

Connecting People through Content – Promoting Community Identity Cognition through People and Places

Nemanja Memarovic¹, Marc Langheinrich¹, and Florian Alt²

¹ Faculty of Informatics
University of Lugano, Via Giuseppe Buffi 13
6904 Lugano, Switzerland

² Inst. for Visualization and Interactive Systems
University of Stuttgart, Pfaffenwaldring 5a
70569 Stuttgart, Germany

Abstract: Large public screens are proliferating in public spaces. Today, most of them are standalone installations that display advertisements in the form of slides, short movies, or still images. However, it is not hard to imagine that these displays will soon be connected through the Internet, thus creating a global and powerful communication medium capable of providing rich, interactive applications. We believe that such a medium has the potential to foster connections within and between communities in public spaces. In this paper we present a research agenda for *interacting places*, i.e., public spaces that connect communities through public displays. We then report on our initial work in this space, in particular on using public displays for creating what we call *identity cognition* – increasing the sense of being connected between community members occupying the same space. We have investigated two options for achieving identity cognition: (a) through content that originates from the *environment*, and (b) through content that originates from *people*. Content originating from the environment portrays information about a display’s surrounding. For this type of content, identity cognition is usually being achieved *implicitly* by stimulating the effect of ‘triangulation’, an effect where particularities of the physical space act as links between people. Content originating from people, on the other hand, *explicitly* achieves identity cognition by promoting community values through content that expresses the attitudes, beliefs, and ideas of individual community members. We have built and deployed two public display applications that support identity cognition using environmentally-sourced content and people-sourced content, respectively.

Keywords: interacting places, community interaction, public space, public displays

Introduction

Public space plays an important role in our lives and often constitutes the origin of local community building: we bump into our neighbors in the street and have a quick chat; we meet friends in the city center for a quick lunch; or we go for a nice evening stroll in the park with our spouse. Streets, city centers, and parks are just some of the public spaces that comprise our everyday setting, and which provide the space for people with common interests and values to bind, interact, and create a shared emotional connection – a sense of belonging to a place (Carr et al. 1992). However, communities in public spaces often encounter two problems that we refer to as *dispersion* and *interleaving*. Interleaving describes the fact that public spaces are usually occupied by groups of people from different communities that often have difficulties in understanding each other, due to a lack of interaction. A typical example would be elderly people and teenagers that do not visit public spaces at the same time and thus remain wary of each other (Holland et al. 2007). Dispersion describes the fact that members of the same community are sometimes dispersed across multiple physical locations, which in turn diminishes their sense of the community. For example, when we change our place of residence we still want to keep the connection with the previous place and the local community (Carr et al. 1992).

Public displays may play an important role in overcoming dispersion and interleaving effects among and within communities, both in and across public spaces. Large LCD screens are becoming a pervasive resource in urban public spaces due to their significant price drops: we can find them at the bus and tram stations showing the latest news and current schedules, in universities promoting interesting talks and events, or on an entire building façade advertising a new brand product. Although most of these displays are isolated installations

that run locally stored content in the form of slide shows, videos, or even still images, it is not hard to imagine that these displays will be networked in the near future (Clinch et al. 2011, Ojala et al. 2010). Networked and empowered with rich input capabilities through touch (Peltonen et al. 2008), gesture (Rubegni et al. 2011), and/or mobile phone interaction (Ballagas et al. 2006), public displays have the potential to become a powerful new communication channel. We envision that such a channel could be highly beneficial for connecting communities.

