest, we furthermore identified that our demonstrator should be build on the following three pillars:

1. Pervasive displays should **engage** users and be **interactive**
2. Content should be **targeted** to individuals and groups
3. Displays should be **sensitive to the context** of their surroundings

Many systems have been built with the above features, however, little work has been carried out that considers displays as a collective, programmable network resources. Thus we look at the system from a distributed systems point of view, initially focusing on gathering context in a scalable and systematic way.

Considering these pillars and business requirements, we have chosen pervasive advertisement as first application. The prototype shows how content can be adapted to users that are passing near displays in a medium to large sized shop or shopping mall. Selected content is *targeted* towards their interests and augmented with QR-codes that enables *interaction* by accessing secondary content web pages with a mobile phone.

The secondary content page offers among other things, the possibility to claim a discount on the advertised product in form of a barcode coupon. In order to redeem the coupon the customer is able to request directions to a shop selling the product from the display system. Directions are displayed as arrows on the display. Customers are being tracked and whenever they approach another display, navigational cues are being shown on top of the display. At the shop check out the coupon is being scanned directly from the mobile's screen and the discount applied. The scan is also interpreted as location from which the system can infer that the user has arrived at its destination.

The implementation of the navigation support shows two important features: First, it shows the usefulness of networked and collaborative displays. Second, it illustrates how a user goal (*lead me to the store selling this product*) can be used as context for adapting the display content.

3.1 Support for context-awareness

We have based our prototype on our generic Context Management Framework (CMF) [3]. The CMF has been developed in several EU projects and consists of *Context Agents* that are responsible for acquiring context from sensors, processing and storing it. Agents collaborate in clusters providing access to context information that is distributed among them. A high-level interface is realized by our Context Access Language (CALA), a distributed query language optimized for accessing context information in a distributed system. CALA queries can be issued to a Context Agent using XML-RPC.

Each display runs a Context Agent that tracks users via their personal Bluetooth (BT) devices. A content scheduler per display adapts the content to the display context, in our case nearby user and their preferences. Secondary content is accessed by a QR code reader on the mobile device and provided by a PHP-enabled web server. The web server controls navigation support by updating corresponding context information in the CMF.

In addition our prototype includes a till system that reads barcodes by accessing a local context agent. This way information is re-used, in this demo to infer the users' situation and stop navigation support.

We identified several advantages of using our generic context middleware, e.g.:

- transparent storage locations by using CALA
- reuse of context information
- the CMF is self-managed
- suitable for managing both static and dynamic information

3.2 Privacy Conscious Tracking

The requirement for fast potential commercialization implied that (1) we had to choose a tracking technology that can readily be used in the market and (2) that we need to preserve the privacy of the users.

For this reason we chose to use Bluetooth as it is available on most mobile phones. In contrast to most common approaches we do not use BT discovery but we "ping" known devices. This implies an opt-in model in which users register their MAC address along with their interests. User registration is performed via a web page and the MAC address can be registered in the system via a small scanning tool.

The pinging approach is privacy preserving as only those devices can be tracked that the users explicitly registers. In particular the device does not need to be in discoverable mode and is thus hidden from other, potentially malicious, scanners.

For future work we are, among other privacy preserving techniques, interested in developing a tracking management system that optimizes detection rates by intelligently adapting the number of MAC addresses to be scanned. Our implementation already supports a certain level of dynamic configuration of the MAC addresses in the systems.

4 Summary

We have described our vision of pervasive advertising and briefly outlined a prototype that has been developed to explore middleware and privacy aspects of future distributed pervasive display networks. We are particularly interested in programming abstractions and privacy-conscious tracking technologies.

The prototype has been demonstrated at a major trade fair for three days. We estimate that the demonstrator has been shown 40-50 times. Visitor feedback can be summarized as:

- a high concern for privacy in case of customer tracking
- acceptance for an opt-in solution
- acceptance for pervasive advertising coupled with useful services like navigation
- high acceptance after seeing that the mobile could retrieve a discount coupon
- context-aware middleware with well defined APIs is added value for hardware

References

1. O'Hara, K., Perry, M. and Churchill, E. (eds.) Public and Situated Displays: Social and Interactional Aspects of Shared Display Technologies (Cooperative Work, 2), Kluwer Academic Publishers, 2004
2. NEC Eye Flavor, http://www.nec.co.jp/press/ja/0812/1601.html
3. L. Sanchez, J. Lanza, M. Bauer, R. L. Olsen and M. Girod Genet, A Generic Context Management Framework for Personal Networking Environments, Workshop on Personalized Networks, In Proceedings of 3rd Annual International Conference on Mobile and Ubiquitous Systems, San Jose, USA, 2006
4. Scala Homepage, http://www.scala.com
5. Storz, O., Friday, A. and Davies, N. Supporting content scheduling on situated public displays. In Computers & Graphics, volume 30, pages 681–691. Elsevier, October 2006.
6. Strohbach M., Kovacs, E., Martin, M. Pervasive Display Networks, Exhibition at Integrated Systems Europe (ISE), Amsterdam (February 2009)

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Person Aware Advertising Displays: Emotional, Cognitive, Physical Adaptation Capabilities for Contact Exploitation*

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Abstract. Out-of-home-displays have become a well-established medium in public advertising. In the future however, the ever more demanding audience will not be satisfied by today's contents. This paper describes an approach to utilize the human emotional, cognitive and physical state for improving the efficiency of outdoor advertising. The paper starts with a vision of out-of-home-media in the year 2034. That followed, we present a concept to use person awareness and adaptive content to better exploit the contact with the passers-by. Finally we describe the design and techniques of our display prototype system.

Keywords: Pervasive advertising, Out-of-home-displays, Interaction techniques, Computer vision, Context-aware computing

1 Advertising Displays in 2034

In the history of out-of-home-advertising, observers have become increasingly demanding. For a long time already, the transmission of advertising messages by moving images alone had become too clumsy. The modern ad has to be at the same time aesthetically appealing, informative, touch the viewer emotionally and surprise him by an ingenious advertising rhetoric. With the emergence of interactive media, advertisements have now to be invitations to play in which observers can actively participate in.

Advertisers today use sophisticated strategies to cope with manifold requirements. Holistic campaign strategies and social engineering [1] help to tailor the ad to the informational needs of the target group. The dilemma of advertising is that it cannot be tailored to the needs of the actual audience: an audience that has received the same ad just before, an audience that has missed the beginning of the ad, an audience that is interested in getting more detailed information, an audience that is engaged in entirely different activities.

In 2034, advertising displays are aware of their ambient. This ambient consists of the physical context on the one hand; but most physical constants such as location, architecture and visibility can be dealt with beforehand. The key application area for autonomous awareness is instead the ever-changing user context in front of every

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display: the individual persons passing by, or taken the sum of them, the active environment.

In 2034, advertising displays are aware of this active environment. They know what is taking place in front of the display, how many persons have made contact with the display, what are the interactions within the group, who is attentive and who is entertained, who still can be contacted, his attention grabbed, or what has to be done to keep the passerby involved in front of the display: to exploit the contact.

2 Adaptive Contact Exploitation

Most research in the area of adaptive displays deals with information management in multi-user environments including concerns such as identity, privacy, shared use or collaboration. An example of an ambient display framework that adapts interaction principles to the user is given by Vogel and Balakrishnan [2]. Their work focuses mainly on the transitions from implicit to explicit interaction, using indications of the passer-by such as body location, orientation and hand gestures. Our approach is based on this idea. But in order to achieve a more holistic awareness of the active environment, we propose that advertising displays may react in an adaptive way to psycho-physiological states.

Computational techniques for sensing, analyzing and influencing the cognitive-emotional user state are a new field of research aiming to discover the spectrum of the observer's internal states, such as joy, anger, boredom or high mental workload. Together with physical information about the user and behavioral patterns they enable a system to become person-aware. In our scenario this person-awareness is used to extend and improve the contact of the user with the advertisement to better exploit the contact. An image of one of our sample applications and a schema of our concept of adaptive control can be seen in Figures 1 and 2.

Figure 1, Sample Application

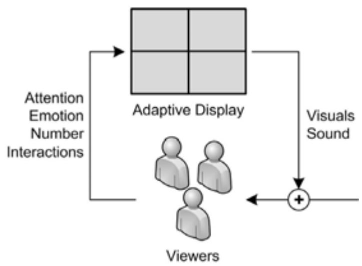

Figure 2, Adaptive Control

In our approach, we enhance advertising displays to address two kinds of adaptations: (1) adaptation to the active environment, and (2) adaptation to the individual user.

Adaptation to the active environment means adaptation to many people in front of the display and the relationships among them. An evident application adapts to the number of passers-by in front of the display. For example, if there are too many passers-by in front of the display to realize a 1-to-1 interaction, a reactive advertisement is shown. If there is a manageable number of passers-by and possibilities for group interactions, an initial for an interactive game is given. If there's no one in front of the display, an auto-active ambient display is shown.

Adaptation to the user means adaptation to the involvement of the viewer and includes balancing the content according to the user's cognitive-emotional state. An evident application takes the gaze of the observer to detect his awareness of the content, and facial expressions to get indications if the used social technique is approved by him, or if another type of content has to be selected and put in the foreground. For example, the system can transition from informative to more entertaining content if the viewer shows indications of decreasing attention to details or emotions (like joy or anger) that may prevent an effective information reception.

3 Prototype for a Contact Exploiting Display

In order to test our approach, we designed and set up a prototype consisting of a computer vision framework to collect information about the user, a wall of luminous plasma displays showing several graphical applications that adapt to the users' cognitive-emotional and physical state, and a software framework that supports the adaptation. We chose a vision-based sensing framework as it is a convenient sensor technology in this scenario allowing to collect information about user positions, orientations, movements and facial expressions as well as about many features of the environment. Not least, computer vision operates non-invasively and supports implicit interaction. To draw attention to the display, in our sample advertisement a dynamic image of a rotating car is shown that implicitly reacts when potential audience passes the screen. The displayed content then depends on whether the viewers are recognized to be more focused and attentive or if they show emotions like joy or anger. Viewers with a more or less neutral expression are now able to explore the car from the desired viewing angle, while expressions like smiling and anger lead to a funny animation of the car. The aim is to keep the passers-by to stay. If all viewers have disappeared, the advertisement switches back to dynamic content, an auto-rotating car.

To obtain information about single viewers, our approach exploits *model-based techniques* to accurately localize and interpret the visible human faces. A model imposes prior knowledge about the face and represents important face properties via a number of expressive parameters. Such properties include the location in three-dimensional and image space, the shape of mouth, eyes, eyebrows and other facial components. We utilize state-of-the-art techniques to estimate the best model parameterization for every image with high accuracy and in real-time [3].

From the fitted model high-level information is derived. The position of the face in the image is utilized to estimate the user's *gaze direction*. This information is then applied to get indications about the viewer's direct attention on specific display regions or his content involvement. In the future, we will integrate a three-dimensional model to determine the face position in 3D space rather than image space. Furthermore, we plan to use rotational and transitional velocity to gain information about head gestures giving indications on the viewer's focal awareness or situational involvement.