The remainder of the paper is organized as follows: firstly, we will summarize the problems communities face in public spaces by drawing from related work in community informatics (Gurstein 2007), architecture (Carr et al. 1992, Gehl & Matan 2009), environmental behavior (Holland et al. 2007), community psychology (Clark 2007, Lave & Wenger 1991), and ubiquitous computing (Jones et al. 2008). We then describe our broader research agenda by drawing on our previously developed *community-space cluster* (Memarovic & Langheinrich 2010b) and defining the concept of *interacting places*, i.e., public spaces that facilitate community interaction. This paper focuses on one item from the community-space cluster in particular, namely *identity cognition*. Identity cognition aims at stimulating the connectivity between community members that reside in the same space. We will report on two distinct approaches we developed for facilitating identity cognition through public displays: (a) through content that originates from the *environment*, and (b) through content that originates from *people*. By reflecting the display's *environment*, identity cognition can be achieved *implicitly* by stimulating the effect of 'triangulation', an effect where special features of the space act as a link between people. On the other hand, by reflecting the common ideas, beliefs, and ideas shared by the *people* in the space, identity cognition would be stimulated *explicitly* by promoting community topics of interest and values. The paper will report on two deployments and one study that explored these two approaches to identity cognition. Finally, we will conclude with a short discussion on the challenges in this area.

Communities and Public Space

In previous work we explored the connection between communities and public spaces (Memarovic & Langheinrich 2010a). In his seminal book from 1992 "Public Space" Stephen Carr, a pioneer in the research on public spaces, describes public space as "the common ground where people carry out the functional and ritual activities that bind a community [...] it is the stage where the drama of communal life unfolds." Similarly Holland et al. (Holland et al. 2007) note that public spaces "allow people to meet on ostensibly neutral ground in planned and unplanned ways, to interact with others within the context of the whole community." Due to these and many other properties, public spaces are inhabited and shared by different communities or social groups that may not communicate well between each other because of the perceived differences or prejudices. On the other hand, people with the same preferences, values, and beliefs, i.e., members of the same community or social group, are scattered across physically separated public spaces. These are just some of the problems that communities are facing in public spaces.

We defined four basic problems by drawing from related work in community informatics (Gurstein 2007), community psychology (Clark 2007), architecture (Carr et al. 1992, Gehl & Matan 2009), environmental behavior (Holland et al. 2007), social networking (boyd & Ellison 2007), and ubiquitous computing (Jones et al. 2008).

- *Weakening Connections Within Local Communities*. Traditionally, communities were formed within a small geographical region, i.e., within a certain locality: neighbors bumped into each other on the streets, i.e., in public space, to share the latest news, help with a heavy grocery bag, or just 'hang out'. These activities, in turn, helped in creating the common identity (Clark 2007). Unfortunately, today's highly mobile lifestyles make this harder and harder: people relocate more often than they used to 20 years ago, more time is spent in commuting from/to work,

and spare time is often spent traveling to distant places (Clark 2007). The 'common identity' and integration that existed within the communal life tends to get lost. Although today's ICTs provide a plethora of ways to stay in touch with friends and family through mobile phones, email, and social networking services, getting to know people who live 'right next to you' seems to get harder. Much can be found in the literature on virtual and traditional communities (Gurstein 2007) and their differences: although your Facebook account could potentially contain all your friends it still might fail to help you out with a tablespoon of sugar when you need one (Boyd & Ellison 2007).

- *Time-Sharing and Community Avoidance.* Because of benefits that public spaces offer, they are usually occupied with many different people that often belong to diverse social groups and communities. Sometimes these groups "time-share" public spaces out of convenience since they might be available at different times, but more often, different communities 'time-share' public spaces in order to avoid others. A typical example would be elderly citizens and teenagers (Holland et al. 2007). This inability to co-share public space at the same time sometimes even forces certain groups to move from their preferred space and find the one where they would be left a lone, e.g., within the 'gray' or 'slack' areas, such as remote hallways or walkways (Gehl & Matan 2009). As Holland et al. (Holland et al. 2007) conclude, public places should promote the 'provision of difference', i.e., they should be able to cater to the needs of different groups successfully and in a concurrent way, and should not be promoting social homogeneity. They furthermore point out that "being able to be seen in public and to be able to see different types of social groups may go some way to enabling everyone, and children and young people in particular, to observe difference, and thereby perhaps, promote tolerance for social diversity."
- *Weakening Connections among Distributed Communities.* Although we relocate more often than we used to, we still like to remain connected to our own geographical roots, and to the public life within them. Some places, e.g., Washington Monument and the Statue of Liberty (Carr et al. 1992), even have the ability to emit connections that exists within a larger society. Public spaces are one of the core drivers that enable people to connect or re-connect within larger communities. However, as previously mentioned, today's high rate of mobility often leads to that people physically disconnect from such local roots. Although today's ICTs allow people to join virtual communities (e.g., online social networks) that provide one way to connect distributed members, their "hiding-behind-a-screen" access model might not be enough to stir up the feeling of belonging. Recent research points out the benefits of mixing the online and offline communities (Matzat 2010).
- *Sense of Isolation in Remote Communities.* Although we have been talking about re-connecting members to their communities within and outside public spaces, there might be cases where having too strong a focus on that particular community can potentially weaken the sense of community. For example, in remote communities, such as rural villages, we can often see their members feeling "left out" and having desires to see 'what lies beyond' their part of the world (Jones et al. 2008). Connecting such isolated groups to other communities might be beneficial: not only could it "spice" up the social life, but it could also help to instill a new sense of "connectedness" and camaraderie by reflecting and confirming the community's uniqueness within 'the world'.