To determine a *facial expression*, a classifier exploits the model parameters to obtain the current shape of the mouth or the opening degree of the eyes. In addition, muscle movement is determined from the motion of particular facial feature points. We experiment with facial expressions to get information about viewer states such as joy, anger and surprise. For a detailed overview about this research topic we refer to the work of Pantic et al. [4].

The number of users is obtained from the number of visible faces in the image. In the future, we will complement these vision techniques by a *person tracking* application to maintain the association with a moving passerby.

To support such complex user-centric adaptive applications, we are also developing a framework that is based upon the paradigm of component-based software engineering [5]. The framework supports the adaptation of the behaviour of single components via parameter adjustment. This facility is especially useful for our computer vision applications as these techniques often need to be adjusted for specific conditions or requirements. Furthermore, structural reconfiguration replaces one component by another (for example a component for auto-rotation of a car by one for user control) to form an efficient and flexible base for the developed applications.

4 Prospects and Future Work

We have shown a vision of pervasive advertising displays that adapt to the emotional-cognitive and physical state of the audience. Our first prototype is able to adapt content to facial expressions and to positions of individual viewers. The next step is to extend the adaptation capabilities of our system. A first presentation of an early prototype at the FET09 exhibition produced promising feedback of the audience. On the part of advertisers, content that makes use of the proposed adaptation capabilities has to be created. By the year 2034, predefined target-group-specific advertising content will not be enough. In the future, observers will be even more demanding: they will expect that advertising displays ingeniously adapt to their internal state.

References

1. Kroeber-Riel, W., Esch, F.-R.: Strategie und Technik der Werbung. Verhaltens-wissenschaftliche Ansätze. Diller, H., Köhler, R. (eds.). Vol. 6, Kohlhammer, (2004)
2. Vogel, D., Balakrishnan, R.: Interactive public ambient displays: Transitioning from implicit to explicit, public to personal, interaction with multiple users. UIST '04, pp. 137–146. ACM Press (2004)
3. Wimmer, M., Stulp, F., Pietzsch, S., Radig, B.: Learning local objective functions for robust face model fitting. IEEE Trans. on Pattern Analysis and Machine Intellig., (2008)
4. Pantic, M., and Rothkrantz, L. J. M.: Automatic analysis of facial expressions: The state of the art. IEEE Transactions on Pattern Analysis and Machine Intelligence, (2000)
5. Schroeder, A., van der Zwaag, M., Hammer, M.: A middleware architecture for human-centred pervasive adaptive applications. PerAda'08. IEEE Computer Society Press, (2008)

Affordances and Signifiers of Community Noticeboards

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Abstract. Digital community displays pose many socio-technical challenges which must be overcome if they are to make successful contributions to a community, yet paper-based noticeboards appear spontaneously as surfaces are appropriated for notices with little or no design effort. We speculate on how this appropriation of surfaces might be harnessed to design more successful digital noticeboards.

1 Introduction

The noticeboard is an indispensable and ubiquitous part of many communities, found in neighbourhoods, workplaces and other forms of social network. They can be used to advertise events, jobs, services or items for sale and allow lightweight advertising to members of the public, usually free of charge. Many of these displays are spontaneous and self-organising: any surface can become a noticeboard and any window a display case. As availability of suitable technology leads to a rise in public displays, the use of these displays as noticeboards has been a natural step, both in the workplace (e.g. Plasma Poster [1] and the Notification Collage [2]) and increasingly in public areas (e.g. eyeCanvas [3] and Campiello [4]).

Our experience with digital noticeboards derives from two real-world deployments. In Wray, a small rural community in North West England, we have deployed a public photo display in an effort to understand the ways in which public displays can support communities [5]. From the outset, feedback from residents has spoken of a desire for community information which might commonly be found on noticeboards, such as advertisements, timetables and newsletters. For this reason, we are particularly interested in the ways that existing public displays, especially noticeboards, are utilised within the community.

In Münster, Germany, the iDisplay system [6] has been installed in university hallways, providing much of the functionality desired in Wray. Notices can be posted using a web application, to appear besides information such as bus timetables and weather forecasts. Users can connect to the display using Bluetooth to download notices, request an email containing the information or send them to a friend using SMS.

One of our greatest challenges in deploying such digital displays has been achieving the kind of natural behaviour seen in non-digital displays, due to the complexity brought by technology. In this paper, we examine how we might take cues from existing noticeboards when designing our digital displays.

2 What Makes a Noticeboard?

Despite our observations that designing to support communities is a complex socio-technical problem, communities are nevertheless filled with community noticeboard displays, some of which are planned by local authorities and some of which have developed organically over time through the contributions of community members. In Wray, for example, the village post office is home to two noticeboards: an actual pinboard specifically installed for community notices and a second noticeboard which has appeared on the side of a branded drinks refrigerator (Fig. 1). Both feature a similar selection of local businesses, small job openings, services for hire and items for sale, but the second board seems to be somewhat more active and certainly more vibrant. What was it about this appliance that invited dozens of villagers to leave advertisements?

Fig. 1. Two post office noticeboards.

Donald A. Norman appropriated the term ‘affordances’ to refer to the tasks which a user *perceives* an object to be capable of [7] and more recently, this was expanded upon to include ‘signifiers’, suggesting “we know how to behave by watching the behaviour of others, or [. . .] the trails they leave behind” [8]. In many ways this is similar to Harrison and Dourish’s ‘spaces’ and ‘places’, in which interactions are governed by both the physical space in which they are situated and the cultural expectations associated with that particular place [9].

Certainly, the presence of a large, smooth surface in the post office invites notices to be posted using adhesive tape or tack, and the refrigerator is located where customers will queue to reach the counter at busy times, while the pinboard faces away from the majority of the shop. Although we had speculated that it might even have been an intentional attempt to cover a large, unwelcome advertisement, the actual motivation was more prosaic: the shopkeeper had wanted somewhere noticeable to post upcoming events etc. while keeping long-term advertisements (largely business cards) on the pinboard.

In this case, action by an authority figure caused the surface to afford the qualities of a noticeboard, but this need not always be the case. For example, a whiteboard in our department kitchen had remained blank and unused for several years until one of the authors wrote a message ("Has this always been here?") as an experiment, to see whether this would inspire further use of the board. Within an hour, a response had appeared, followed by a word association game and drawings. Although the board was wiped clean repeatedly by a member of staff, messages continue to appear, followed by a rack of pens and magnets and it eventually came to be used for official notices. After the first message, the board appeared to afford lightweight, playful messaging by provoking a response and signifying that leaving a message was 'allowed', much like the 'honey pot' effect in which activity around a display invites further participation [10].

3 Designing Digital Noticeboards

Digital noticeboards can potentially offer several clear advantages over traditional noticeboards: multimedia notices; automatic clearing of out-dated content; more fine-grained access control; adverts which grow more urgent as deadlines approach etc., but these advantages might come to the cost of the natural interactions described above as complexity is introduced. Here we consider several design guidelines which might be followed to help digital displays afford greater levels of simple, intuitive interaction to communities.

In both the cases described above, a surface began to afford the qualities of a noticeboard after a single person took steps to use the surface in this way. Often, new community systems may be devoid of content, leaving potential users wary of contributing something inappropriate or unwilling to contribute first. By seeding the display with existing content, perhaps from other noticeboards, this problem could be overcome. This approach was successful with the Wray display, which one of the authors seeded with his own photos of the annual village fair. However, there is a danger that this might restrict the types of content contributed by users if they choose only to follow the example set by early content.

Similarly, there may be advantages to leaving 'stale' content in place. Although we had cited removal of such content as a potential advantage of digital noticeboards, past notices can provide vibrancy to community spaces and signify that the surface is a noticeboard. Were all the notices on the display to expire and be removed, the perceived affordances and signifiers of the surface might disappear. It might be beneficial to ensure that a certain amount of content appears on displays at all times, regardless of its timeliness.

It may also be advantageous to provide multiple methods of communication with displays. Different people are comfortable with different technologies—whereas one person might be most comfortable using SMS, another might prefer free Bluetooth transfers, while another may prefer to access the system from the privacy of their home Internet connection. Many more notices were posted on the kitchen whiteboard after magnets were introduced to allow printed notices, while the iDisplay system provided a variety of different interaction techniques and mediums allowing users to fit the display within their existing routines and processes. This might extend beyond digital technologies: there may often be community members who are uncomfortable with technology altogether and we are currently considering ways for such users to contribute content on paper which could be uploaded by volunteers.

4 Summary

In the foreseeable future, it is perhaps unlikely that digital displays will become as simple to use or widely accepted as paper noticeboards, as their benefits come with the cost of additional complexity. However, through careful consideration of the design, placement and content of displays, we can afford certain interactions and signify appropriate behaviours, decreasing the restrictions introduced by technology to allow digital noticeboards to play a greater role in communities.

5 Acknowledgements

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References

1. Churchill, E.F., Nelson, L., Denoue, L.: Multimedia fliers: Information sharing with digital community bulletin boards. In: Proc. C&T 2003, Kluwer (2003) 97–117
2. Greenberg, S., Rounding, M.: The Notification Collage: Posting information to public and personal displays. In: Proc. CHI 2001, ACM (2001) 514–521
3. Churchill, E.F., Nelson, L., Hsieh, G.: Café life in the digital age: augmenting information flow in a café-work-entertainment space. In: Proc. CHI 2006, ACM (2006) 123–128
4. Agostini, A., Michelis, G.D., Divitini, M., Grasso, M.A., Snowdon, D.: Design and deployment of community systems: reflections on the Campiello experience. Interacting with Computers **14**(6) (2002) 689–712
5. Taylor, N., Cheverst, K., Fitton, D., Race, N., Rouncefield, M., Graham, C.: Probing communities: Study of a village photo display. In: Proc. OZCHI 2007, ACM (2007) 17–24
6. Müller, J., Paczkowski, O., Krüger, A.: Situated public news & reminder displays. In: Proc. AmI 2007, Springer (2007) 248–265
7. Norman, D.A.: Psychology of everyday things. Basic Books, New York (1988)
8. Norman, D.A.: Signifiers, not affordances. interactions **15**(6) (2008) 18–19
9. Harrison, S., Dourish, P.: Re-place-ing space: the roles of place and space in collaborative systems. In: Proc. CSCW 1996, ACM (1996) 67–76
10. Brignull, H., Rogers, Y.: Enticing people to interact with large public displays in public spaces. In: Proc. INTERACT 2003, IOS Press (2003) 17–24

From intrusive to supportive: recommendations for pervasive advertising

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Abstract. Here, we discuss the evolution of advertising in other mediums from a user's perspective, with a particular focus on web advertising. By charting advertisements through their advancement from novelty to sophistication, we can see that technical advances often arrive in conjunction with intrusion and consumer irritation. We compare this to the early trials of non-traditional advertising techniques that have been attempted, and show that many of the same mistakes are being made now as we move towards a new era of pervasive advertising.

1 Introduction

Advertisements have been with us as a society for thousands of years. As manufacturing and printing technologies became more advanced, ever more forms of advertising have proliferated. Large static display-based adverts pervade our environment, with examples including the Goodyear blimp, billboard advertising, conference posters, product information signs and advertising displays.

If we take a historical look at advertising in any medium—be it in television, radio, magazines or the web—we can see similar patterns emerge. Over time, ads become larger, more prevalent, more vibrant, louder and often more obnoxious. In magazines, multiple contiguous pages made up purely of advertisements are not uncommon. On radio, commercial content and normal content can be difficult to distinguish. In movies, prominent product placement is increasingly commonplace. On television, TV shows have been shortened in length to accommodate longer ad-breaks, during which the volume of the broadcast is surreptitiously increased.

Advertising on the web in particular has been degenerating for years into obtrusive, attention-getting, gimmicky ads which are increasingly loathed by users. Advertisements on the web transitioned from modest graphical ads and banners to related websites, to new windows that would "pop-up" unexpectedly from the page you were visiting. More recently, rich media ads have begun serving up video (and sound) to unsuspecting visitors.

These aggressive advertising methods were disliked by users[1], but website owners, without any other viable way to make money from their content, are seemingly forced to use ever-more intrusive forms of advertising to get the user's

[1] Jakob Nielson: "The Most Hated Advertising Techniques" `http://www.useit.com/alertbox/20041206.html`

attention; or in the language of web advertising, to have access to a user's "eyeballs." A single page can have multiple ads from different sources, leaving each advertising element to compete against the others for a user's limited attention. Users began to ignore some ads: for example, "banner blindness" describes the ability of users to selectively close off their attention to certain page elements that have the dimensions of a typical banner ad.

When Google launched their AdWords/AdSense products in 2001 they were hailed as the company that had saved online advertising, because the ads that they favoured were non-boisterous and somewhat contextual. Google AdWords were simple text links that were added to Google search results. The AdSense programme that followed allowed webmasters to embed relevant ads from Google into their own websites. Since the content of the ad was based on the page that a user had visited of their own volition, the content of the ad could be thought of as being personalised to some degree. This respect for the user coupled with the contextualisation of the ad resulted in clickthrough ratios that were superior to what had come before [1].

The key lesson from this is that users have a higher tolerance for ads that support them in or relate to their current task. A webpage with a single contextual ad unit might outperform the same page with multifarious more intrusive techniques, simply because the user is more likely to look at it.

2 Ads in the environment

The earliest examples of "pervasive" advertising using non-traditional techniques in the environment have been poor exemplars. They have used non-traditional technologies which in many cases are not yet mature and leave the user with little recourse when an ad that they do not want is shown to them.

Bus shelters have been fitted with Bluetooth transmitters and readers of advertisements have been recommended to "Set your Bluetooth device to be discoverable". We suggest this request is incomprehensible to most users. Regardless, when a phone with Bluetooth enabled is within range, a text message or video content is pushed to the user's phone. Unfortunately, the bus shelter indiscriminately pushes this content to the phones of all users who are within the range of the system. Advertisements such as this needlessly harass users who may not have even been looking at advertisement as they passed by. This kind of advertisement can deliver a negative experience, and further attempts in this style will result in user frustration and, we expect, the eventual abandonment of having Bluetooth enabled on ones phone.

Ads like this represent a violation of a user's trust in how their personal devices can be used. Early attempts at personalised ads in the environment have also been contentious, like the ad campaign run by Mini Cooper which would display personalised billboards to the user on the side of the road[2]. These

[2] The New York Times: "Billboards That Know You by Name"
`http://www.nytimes.com/2007/01/29/business/media/29cooper.html`

were criticised for being a safety hazard, as they distracted drivers from their task (driving their car safely).

The many systems for “digital grafitti” [2], which allow users to annotate multimedia content in their environment via a mobile device, are an improvement of a kind over traditional environmental billboards, because the information in the system is transmitted over a non-visual channel that you need to “tune in” to (i.e., opt in) to be able to view. But advertising throughout history has been designed to be positioned in the space *between* the user and something that they want to see. One possible future for this kind of technology is a world with multiple advertising channels overlaid on the world which can be turned on and off. A positive step in the right direction are those systems that track a user’s gaze, and report back to the advertising system, telling it which ads were most popular with viewers based on what they looked at [3].

3 Supportive advertising

What we are describing here is our model of “supportive advertising”; an advertising method through which the consumer and the system collaborate in a way. As the user offers up whatever limited information about themselves that they wish to make available, the advertising system can make improved recommendations to them.

Advertising in traditional media (television, radio and print) are all driven by demographics, and in many ways are thus wasteful, having successful campaigns decided by percentages and metrics. A “media buy” will be targeted towards certain demographics, and so the level of personalisation is low. Profile-driven advertising is not possible in these media. In the networked world of pervasive advertising however, we can improve the user’s experience using personal information with their consent.

When browsing the online shopping website amazon.com, a sophisticated recommender system tracks every action of the visitor, from the products that they view and rate to the searches they perform. Through this monitoring technique the website can increase the success of items that they recommend to a particular user, because they are able to personalise these recommendations. Throughout the site a user is given many opportunities to tell the site more about them, by making wishlists and rating products that they’ve already bought elsewhere. We imagine that many users are quite willing to offer up additional information about themselves, because they can clearly see that they are receiving a better service in return. Though they are effectively being advertised to, the incentive for them to engage with the system is clear and compelling.

What we have so far called “advertisements” could also be simply *information*, which we transmit to the user pervasively in support of their current tasks. For example, in a shopping centre, this information would pertain to related products, better deals, and so on. We see the balance between information that a user is asked to provide, and the personalisation achieved by the ad, as critical to the success of these new advertising technologies.

In the following matrix (Figure 1), we present the relationship between high-impact, useful personalised advertising with the level of data disclosure that is required of them. In the top left corner we have these traditional advertisements: banner ads, television commercials, magazine ads and so forth, which are limited to being positioned well by their agencies. Though the quality of these ads and their impact varies greatly, we consider these ads to be low utility. As we move further to the right, the advertisements become more personal, going from the keyword-based AdWords links, to ads on search results (which are more supportive of a task). These ads are more successful, and illustrate a critical feature: when the user is searching for information or products, they are much more willing to be advertised to.

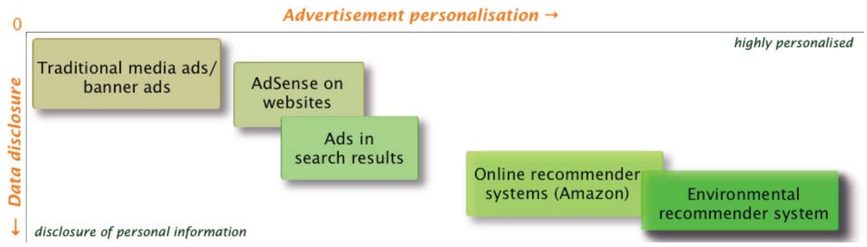

Fig. 1. As more personal data is disclosed, the advertising system's ability to personalise content to the user increases. Both the utility and invisibility of the ads increases also as we move towards the bottom corner.

Ultimately, we foresee a type of *environmental recommender system*, which operates pervasively in a physical environment and is seen as a *positive* influence, because they are used to highlight information or products useful to individual customers, rather than used purely to serve better ads.

We would like to see some level of collaboration between the user and the environmental ads, to engender trust in these systems. Otherwise, will we see cluttered web advertising spaces give way to cluttered physical spaces where ads vie for control over any and all communication channels? It's not hard to imagine that pervasive advertisements will follow a similar pattern to what we have seen before in other media, unless we choose to follow a more positive path.

References

1. J. Battelle. *The Search: How Google and Its Rivals Rewrote the Rules of Business and Transformed Our Culture.* Portfolio Hardcover, 2005.
2. S. Carter, E. Churchill, L. Denoue, J. Helfman, and L. Nelson. Digital graffiti: public annotation of multimedia content. In *CHI '04 extended abstracts on Human factors in computing systems*, pages 1207–1210, NY, USA, 2004. ACM.
3. J. Müller, J. Exeler, M. Buzeck, and A. Krüger. Reflectivesigns: Digital signs that adapt to audience attention. In *Proceedings of Pervasive 2009*, 2009. To appear.

Automated Computational Aesthetics for Pervasive Graphical Advertising

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Abstract. Graphical advertisements can be seen on digital signage, mobile phones, and online webpages, and fomenting user interest in the ads is important for both publishers and advertisers. This work addresses the issue of making Web graphical ads more attractive and compelling, with the end result hopefully being a positive emotional response from the user that produces a click. We developed a system for displaying advertising images in an attractive, pleasing manner using automated heuristics based on fundamental colour theory whereby our system automatically analyses an image, extracts important colour characteristics, and dynamically sets key colours in a surrounding frame.

1 Introduction

Graphical advertisements are an increasingly pervasive and important component of advertising campaigns, with such ads being seen in many electronic contexts, including digital signage in public spaces [5], targeted messaging in mobile phones [6], and online static banners or Adobe Flash objects on a webpage. However, drawing the user's attention to the ads in a positive manner continues to be difficult. In this paper, we directly address this problem in the context of online Web advertisements, although our approach can be applied to other pervasive advertising mediums that display graphical ads.

In Web advertising, advertisers own an ad, and webpage publishers show ad impressions (the rendered instances of an ad). Graphical online advertising is a multi-billion dollar industry that generates revenue for the publishers and product interest for the advertisers [2]. Graphical ads can be part of either cost-per-click or cost-per-mille advertising campaigns, and in both cases, fomenting user interest and generating clicks on graphical ads are important for both the publishers and the advertisers. A high click-through rate (the ratio of the number of clicks to the number of impressions) is thus very desirable.

However, attaining clicks on a given ad impression can be difficult because users may simply not be interested in the advertisement or may be experiencing advertising fatigue. Publishers attempt to fight this indifference by offering

* This work was conducted while the author was with Yahoo! Inc.

more relevant advertisements based on user demographics or the content of the page [1]. Nonetheless, graphical ads in particular perform poorly, with click-through rates above 1% typically being considered successful.

This work addresses the issue of *making the graphical advertisements themselves more attractive and compelling*, with the end result hopefully being a positive emotional response from the user that produces a click. In Section 2 we discuss a design and implementation that automatically chooses aesthetically-pleasing advertisement colour schemes from advertisers' image catalogs, and in Section 3 we discuss our vision of advertising in the future.

2 A system for automated aesthetics

We developed a prototype for displaying graphical ad images in an attractive, pleasing manner using automated heuristics based on fundamental colour theory. Although aesthetics are inherently subjective, we note that in informal demonstrations, viewers of our prototype were very pleased by our results, some of which are shown in Figure 1.

This work addresses a use case where an advertiser wants to run a Web-based graphical advertising campaign that rotates images from a catalog of their goods. Since the number of images may be large (for example, it may be a collection of clothing images on the order of hundreds), crafting a pleasing colour scheme for all the images may be too large a task, so the inclination might be to place the image inside a generalised graphical frame with some default colour. While this approach is sound, it also produces a rather visually-dull set of ads.