By using space as a dimension (interleaved vs. dispersed, or intra vs. inter), the above problems can be grouped into a 2x2 grid: Within the same public space, communities have the problems of identity loss, i.e., weakening connections within a local community, and lower perception of other communities, i.e., time-sharing and community avoidance. At the other end of the spectrum, in communities that are scattered across physically separated spaces,

members might suffer from the lower sense of belonging. At the same time, these distant places may contain the ‘spice’ that could enrich social life of isolated and remote communities that ache from too homogeneous structures.

With the two parameters, i.e., community and space, we thus defined a *community-space cluster* that describes four research areas for “community interaction” (Memarovic & Langheinrich 2010b), i.e., for supporting communication between members of the similar or distinct community that reside both within and across public spaces: 1) *Identity Cognition*, i.e., raising the awareness and sense of being connect between local community members, i.e., from within; 2) *Local Connectivity*, i.e., promoting social diversity and connection between communities that occupy the same public space; 3) *Remote Connectivity*, i.e., shrinking the distance between distributed communities by enabling synchronous and asynchronous communication between them; and 4) *Identity Infusion*, i.e., instilling a sense of community in a social group through connecting it with (and contrasting it to) remote communities, i.e., infusing it from outside. These four cases are summarized in Table 1 below.

		Community	
		Intra-/Within	Inter/In Between
Place	Intra	<i>Identity Cognition</i> Increase community awareness between local members.	<i>Local Connectivity</i> Increase awareness of social diversity between local communities.
	Inter	<i>Remote Connectivity</i> Connect spatially distributed communities with similar interests.	<i>Identity Infusion</i> Enrich local community through exchange with remote communities.

Table 1 Community-space cluster and community interaction (Memarovic & Langheinrich 2010b).

We call public spaces that stimulate community interaction via public displays *interacting places*. Scenarios that illustrate the potential of interacting places can be found in previous work (Memarovic & Langheinrich 2011b). The application of interacting places within the community-space cluster is illustrated in Figure 1.

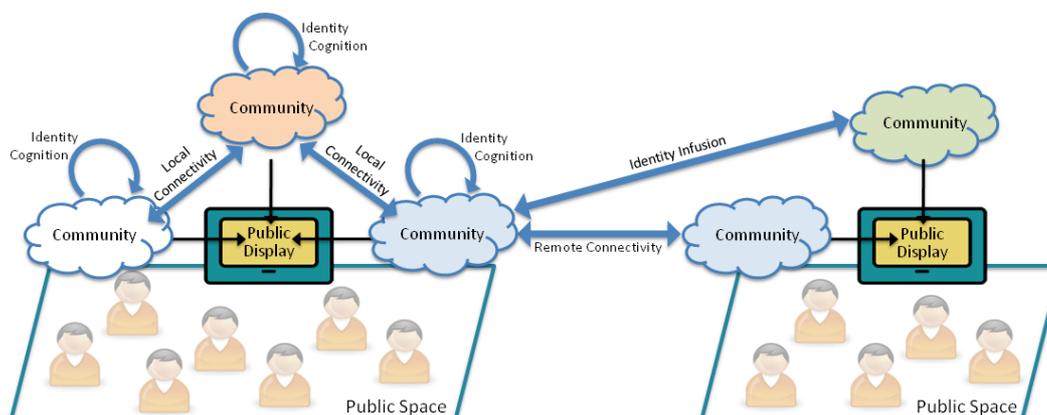


Figure 1 - Communication between communities and public places through situated networked public displays (Memarovic & Langheinrich 2010b).

Our initial research focus in the above agenda has been chiefly on *identity cognition*, as both local and remote connectivity, as well as identity infusion, can benefit substantially from this. Below we will describe two main avenues of research on how to source public display content for supporting identity cognition, namely: (a) through content that originates from the *environment*, targeting *implicit* identity cognition, and (b) through content that originates from *people*, targeting *explicit* identity cognition.

Implicit Identity Cognition: Environment-Originating Content

People go to public spaces to fulfil their needs, for example, relaxing by taking a nice evening stroll in the park, ‘killing some time’ by sitting on the bench and observing what other people are doing, or spending some time with their child on the playground. One of the needs we are pursuing in public spaces is active engagement with the environment and the people in it – independent of whether they are strangers in a site or members of a familiar group. As Carr et al. note we are more likely to socialize with other people in the space if the space contains an unusual feature such as a fountain, sculpture, or even street entertainment (Carr et al. 1992). This unusual feature often sparks the effect of ‘triangulation’ between people, an effect whereby the special feature of the place provides the link between people and prompts strangers to talk to each other.



Figure 2 – a) A “Fun Fact” in FunSquare, and b) FunSquare App sparking triangulation

Content originating from the environment reflects a display’s surrounding. This type of content *indirectly* promotes identity cognition between people occupying the same physical public space by providing a ‘ticket-to-talk’ through the effect of triangulation. To build on top of current behaviour in public spaces we decided to digitally create ‘special’ features of the place. These might come in the form of presenting information about a particular location, e.g., the number of people that are occupying the space, current weather conditions, or even the number of Facebook and Twitter posts citing that particular location. The pitfall of simply presenting spatially relevant information could be that people might not see its significance and might not find the information interesting. However, by presenting the relevance of contextual information within the world, the information might become more significant. The connection between the information from within the public space and outside the public space was the inspiration for our work on *autopoiesic content* (Langheinrich et al. 2011). Autopoiesic content is content that is not explicitly entered, but is instead dynamically created by individual displays, based on existing *content fragments*, a set of continuously updated *context streams*, and manually controlled *matching templates*. Content fragments are static pieces of information, such as text (e.g., speed of a dragon fly), images (e.g., Flickr images), or videos (e.g., YouTube videos). Context streams are dynamic pieces of information that are sensed within display surrounding, e.g., number of people around the display, current wind speed, or even a live video stream. The two pieces, i.e., content fragments and context streams, are then paired through a carefully crafted matching template to create a new piece of content, e.g., “The speed of a dragonfly (97 km/h) is more than 4 times the current wind speed in the city (23 km/h).” In this way we also tackle the challenging issue of continuously creating content for public displays (Storz et al. 2007, Taylor and Cheverst 2009).

We embedded this type of content in an application called *FunSquare*, which presents it as a “fun fact” (as can be seen in Figure 2a above) to stimulate triangulation. As part of the First International Open Ubiquitous City Challenge – UbiChallenge (Gil-Castineira et al. 2011), FunSquare was deployed at the city of Oulu, Finland for two days at two locations: the public

library and the market square (town center). For the two days we conducted observations and interviews, which were manually transcribed, coded, and analyzed. In general, the environment-originating content was received well. The majority of interviewees reported that they found the content nice, funny, and interesting. We also observed several instances of triangulation (cf. Figure 2), offering an early indication that autopoiesic content may be suitable to create interacting places. Detailed results can be found in (Memarovic, Elhart & Langheinrich 2011).