In our work we developed a system that automatically analyses each image, extracts important colour characteristics, and dynamically sets key colours in a surrounding Adobe Flash frame that we can co-develop with the advertiser. For images smaller than 1000×1000 pixels, our approach is generally very fast, taking approximately a second to process an image using an off-the-shelf Core2Duo desktop running Red Hat Linux. Our system was written in C++/STL using the open-source ImageMagick library.

The processing proceeds in a series of steps. First, given an image, we crop and retain its center 25% region by area: given an image of width W and height H, we retain the rectangular region with diagonal corner coordinates $(\frac{1}{4}W,\ \frac{1}{4}H)$ and $(\frac{3}{4}W,\ \frac{3}{4}H)$. This cropping allows us to concentrate on the image's subject matter so that important colours can be later extracted. We note that the subject of a photo may not be in the center, and in fact in general photography, it is very often recommended to place the subject on one of the $\frac{1}{3}$ axes of the image according to the Rule of Thirds [4]; however, in commercial product photography the subject is almost always directly in the center.

Second, we analyse the cropped image pixel-by-pixel, quantise each pixel's colour, and create a histogram of bucketised RGB values, typically with 32,768 buckets and sorted by brightness. From this histogram we can determine the image's characteristics with regard to the colour values in its highlights, midtones, and shadows as well as the colours' frequency of occurrence.

Fig. 1. Sample ads showing the surrounding colours being based on an image's highlights, midtones, and shadows. The images are copyrighted by their respective owners.

Third, following a set of business rule heuristics, we pick colours from the histogram from which we can set the surrounding colours in the frame. In the images shown in Figure 1, we picked up to three colours from the image which are then stated in an XML file that the Flash object reads and uses at display-time to set its colours (using ActionScript). In the clothing ads, the colours for the surrounding frame and the block around the price were set with the image's prevalent midtone and shadow colours, respectively. A similar approach was taken in the car ads, with the colour of the button using the prevalent highlight.

The business rules used in last phase are obviously the most crucial and must be done in accordance to the advertisers' tastes. In other trials of our prototype, we also used frame colours that were chosen as the complement of colours found in the image (where we use the term "complement" in the strict sense of the colour that is 180 degrees diametrically opposite another colour on an RGB-CMY colour wheel [3]). A variety of other rules may be used, such as constraining the colours for users in particular demographics (such as pastels for women and vibrant colours for users under 25). Further, in a pervasive computing environment, these rules might leverage such context as audience eye movement, the weather and season, or ambient light. Once such heuristics are laid out, images can be driven through the system to produce the automated renderings.

3 Conclusion

Over the next 25 years, webpages, mobile phones, and digital signage will host an ongoing war between the advertisers eager for user interest and interaction and the users irritated by increasingly-pervasive advertisements. We envision a future where ads will be completely personalised and delivered with surgical precision. Even when the anonymity of a user is preserved, a tremendous amount of information can today already be drawn and inferred from basic Web-surfing behaviour that can reveal, for example, the user's gender, age, income, political leanings, and personal interests. Given this information, an advertiser (with the help of the publisher's platform) is able to deliver a specifically-tailored ad. On the other hand, users have already developed a keen sense of dullness in responding to online advertising. Additionally, ad-blocking systems deployed at either the user's browser or in proxies make the advertiser's job more difficult.

Our opinion is that digital pervasive advertising 25 years from now must take the form of self-standing, aesthetically-compelling works with which users will *want* to interact. Such advertising must be able to provoke a positive emotional response using the digital medium in a way similar to how TV commercials during the Super Bowl are considered a significant form of entertainment. Our work in developing an automated system to produce visually-pleasing graphical advertisements is based on basic colour theory, and we expect future successful pervasive advertising to leverage an intersection of the innovativeness of computer science research and engineering, the aesthetics of graphic design and photography, and the business acumen of advertising agencies.

References

1. A. Broder, M. Fontoura, V. Josifovski, and L. Riedel. "A Semantic Approach to Contextual Advertising," In *Proceedings of SIGIR*, 2008.
2. S. Clifford. "A Web Shift in the Way Advertisers Seek Clicks," The New York Times, April 21, 2008.
3. R. Hirsch. Exploring Color Photography. Mcraw-Hill, 2004.
4. B. London, J. Upton, J. Stone, K. Kobre, and B. Brill. Photography, 8th ed. Prentice Hall, 2004.
5. K. O'Hara, M. Perry, and E. Churchill (eds.). *Public and Situated Displays: Social and Interactional Aspects of Shared Display Technologies.* Kluwer, 2003.
6. M. Reardon. "Advertising seeps into the cell phone," CNET News, September 14, 2006. http://news.cnet.com

Studying UI Design for Mobile Advertisement

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Abstract. The special characteristics of mobile phones make them an interesting platform for pervasive advertisement. In addition to their nature as personal always-on devices, the mobility and sensor features of mobile phones can be harnessed for advertisement in situationally appropriate means. However, how this is designed in a pleasant yet effective manner is a challenge which should be carefully considered if we wish to successfully implement mobile phone push advertisement. In this paper, we present our on-going research and preliminary results on studying the mobile phone user interface design for push advertisement through mobile maps.

1 Introduction

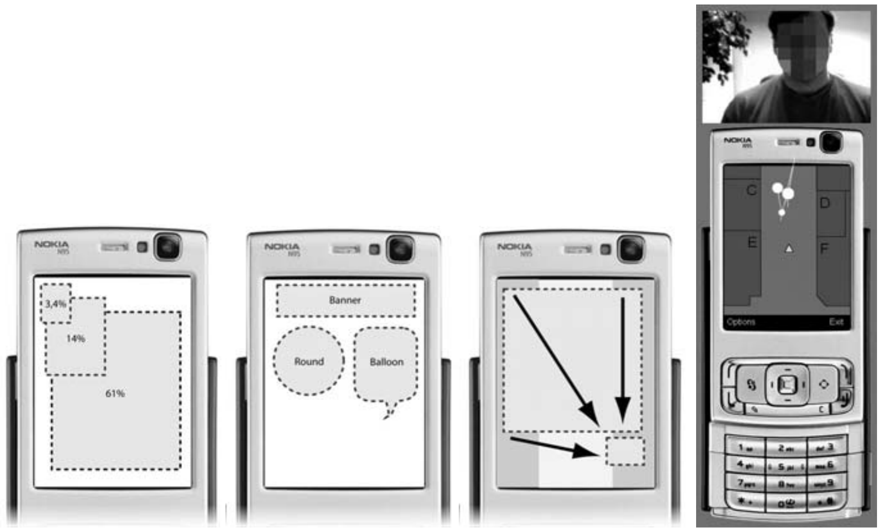
The mobile devices carried by most of us present lucrative possibilities for advertisers and other commercial players for pushing users with location-sensitive and personalized advertisement content. The most advanced mobile devices can provide location-aware functionality through position recognition (such as GPS), and combine this with map-based services. In this paper, we explore the design issues related to visual presentation of push advertisement in mobile devices.

Even though mobile advertisement is still immature when compared to internet advertisement, pilot experiments have been done and reported. Mostly solutions have been based on SMS technology [5]. Direct information push has been found to be most efficient and convenient for presenting advertisements in mobile contexts and through mobile devices [6] because it requires least user interaction and effort from the mobile user. However, user studies indicate that user attitudes towards SMS-based push advertising can be negative unless the user has specifically given consent for receiving advertisement [7]. Visual design of advertisements have been studied both in desktop and mobile environments. Animations in banner advertisements have been found to result in quicker responses when compared to static advertisements in both desktop [4] and mobile [6] contexts. However, animations have been found to be more disruptive than static content [1], and research findings on the effect of animations to how users remember the advertisement content are conflicting ranging from no effect on recall [1] to better recall [4] and even to worse recall [2] than with static advertisements.

2 Research Set-Up

Research on visual human perception has shown that visual attention and eye movements have strong relationship, and that visual attention is highly related to occurrence of eye fixation [3]. In our study we track eye movements (saccadic and fixations) and analyze them to obtain indications on arousal of attention i.e. long time eye fixations.

Twelve voluntary test users (5 male, 7 female) participated in the experiment. None of them worked in IT industry. The ages of the test subjects ranged from 18 to over 60. Eight out of 12 wore eye glasses. The user interface was implemented with Flash, and it was presented to the test users through desktop computer equipped with eye-tracking functionality (Tobii 1750), Fig 1.



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a. b. c. d.

Fig. 1. Illustration of visual variables, i.e. (a) sizes, (b) forms and forms of pop-ups, and (c) illustration of pop-ups that was reduced into thumbnail at the bottom of the screen, and (d) the map based user interface used in the experiment, with camera view of the user. Eye tracking data with dots representing eye fixations, and lines eye movement tracks.

The test procedure started with a brief background questionnaire and calibration of the eye-tracking equipment. Then, each user was presented an imaginary shopping mall map view on a mobile phone with 29 push advertisements that varied with respect of the following aspects: size, duration on the screen, shape, location on the screen, and animation effect (see Fig. 1). The users were asked to “move” along the path visible on the map using the arrow keys of the keyboard, and ads appeared on screen along the way. The UI used in the test was very simple for the purpose of avoiding distracting elements that would draw user attention into details not relevant for the study.

3 Results

The results presented here are based on both the analysis of eye-tracking data and the subjective comments and ratings given by the test subjects.

Form. The eye-tracking data indicates that sharp corners draw attention of the user to the corners. For example, in rectangular formats, the eyes were easily drawn to the corners of the pop-up. The same was observed with balloon-formatted pop-ups. The sharp corner of the balloon clearly draws attention to the tip of the shape. This may result in reducing the attention that is directed towards the content of the balloon (which is presented in the upper part of the shape). However, this can be exploited by pointing the sharp point of the shape into the exact location on the map, which may make it easier for the user to perceive the connection between the pop-up and the map location where the advertisement belongs to. If the rectangle used for pop-up was long, extending from one side of the screen to the other, it caused restless movements of eyes. Also, viewing content was not possible with one glance, which caused lots of eye movement and activity within the pop-up

Size. The smallest size pop-up was clearly the least distracting according to the eye-tracking data. The eye-tracking data showed that smallest sized pop-ups caused less eye movement than the bigger ones, and allowed the users to continue to follow the map menu with minimum distraction. However, especially elderly test subjects experienced the smallest pop-up size to be too small to read. Also, not much content can be squeezed into a pop-up of this size. The biggest pop-up was experienced often to cover too much of the screen area and therefore be distracting. Also, the biggest pop-up caused most eye movement and restlessness of gaze. However, this is not necessarily harmful when eye movement is caused by the details inside the pop-up: the big pop-up may just give the users an opportunity to digest the details of the content better. This observation supports the findings made by Rau et al. [Rau 9] who suggest that using a small sized mobile advertisements causes least distraction on the primary information needs of the user (in this case, viewing the map). The middle size pop-up was clearly most pleasant according to the subjective ratings, and it seemed to be quite effective in regard of eye movement. It caused clear and precise fixations and did not make the eyes wander excessively inside the pop-up, or between the pop-up and the surrounding UI. The older users, who complained that the smallest size pop-up was too small to read, felt comfortable with this size, too.

Duration. When the pop-up was located at the top of the screen, the test users noted it significantly faster, than if it was located at the bottom of the screen. The average time to first fixation for pop-ups at the top of the screen was 0.19 seconds, whereas for pop-ups that were placed at the bottoms the average time to first fixation was 0.29 seconds. The experiment design defined the imagined walking direction on the map to be always towards the top of the screen. Therefore, the users had their attention mostly on the top of the screen, as it was the part of the screen that was new and changing. Therefore, we assume that the significance of the location is related to the direction of movement, i.e. the users note better the pop-ups that are placed on the direction of movement. On the other hand, when pop-ups are placed on the top of the screen, they may also cover new information presented by the map interface. This may cause more distraction than the pop-ups lower on the screen covering the old parts of the map. This design dilemma cannot be avoided, even though it can be reduced by optimizing the size of the pop-up.

4 Discussion

Limiting the study, the test setting was very controlled, and thus did not achieve very high level of realism - In mobile situations, the users would not be able to follow the screen of the device uninterrupted and with full attention. However, in a static test setting we were better able to control the environmental variables that might have a strong effect on the results, and concentrate on the variations on controlled variables. This was necessary because of controlling the environmental parameters always unpredictable in mobile and realistic usage situations. On the other hand, this has an effect on the results. For example, the level of attention the user can direct towards the mobile application is very different in real mobile conditions, which has a strong effect, for example, on the optimal duration of pop-up and on how quickly the user can pay attention on the advertisement. The results presented here represent an optimal usage situation where the user pays full attention on the application and is not distracted by the surroundings.

References

1. Bayles, M.E.: Designing online banner advertisements: should we animate? In Proc. CHI 363--366 (2002)
2. Burke, M., Gorman, N., Nilsen, E., Hornof, A.: Banner Ads Hinder Visual Search and Are Forgotten. In Proc. CHI, 1139--1142 (2004)
3. Hoffman, J.E., Subramaniam, B., The role of visual attention in saccadic eye movements, Perception & Psychophysics, 57 (6), 787—795 (1995)
4. Li, H., Bukovac, J.L: Cognitive impact of banner ad characteristics: and experimental study. Journalism & Mass Communication Quarterly, 76, 341--353 (1999)
5. Merisavo, M., Vesanen, J., Arponen, A., Kajalo, S., Raulas, M.: The effectiveness of targeted mobile advertising in selling mobile services: an empirical study. International Journal of Mobile Communications, 4, 2, 119--127 (2006)
6. Rau, P.-L., P., Chen, J., Chen, Duye: A study of presentations of mobile web banners for location-based information and entertainment information websites. Behaviour & Information Technology, 25, 3, 253--261 (2006)
7. Tsang, M.M., Ho, S.-C., Liang, T.-P. Consumer Attitudes Towards Mobile Advertising: An Empirial Study. International Journal of Electronic Commerce, 8, 3, 65--78 (2004)

Personalized Pervasive Advertisement through Service Blending - Automatically Enriching the Call Experience

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Abstract. This work shows how *Service Blending*, a feature that can enrich communication services by adding additional multimedia or static services to SIP-based sessions, can be used to produce pervasive advertisement during active communication sessions. It is discussed why this is a step towards pervasive advertisement, an example scenario for clarification is presented and the acceptance for such a feature has been exploited with the presentation of a demonstrator at a large fair.

1 Introduction

The IMS [4] introduces service enablers for voice, video, messaging and much more. Applications can use them to provide services like VoIP or IPTV to users. These enablers, however are not linked together to target a multi-device and multi-session environment.

We have introduced a *Personalized Communication Controller* (PCC) [3] for personalizing IMS services over multiple different enablers. The PCC is located at the application layer of the IMS and brings together all user-related information, like device capabilities, user preferences and context information. It also works as a communication endpoint for each user, which means that the PCC has knowledge and control over all incoming and outgoing communication sessions. Thus, it is able to provide real-time decision-making, respecting the user's personal preferences, the current multimedia sessions, the user's context and the device and session capabilities that are valid for a particular user and session. Additionally the PCC can enrich existing sessions with additional content automatically – a feature we call *Service Blending*. This additional content can range from static content, like web pages to sessions with multiple different multimedia streams. Since this content's media path is different from the one of the main session, its lifetime can range from pre-session-establishment only (during ringing) to the main session's lifetime. Even a lifetime that is longer than the lifetime of the main communication is possible.

In this environment a new set of communication clients emerge that have capabilities beyond pure voice communication and text messaging. Industry fora like RCS (Rich Communication Suite) [5] prove that vendors and operators are trying to push for new technologies and better user experience. In this paper, we assume the use of such Rich Communication Clients, which are for example capable of handling multiple sessions at a time and can run on a PC as well as on a mobile device.

2 Pervasive Advertisement and More

Advertisement can be pervasive in multiple ways: for example by detecting user proximity and displaying user relevant ads on public screens [1] or by detecting the location of the users' mobile devices and offering location based offerings [2]. We believe that the knowledge about what the user is doing in a particular moment also helps to make the advertisement pervasive. Furthermore the knowledge of the exact device capabilities also helps to adjust the format and type of advertisement. If advertisement then integrates into the device's user interface without annoying or interrupting the user, it can be presented to the user on the same screen on which he experiences his main communication session without bothering him.

Of course the *service* that is blended to a certain user's session is not restricted to advertisement. In fact the PCC only provides a *personalized recommendation system* which can invoke any kind of service that the device is capable of. Online games, supporting services like shared folders or social network services (SNS) can be introduced to the user via the blending mechanism. We believe, however that advertisement can be a main driver to get to a heterogenous service environment where such services can be recommended and used over the existing communication infrastructure by the users.

3 Discussion of Advantages

In the following, we explain how Service Blending technology can help to make advertisement more pervasive:

Advanced pricing models: The benefit of advertisement *during* an ongoing session could be utilized by the operator and handed back to the user, who can have special rates for outgoing calls for example. Thus, new revenue possibilities can be created for operators and for 3rd-party advertisement providers, and the user acceptance for this kind of advertisement may raise in the future.

Capability-aware advertisement: Since the PCC knows about the capabilities of the users' devices, it can adopt the format and the type of advertisement precisely to the device that is currently used. For example, it can adjust resolution or codec of an RTP stream to exactly match the device's capabilities. Using the PCC blending mechanism for advertisement therefore avoids presenting advertisement in wrong media formats or with the wrong session capabilities for the device currently in use. This makes the advertisement service more stable and provides a better experience to the user.

Context-aware advertisement: Even more important than evaluating device capabilities is the information about ongoing media sessions that a user has at a particular moment. For example, if the user has an audio/video session ongoing on the same device, he will look at the screen, and an advertisement as picture or HTML page fits very well. Time gaps with no interaction during the session can be filled with advertisement, which transforms the advertisement from a “cannot-avoid annoyance” to a “time-bridging feature”, and this may increase the acceptance of advertisement in the future. Location-based advertisement is also possible if the PCC has access to additional context sources like the location of a user during the call. Moreover, the PCC includes a user profile engine that can evaluate user preferences and influence service blending decisions based on the results. In this way user interests can be easily integrated into the selection of blended advertising services and other services.

Seamless integration: By integrating the advertisement directly into the call view of the respective communication client, the annoyance factor at the user side can be minimized. The advertisement exists then next to a useful service like a call and does not overlap with this experience. We believe that this helps to make advertisement pervasive, since the user is not disturbed by its existence. It would also be possible to seamlessly integrate public resources, e.g. digital signage (DS) devices that are registered in the NGN in the user experience. In fact, the addition of a publicly available DS device could be a *service* itself – that is available based on user context information like location. In case the user accepts this service blending, the PCC is able to fork sessions, based on service capabilities and user preferences, to the best fitting device that is registered with the user at the moment. High resolution advertisement pictures or movies can then be presented at the DS device.

4 Example Scenario

Service blending technology allows the users to control the things that they want to see or not during their call experience. The following example shows a simple call flow with additional content blended automatically by the PCC.

Figure 1 shows the basic scenario flow: The session is established over an IMS infrastructure, where both users have their own PCC module instance that manages their devices and calls. The preferences of each user are evaluated during the call setup. User B receives advertisement because his profile allows this kind of service blending in exchange for a better pricing. Of course, this advertisement can also be personalized to user preferences, as the PCC knows about the preferences of User B. Furthermore, service capabilities can be analyzed by the PCC of User B, and the format and even the type (i.e. streaming content or static content like images or HTML pages) can be adjusted accordingly. Service or network operator policies are also evaluated during the setup of the blending session – User B’s advertisement service is thus opened automatically on his device and stays open until the session ends. This allows the usage of flexible

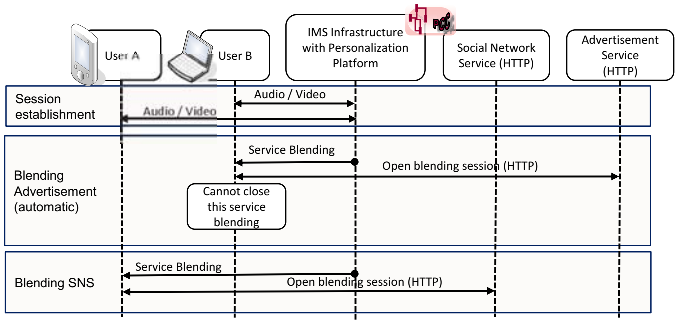

Fig. 1. Overview about Advertisement and Personal Link Scenario

pricing models for operators as they can offer their users special call prices linked with advertising.

Additionally another service is blended into the call: User B has a preference setting to share his SNS page with his friends during a call. This implies that the PCC knows which contacts of User B are considered "friends" for him which can be expressed in the user profile.

5 Summary

In this paper, *service blending* was introduced as a feature that can be used for pervasive advertising. A scenario was presented that outlined how the mechanism is used – not only to present advertisement to the user, but also introduce additional services to existing multimedia communication over NGN-like network infrastructures.

We demonstrated the concept of service blending, including the beforehand mentioned scenario on blended advertisement on Mobile World Congress 2009 [6]. The general comments where positive and advertising was accepted as main driver and revenue generator for solution based on this concept. Privacy concerns where issued, mainly in the context of exposing the NGN user identity to 3rd parties. However, this issue can be solved by using identity management systems which are not part of the proposed feature.

References

1. Matthew Sharifi et al.: Public Display Advertising Based on Bluetooth Device Presence, Mobile Interaction with the Real World (MIRW 2006), (2006)
2. Koelmel, B. and Alexakis, S.: Location Based Advertising, M-Business 2002, (2002)
3. Schuelke, A. et al.: Real-time SDP Personalization in a Multi-Device Environment. Proceedings of WTC 2008, (2008)
4. 3GPP TS 23.228: IP Multimedia (IM) Subsystem stage 2. http://www.3gpp.org/ftp/Specs/html-info/23228.htm

5. Rich Communication Suite Initiative - Business Initiative White Paper. http://www.gsmworld.com/rcs/index.shtml, (2007)
6. Schuelke, A. et al.: Service Personalization Demonstrator, Mobile World Congress 2009 , Barcelona (February 2009)

Trust-based SPAM Prevention for Pervasive Advertising

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Abstract. In recent years, electronic displays have become ubiquitous leading to pervasive computing-based advertising. However, at the same time, SPAM advertising and protection of user's privacy are critical concerns. These concerns are discussed in a decentralised mobile advertising scenario in this paper. A novel trust-based system for pervasive advertising is presented.

Key words: Trust, SPAM Prevention, Pervasive Advertising

1 Introduction

Electronic displays have become ubiquitous and are replacing traditional posters and billboards, leading towards pervasive computing-based advertising. Using the pervasive computing environment as a new advertising platform has resulted in some concerns:

- In a decentralised mobile advertising environment, mobile devices should be able to process requests from different pervasive service providers - providers without consulting any central authority.
- Entities that are previously unknown have no previous interaction history available to predict whether the outcomes are genuine or malicious.
- Pervasive computing characteristics also include mobility and ad-hoc connections.
- These characteristics create opportunities for malicious SPAM advertising[1].

The main focus of this paper is on SPAM prevention. There are several types of attacks that can be used by malicious providers to send SPAM, in particular: Spoofing Attack, Sybil Attack (e.g. *ballot-stuffing* and *bad-mouthing*), Conflicting Behaviour and Newcomer attacks [3].

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[1] SPAM advertisements are unwanted advertisements that are sent to users regardless of their personal preferences. Conversely, genuine advertisements are useful advertisements to users, which are sent according to user's shopping list or preferences.

2 Trust Management

Trust is a social phenomenon, which has been defined by researchers in different academic fields. As defined in [1], "trust (or, symmetrically, distrust) is a particular level of the subjective probability with which an agent assesses that another agent or group of agents will perform a particular action, both before he can monitor such action (or independently of his capacity ever to be able to monitor it) and in a context in which it affects his own action". It is the major driving factor between collaborating entities in ad-hoc environments.

Computational trust management [2] attempts to model the human notion of trust to make future predictions of behaviour based on evidence. Computational trust management enables entities to make decentralised decisions and to process requests from not only known entities but also unknown entities. Furthermore, trust evolves over time based on past interaction history.

In a decentralised mobile advertising scenario, trust is involved when providers request access to mobile devices for users' shopping lists, users' context information or to display/play advertisements. Trust values that mobile devices have for providers evolve based on the mobiles' detection of users' positive feedback, e.g. users read the recommendation advertisements, went to the recommended shops and/or bought the recommended items.

3 Pervasive Advertising Scenario

Figure 1 illustrates a decentralised mobile pervasive advertising scenario. When *Provider A* (P_A) first discovered Alice and Bob's mobile devices (E_a and E_b), it sent requests to E_a and E_b. Based on the positive feedback that was provided by nearby mobile devices, E_a and E_b decided to upload the users' shopping lists to P_A. Assuming that Bob's shopping list was *1 FIFA09 Game*, P_A replied with the information of the shop *HMV* and the game to E_b. Bob read P_A's recommendation and bought the game. Later, P_A requested some further information about Alice and Bob, e.g. favourite brands. Since the previous experiences with P_A were positive, E_a and E_b granted access to the information, e.g. Alice's favourite brand is *BT*.

E_a received a request from *Provider C* (P_C) when Alice arrived at *BT*. E_a accepted the request. E_a was also discovered by *Provider B* (P_B). P_B started a **spoofing** attack, which sent some SPAM advertisements to E_a while pretending

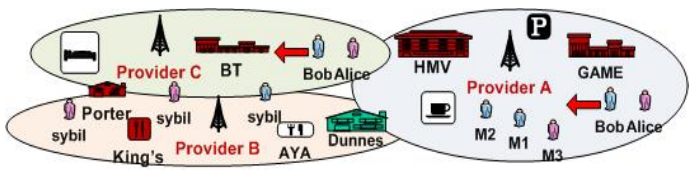

Fig. 1. A Decentralised Mobile Pervasive Advertising Scenario

to be P_C. Since Alice deleted all of the SPAM, E_a set the experiences with P_C to be negative and blocked P_C.

Bob joined Alice and E_b was discovered by both P_C and P_B. P_B carried out a **Sybil** attack that created a few Sybil mobile devices. When P_C sent a request to E_b, P_B used a **bad-mouthing** attack on P_C by controlling the sybils to provide negative feedback. The negative feedback from E_a and P_B's sybils resulted in P_C's request being rejected. P_B then sent a request to E_b, P_B performed a **ballot-stuffing** attack to make the request to be accepted by E_b.

Bob chose *King's* for lunch from P_B's recommendations. While Bob and Alice are in *King's*, P_B sent some SPAM to E_b. Bob ignored all of the SPAM, so E_b was confused with P_B's **on-off** behaviour and had difficulties to predict the future requests from P_B. E_b refused to interact with P_B. Shortly afterwards, P_B sent a request to E_a. E_a received some negative feedback from E_b and some positive feedback from a few other mobile devices around. The **conflicting behaviour** resulted in E_a not being able to decide whether or not P_B is trustworthy.

4 Trust-based SPAM Prevention

In the given mobile advertising scenario, Alice and Bob's mobile devices were able to process trust requests from unknown providers without consulting any central authority. Higher levels of information are granted to requesting providers based on positive past experiences and rejected requests if negative interactions took place. However, without any prevention mechanisms, SPAM was easily sent across. Furthermore, protecting users' privacy is another critical concern. As discussed in the scenario, the malicious provider was able to not only send SPAM to users but also gain access to the privacy information of users via different attacks. To prevent from SPAM advertising and protect users' privacy, the Enhanced Trust-based Access Control model (**EnTrust**) shown in figure 2 is presented which controls access to resources based on trust values obtained by entities. Trust in EnTrust model is categorised as behaviour trust and recommendation trust. Behaviour trust is used by entities to predict outcomes of the future interactions with others and recommendation trust is the trust that one has in the recommendations for third parties from another. Trust values are in the range of [0,1], where the closer the value to zero, the lower the trust and vice versa. A neutral trust value is assigned to unknown entities to allow initial basic interactions between unknown entities. Trust values evolve overtime based on positive and negative interactions. Assuming EnTrust was installed on Bob's mobile device from the previous section. When P_A requested to display the *FIFA09* advertisement received by EnTrust, the identity was forwarded onto the *Entity Recognition* component. Then the request was forwarded to the *Trust Manager* component. The *Trust Manager* component requested a trust value for P_A from the *Trust Formation* component and forwarded to the *Decision Maker* component. The trust value was evaluated against the risk. P_A was informed of the granted decision and E_b displayed the advertisement to Bob. E_b detected that Bob read the advertisement, went to the shop that was recommended by

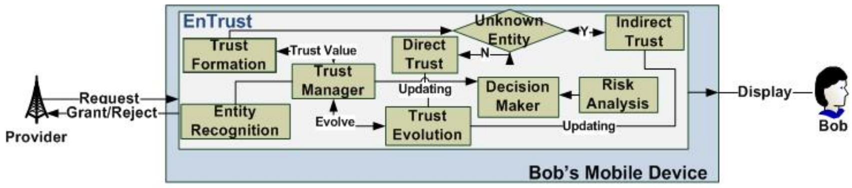

Fig. 2. EnTrust

P_A and bought the game (e.g. removed it from his shopping list). Therefore, the *Trust Evolution* component increased the *Direct Trust* with P_A.

Different components of EnTrust attempt to prevent mobile devices from different type of attacks. The *Entity Recognition* component is responsible for checking identities of requesting entities in order to prevent from identity usurpation/*spoofing* and *Sybil* attacks. Finally, trust values of unknown entities are formed by requesting recommendations from nearby entities. However, to prevent from *ballot-stuffing* and *bad-mouthing*, recommendations are re-calculated in the *Trust Formation* component.

5 Conclusion and Future Work

SPAM advertising was described in a mobile pervasive advertising scenario in this paper. Several attacks were discussed that potentially enable SPAM advertisements to be sent across the given mobile advertising scenario. To prevent users from receiving SPAM advertisements, a trust model called *EnTrust* was introduced in this paper. In the given scenario, *EnTrust* facilitates mobile devices to interact with other mobile devices in a decentralised manner, these include making autonomous decisions, processing requests from both previously known and unknown pervasive service providers. *EnTrust* also attempts to prevent mobile devices from receiving SPAM advertisements from different types of attacks.

Trust components of EnTrust have been designed and implemented and these are currently being evaluated under the described attacks. The preliminary results have shown that EnTrust performs more effective than two existing trust models under the described attacks. Further evaluation is currently taking place and the results will be published.

References

1. D. Gambetta. Can we trust trust? Trust: Making and Breaking Cooperative Relations. Basil Blackwell, p.213-237, (1988).
2. M. Blaze , J. Feigenbaum , and J. Lacy. Decentralized Trust Management. *In Proc. of the 1996 IEEE Symposium on Security and Privacy*, p.164, (1996).
3. Y. Sun, Z. Han, W. Yu, and K. Liu. A Trust Evaluation Framework in Distributed Networks: Vulnerability Analysis and Defense Against Attacks. *In Proc. of the IEEE INFOCOM*, (2006).

Profiling and targeting opportunities in pervasive advertising

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Abstract. Pervasive computing has created a need to profile users of these systems in a way never required in traditional computing. To pursue many of the commonly expected goals of pervasive advertising, we also need rich sources of profile information to build up a model of a user's identity and so target ads to them more effectively. We present an advertising platform that uses information gleaned from a person's Facebook profile to target personalised ads to them in a pervasive environment. Our system uses the existing Facebook application platform and has tunable privacy settings. Secondly, we propose a new class of advertisements that are made possible with this platform.

1 Introduction

Adaptive systems that operate within the environment have always needed to be responsive to the user, by being aware of the presence of people, as well as ideally some personal information about each individual user. The presence of users within a particular space can be sensed via camera systems, or near field communication technologies such as RFID or Bluetooth.

Uniquely identifying and remembering these users, and storing and accessing personal profile information about them has presented a more difficult problem. Some systems learn about the user through their implicit and explicit interactions with the environment. Other techniques require the user to explicitly provide this information to each system by entering it manually, which puts the onus on the user to populate this new record of their preferences. Systems like GroupCast identify users by wireless badges and display content to them based on pre-stored profiles [3]. Mahato et al. describe a method to encode profile information into the broadcasted "friendly name" of a Bluetooth device [2].

Techniques such as these require an external, newly-generated profile to base their adaptations on. We argue that users will be unlikely to maintain two or more profiles to service the personalisation needs of multiple separate systems. We are investigating ways to harness pre-existing profiles which users already keep up to date, and believe such a platform to be an ideal foundation for pervasive advertising.

2 Pervasive profiles

The envisaged new generation of pervasive, population-aware advertisements will ideally go beyond presence and demographic information and tailor their messages more directly towards individual people in the environment. A well-designed personalised advertisement may be more persuasive to a customer than a traditional billboard. However, we can expect users to be skeptical of an advertising entity's attempts to gather information about them.

On the other hand, users have been found to be quite willing to generate and share personal information freely on social networking websites like Facebook, Bebo, LinkedIn and MySpace. This information goes beyond merely demographic information on age, sex or nationality, and often encompasses significantly personal information such as a user's favourite musicians, films, and groups that they belong to[1]. Beyond all of this information, these social networking websites also catalogue a user's designated "friends" who are also present on the site, giving a rich view into the life of each person.

Facebook incorporates an application platform, which allows activity that occurs elsewhere to be integrated into a Facebook user's profile. As the social network website becomes a digital nexus, bringing together disparate threads of activity from across the web (for example, photos posted to flickr, status updates on twitter, social bookmarks on delicious), they come to represent a complete picture of the user's interests.

We see an opportunity here to take this rich seam of market data available through social networking websites, and make it available within a framework for pervasive advertising. We have developed such a platform, which consists of a method to gather profile information using the Facebook application platform, which links a user's real-world presence to their online presence. We can identify users uniquely by their Bluetooth-enabled devices—most commonly mobile phones—and through nothing more than their movement throughout an environment, we can provide rich profile information to applications running nearby.

3 Deploying Facebook applications in the wild

The Cityware project has previously deployed a set of Bluetooth-enabled nodes around a city environment, that tracks users who have joined the system [1], which works in a similar way to our system. Users can get involved by installing an application into their Facebook profiles and entering their mobile phone's unique MAC address into it. Once the application is granted access to the user's profile, it can then see some or all of the user's personal information (based on Facebook's relatively comprehensive privacy controls).

The application is given access to a wide range of profile information, from sex, age and education history to images of the user, and identities of their friends, including whether they are in a relationship (including, in some cases,

[1] The Facebook platform API:
`http://wiki.developers.facebook.com/index.php/Users.getInfo`

the identity of their significant other). These fields can be selectively hidden from an application by the user, leaving their privacy in their hands. Our application can be accessed and installed at `http://apps.facebook.com/basadaeir`.

We have a collection of networked Mac mini computers deployed around our research lab which can then sense a user's presence via their Bluetooth handset, and go on to access their Facebook profile information by looking up their MAC address in a local database. This builds on previous work we have done on distributed presence-aware collaborative tools for office blocks [5].

Due to the limited range of the Bluetooth wireless system, this design allows us to target proximate users with ads specific to their interests on the screens attached to the Mac minis. Secondly, if we place one of these machines in an area of high-traffic, such as a doorway or portal into a larger area, we can track users as they enter an area, and perform more demographic analysis over a population of users that we know to be in the vicinity. There is value both in this aggregated information about a captive audience, as well as the more fine-grained information about individual people.

3.1 New Privacy Issues

Bringing digital information into the physical world like this requires careful consideration. The visibility of the displays in an environment poses an acute privacy problem. Advertisements that are highly-targeted to one single user will undoubtedly be observed by other customers, which raises the likelihood of an unfortunate ad being shown to a wider audience than desired. The user's identity must be protected at all times if these type of systems are to be accepted.

A practice of "privacy in numbers" could apply here: from the well known adage of "safety in numbers," advertisements based on the aggregate interests and characteristics of the people in its environment would be safer to display on public screens. For example, metrics like the ratio of male to female, the age distribution, or some categorisation of shopping preference.

4 New advertising opportunities

Though the rich profile information that is exposed in this manner is obviously very attractive to advertisers, we are eager to explore alternate visions of future advertising which do not require such deep disclosure of personal information by the users in the system. We also foresee a chicken-and-egg type problem wherein the inventory—the actual ad content—that is highly-targeted to a single person simply does not exist, because the means to deliver it doesn't exist yet either.

For the film *Minority Report*, director Steven Spielberg hired prominent futurist thinkers to present him a viable view of the future, which included the future of advertising. In this view of the year 2054, the privacy battle between consumers and corporations which we have yet to live through has been decided in favour of corporations, and so shops know each consumer by name. The person's eyes are literally the gateway to their personal profile, taking the common advertising term "eyeballs" to its grotesque extreme.

The above example is not the future of advertising that we want to see. If indeed pervasive advertising becomes commonplace, we will have a wide range of new digital, networked displays distributed around shopping areas and recreational environments. This proliferation of displays offers a chance at a new generation of information access in public spaces. Rather than designing a better billboard specifically to target ads more effectively at individual users, we are researching ways to improve the shopping experience using this information.

Advertisements that are aware of the users within a space or immediately nearby offer a range of new opportunities for targeted information displays:

1. Ads can be reactive to repeat customers, rewarding them for returning by selectively lowering prices.
2. People who are "hubs" in the larger social network (those with many connections) are more valuable to shops, as they will have more influence among their peer group, acting as mavens for products, shops or services. Thus a shop could preferentially offer them benefits and special offers.
3. As the advertisement can deduce how many people in an area know each other by analysing their friend lists, businesses in the area (restaurants in a shopping mall for example) could proactively offer promotions for groups of four or more people who arrive together once they have been observed in the mall together.

These new customer interactions allow the shopping outlets to see the customer as a resource to be optimised. Based on the user's preferences, they can be directed towards shops which want to provide them with better deals and special offers, in a similar manner to the MobiDiC system [4]. Shops with similar customer bases can coordinate to share customers by cross-promoting products. We think that these type of opportunities add a complementary approach to more traditionally targeted advertising.

References

1. V. Kostakos and E. ONeill. Capturing and visualising bluetooth encounters. In *adjunct proceedings of the conference on Human factors in computing systems (CHI 2008)*, Florence, Italy, April 2008.
2. H. Mahato, D. Kern, P. Holleis, and A. Schmidt. Implicit personalization of public environments using bluetooth. In *CHI '08: CHI '08 extended abstracts on Human factors in computing systems*, pages 3093–3098, New York, NY, USA, 2008. ACM.
3. J. McCarthy, T. Costa, and E. Liongosari. UniCast, OutCast & GroupCast: Three Steps Toward Ubiquitous, Peripheral Displays. *Lecture Notes in Computer Science*, pages 332–345, 2001.
4. J. Müller, M. Jentsch, C. Kray, and A. Krüger. Exploring factors that influence the combined use of mobile devices and public displays for pedestrian navigation. In *NordiCHI '08*, pages 308–317, New York, NY, USA, 2008. ACM.
5. M. Stabeler, G. Stevenson, S. Dobson, and P. Nixon. Basadaeir: Harvesting user profiles to bootstrap pervasive applications. In *Pervasive 2009 Late-breaking results*, 2009. In submission.

Mobile Contextual Display Systems

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1 Introduction

In recent years many conventional public displays were replaced by electronic displays hence enabling novel forms of advertising and information dissemination. This includes mainly stationary displays, e.g. in billboards and street furniture, and currently first mobile displays on cars appear. Yet, current approaches are mostly static since they do not consider mobility and the context they are used in.

In our work we explore how mobile public displays, which rapidly change their own context, can gather and process information about their context. Data about location, time, weather, people in the vicinity etc. can be used to react accordingly by displaying related content.

2 Approach

In order to explore the value and impact of context-aware mobile displays in public environments we deployed a system capable of selecting and displaying content based on context data derived from different sensors.

First, we integrated a tablet PC with a standard backpack (Figure 1). The tablet PC received information about its current position by using a Bluetooth GPS receiver. For displaying content on the screen we implemented a tool allowing for specifying campaigns in certain areas by using the Google Maps API. Once a person moves into one of the defined areas, the tool automatically selects a previously created and locally stored image based on the current location.

Figure 1: Prototype of a Contextual Mobile Display

3 Prototype System for Contextual Advertising

In order to explore the potential of contextual advertising we implemented a web-based system. It includes a component, which allows advertisers to specify campaigns based on their preferences, anchored in location (see Figure 2). These campaigns are stored in a backend and matched against the users' preferences by dynamically creating content for contextual advertising displays. The users are provided with a client for adjusting the preferences with regard to the advertised products. The system architecture is depicted in Figure 3.

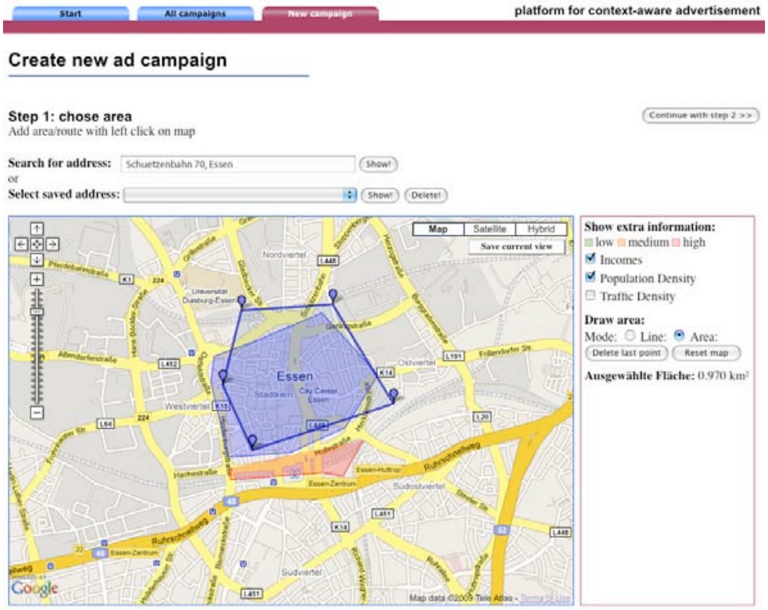

Figure 2: Advertiser's Client for specifying contextual advertising campaigns.

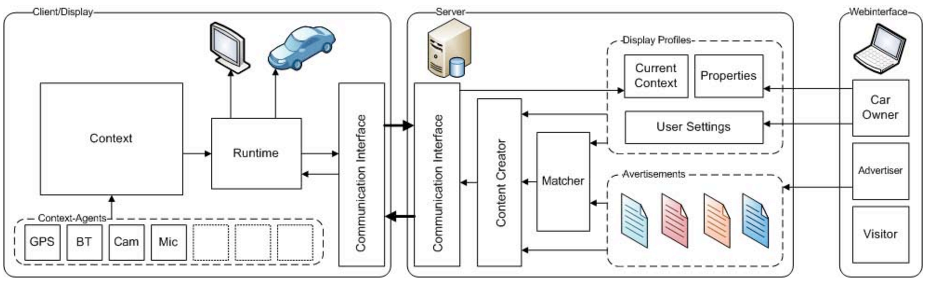

Figure 3: Architecture of the advertising platform. (1) Client-side: context agents gather context data. (2) Communication Interface: data exchange between client and server side (3) Server side: front-end for advertiser and car owner.

4 Situated Demonstration & Focus Group

To get an initial idea of the potential users' attitudes and concerns, we ran a focus group with 8 participants. The subjects all were students, their majors being systems engineering, mechatronics, and arts.

To demonstrate the system we created several campaigns along the pedestrian area of Essen, Germany. The campaigns included information about sights along the way, metro stations, tourist maps, and advertisements for local shops. The images stored for the campaigns were displayed on the screen once the group reached the associated location. The 20-minute demonstration was followed by a discussion during which we also showed the participants alternative ways of displaying the content, such as using electronic paper attached to a T-shirt. Figure 2 shows how we simulated the electronic paper using a portable projector.

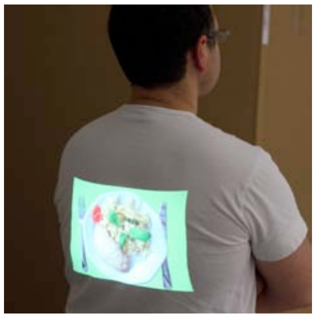

Figure 4: Mockup of a wearable display

5 Initial Findings

All of the participants stated that they would use such a system in return for incentives such as payment per walked distance, coupons, etc. Yet most of them would not walk different or longer routes but considered this a promotion job requiring no or only very little effort. One of the major concerns was that the person carrying the system does not see the content herself in case the display is located on her back though it might be interesting for her. Participants also wanted to stay in control of the content that is displayed and to be able to switch off the system at any time. Some of the participants were concerned that people seeing the display would start asking questions about the displayed content.

In the following we present some of the users' quotes, which outline their opinion about the system and its usage:

- "Information about famous sites around would be great."
- "There might be an information overflow if many people use such a device."
- "I don't mind if somebody knows where I was as long as I can turn off the device whenever I want."
- "I would walk different ways based on the incentive. "
- "I would walk different ways based on the incentive. "
- "I am afraid of being asked questions about the displayed content."
- "I would like to be able myself to see the content."

- “This would be a nice promotion job which requires only very little effort.”
- “I would not wear the devices at night in bars, clubs, etc”.
- “I want to stay in control of the displayed content.”

6 Related Work

The idea of wearable public displays is not entirely new. Falk et al. [1] presented the BubbleBadge, a low-cost wearable computer based on a video game, which people could attach to their coat. Its intention was to support face-to-face communication.

Recently, commercial applications of wearable public displays such as the AdWalker [2] entered the market. This device can be mounted like a backpack. As the name already indicates, its primary purpose is to show static advertisements.

Figure 5: Location-aware advertisements on a taxi

Advertising displays with location-specific content are already used in commercial settings. One example is taxis in the Boston area, which have a roof-mounted display, and adjust their content to their current location (see Figure 5).

7 Conclusion

In the near future developments in the area of wearable computing will make it possible to easily integrate low-weight displays into garments. Using different sensors such as Bluetooth and GPS they can react and display content according to their context. We showed how this could be achieved for location. However, also further context can be taken into account such as the weather or the amount of people in the vicinity of a mobile display.

8 References

1. *Falk J, Bjork S. The BubbleBadge: A Public WearableDisplay. Extended Abstracts of CHI ’99, ACM Press, 1999.*
2. *http://www.adwalker.com*
3. *http://www.clearchanneltaximedia.com/products/taxi-tops-digital-smart.asp*

Activity-based Advertising: Techniques and Challenges

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Abstract. Although information technology has transformed advertising dramatically in the past few years, the greatest changes may lie in the future. Researchers in Pervasive and Ubiquitous Computing have spent the last few years prototyping and studying context-aware systems. These systems use sensors on mobile phones and in the infrastructure to build digital models of the world. This technology has not yet achieved commercial success in advertising applications, but has great potential. In this paper we describe three types of activity-based advertising: 1) inferring general interest categories, 2) adapting advertising to the current context, and 3) using contextual histories to predict the future and adapt present advertising to these predictions.

Keywords: Advertising, context-awareness, activity recognition, privacy.

1 Introduction

The purpose of this paper is to clarify the mobile advertising opportunities enabled by a better understanding of human activity. Advertising is, of course, a crucial technology because it finances many information and communications technology products and services. However, it is our opinion that it is understudied within academic institutions because there is little grant money available for its study and because most people experience advertising as consumers, who often find it an annoyance. This is unfortunate, not only because a healthy advertising ecosystem is important not only for finance reasons, but also because research in advertising research can lead to a better experience for end-users and a more efficient system for advertisers.

We view “Pervasive Advertising” as encompassing digital out-of-home advertising and mobile advertising. Both these areas have grown rapidly in the past year. In 2008, out-of-home advertising sales were up 11% according to PQ Media. Mobile advertising revenue rose much faster—an estimated 60%, according to Gartner. These figures compare well to overall global advertising revenue growth of 2.6% (GroupM).

These technologies are distinguished from each other by their delivery channel—out-of-home advertising is displayed on a digital sign in a fixed location whereas mobile advertising is displayed on a mobile phone. But both share the characteristic with online advertising of being dynamic and adaptable to physical situations. For example, some digital signs can be configured to change with time of day. More recently, digital signs have been outfitted with cameras that can detect demographics such as race, gender, and age group. Although the results are inaccurate, they only need be good enough to make advertisements that are adapted more effective than those that are not.

Mobile advertisements are also adaptable. Using location-based advertising, advertisements can be delivered when the user enters a region, for example, to deliver coupons for a nearby store.

We believe that through better analysis of contextual data, even better targeting will be possible than location-based advertising offers today. An early example of the kind of analysis that can be done can be found in online behavioral targeting. Such systems consider not only the current content when placing an advertisement, but also the user's browsing *history*. This approach is particularly effective if a page is not commercially oriented, because then advertising can address a consumer's previously demonstrated interests. These approaches must be performed with the consumer's consent, a topic we address more deeply in Section 3.

2 Types of Activity-based Advertising

How, then, can histories of *contextual* data help target advertising more effectively? We propose three types of activity-based advertising.

2.1 Inferring Interest Categories

This type is closest to online behavioral targeting. A user's contextual history, their location in particular, is analyzed to determine the user’s interests. For example, if a user frequently goes to Chinese restaurants, then a system may determine that the user prefers Chinese food to other types of cuisine. This fact may not be easily determined through online behavioral targeting, but would be useful for certain advertisers, such as the owners of a newly-opened local restaurant. An example of this approach is Hristova and O’Hare’s Ad-e system [1].

Making such a system effective is technically challenging today. A key obstacle is the difficulty of determining the venues that a user visits. GPS resolution is not accurate enough, and does not perform well indoors. Azizyan and Choudhury [2] have investigated ways to improve the accuracy of venue inference by incorporating data from other sensors such as accelerometers, microphones, and light sensors, however this technology has not yet been demonstrated on a wide scale.

Another challenge is that knowing that a person frequently visits a place or a type of place is insufficient. Someone who spends a lot of time in Chinese restaurants might enjoy the food, or they might work there. Hence, any system that uses context to determine interests should have a mechanism to infer and factor out employment. In past work, we have shown that the combination of a person’s current location and an inference of whether they are working at that location are generally sufficient for detecting that person’s activity outside home environments [3].

2.2 Adapting to Present Context

Another way to use contextual data is to adapt advertising to the current context. Beyond simple location-based advertising, a key component of context is the social situation. Social groups can be detected through a combination of methods, including proximity to others [4]. When a user is in a group, an advertisement that is of interest to many people in the group is more likely to be discussed.

Being in a group can also change how receptive a person is to an interruption. This is important for "push" advertising like SMS messages. When actively engaged in a group, a user might not respond to an interruptive advertisement. However, under other circumstances (say during a conversational lull), the user might be more likely to respond. If these situations can be detected, they could improve the effectiveness of programs in which the consumer has granted permission for push advertising. Our own past work has shown that both timing and content are helpful in improving advertising effectiveness [5].

2.3 Predicting Future Events

Finally, contextual data might be useful for predicting events and situations that would increase the value of particular kinds of advertising in the present moment. For example, a person who regularly eats dinner at different restaurants would have a transportation pattern showing geographical divergence after leaving work. Hence, restaurant advertisements are likely to be valuable before a divergence point, but not afterward [6]. Recent research in predicting future actions from transportation patterns [7] is likely to be useful for these kinds of scenarios.

3 Challenges

Activity-based Advertising faces several challenges. First, the way that advertisers specify and bid on advertisements must be rethought. While keywords have been effective for matching up advertisements with appropriate content, they are not expressive enough to cover the kinds of contextual situations discussed above. However, ad specification and bidding must be simple enough for advertisers to understand how it works, and what adjustments to make to maximize effectiveness.

In addition, the extra complexity of processing contextual information must not overly affect the performance of the ad network placement system. Placement decisions must be made very quickly, and must scale up to millions of users. Portions of such decisions must be precomputed when possible, and the architecture of such a system is likely to be complex and require significant engineering to optimize.

Finally, user privacy must be respected. This means that users must be given control over their data and by default users should not be affected by a system unless they opt-in. Furthermore, parties collecting user data must take steps to make sure that it is securely stored. An additional concern is that someone wishing to access a user's private data might pose as an advertiser. Working out the complete threat model and requirements for protection is an open research opportunity.

To some, it might seem highly unlikely that a consumer would agree to having so much data about them collected and used for advertising purposes. But consider, however, the popularity of today's online email services that display advertising related to the email contents. Consider also the United Kingdom mobile carrier Blyk, which has over 200,000 subscribers that receive free minutes and text messages in exchange for receiving targeted advertising.

Behaviorally targeted advertising has increased the effectiveness of online advertising in part because there is so much data from which to detect patterns and correlations. In addition, web usage is so prevalent that experimental trials may be conducted quickly. Today, mobile and pervasive technologies are not as widely used as web technologies. Data sets are sparse, and trials have been small. However, smart phones are quickly engulfing the more than 2 billion cell phone device market, bringing mobile data services to more people than the PC market can reach.

4 Activity-based Advertising 25 Years from Now

Over the prior 25 years we've seen the expansion of pervasive network technologies create a global information network through which millions of people interact daily. These interactions generate vast amounts of data from which to mine people's online behavior patterns. Over the coming 25 years, we will see the proliferation of pervasive technologies expand to a point where vast amounts of physical situation and behavior data are available for detecting patterns, allowing for much greater accuracy in the modeling of a person's interests and preferences. We will see the ability for systems to target information at what people *do*, not just what they click on.

References

1. Hristova, N, O'Hare, G.M.P.: Ad-me: Wireless Advertising Adapted to the User Location, Device and Emotions. In Proc. 37th Hawaii Int. Conf. on System Sciences (2004)
2. Azizyan, M., Choudhury, R. R.: SurroundSense: Mobile Phone Localization Using Ambient Sound and Light. In ACM MC2R (2009)
3. Partridge, K., and Golle, P.: On Using Existing Time-Use Study Data for Ubiquitous Computing Applications. In Ubicomp (2008)
4. Eagle, N. and Pentland, A.: Reality mining: Sensing complex social systems. Journal of Personal and Ubiquitous Computing (2005)
5. Sala, M., Partridge, K., Jacobson, L., Begole, B.: An Exploration into Activity-Informed Physical Advertising using PEST. In Pervasive (2007)
6. Partridge, K., Greene, D., Begole, B.: Activity-Based Advertising: Auctioning Advertising in Context (2008)
7. Krumm, J., and Horvitz, E.: Predestination: Inferring Destinations from Partial Trajectories. In Ubicomp (2006)