Explicit Identity Cognition: People-Originating Content

Another way to support identity cognition would be through content that originates directly from *people* rather than the environment, i.e., content that expresses beliefs and ideals of a local community. Through this content, identity cognition is being stimulated *explicitly* by directly reflecting on community values. In order to define the properties of this type of content, we have conducted two studies. Our first study aimed at understanding how people communicate in public spaces through analog predecessors of today's digital displays, i.e., with traditional public notice areas (PNAs), more commonly known as notice boards (Alt et al. 2011). Our second study had a goal of comprehending and soliciting desires and wishes of a student community for the type of content they would like to see (Memarovic et al. 2011). Both studies aimed at bringing us closer to designing the interacting places content that directly expresses identity cognition.

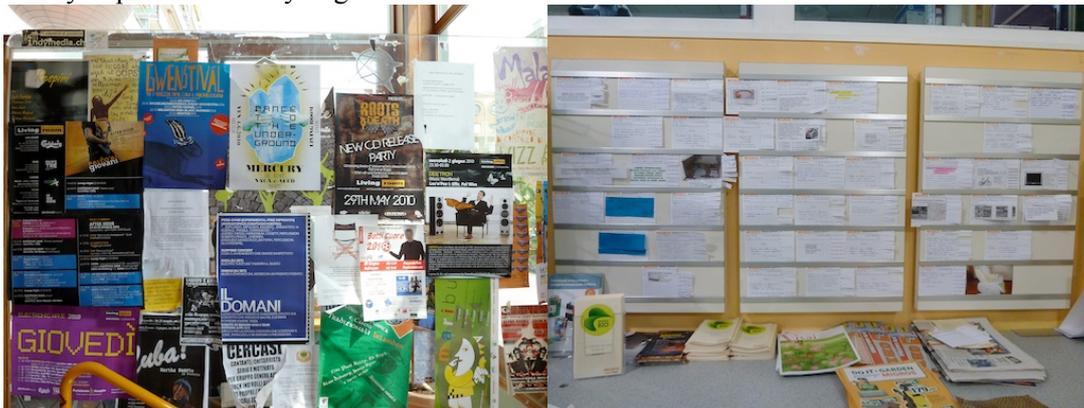


Figure 3 - Examples of data collected from the PNA study

Our study on PNAs was conducted at 28 locations in four different cities in two countries. We took pictures of PNAs over the course of two weeks on a daily basis (more details about the study can be found in Alt et al. 2011). We furthermore conducted interviews with available store/location owners. Our study identified three stakeholders involved around PNAs, namely: 1) *display providers and managers*, i.e., people who are owning the location and the PNA or, in cases of store chains and public authority institutions, higher management that takes decisions for the organization, 2) *content providers*, i.e., people who are creating content for PNAs and who want to distribute the information to the target audience, and 3) *content viewers*, i.e., people who are consuming/viewing the PNA content. We also observed that there are four different types of PNAs: 1) *scaffolded classifieds displays*, i.e., PNAs promoting classifieds in a structured organization/way, usually to be found at retail stores and supermarkets, 2) *unscaffolded classifieds displays*, i.e., PNAs that contain classifieds in an unorganized and flexible manner usually found at universities, education centers, and also grocery stores, 3) *information displays*, i.e., PNAs used to diffuse the information about the organization where the PNA is located, and 4) *event displays*, i.e., PNAs that promote various types of events and can usually be found in bars and retail stores. We also observed that PNAs are used as a *central location for community activity*. In geographical, cultural, and religious communities, PNAs always had a theme that reflected their surrounding. In this way, PNAs support legitimate peripheral participation (Lave & Wenger 1991), i.e., they allow people to stay on the periphery and learn about the people and community in place. Another interesting

finding is that PNAs are often used as a *community support tool*. We observed that at some locations, e.g., in an adult education center, the PNA was mainly used for the exchange of the study related material. This study confirmed our beliefs that networked public displays, i.e., interacting places, could be used to support identity cognition.



Figure 4: Digifieds User Interface (left), User Interacting with Digifieds (right)

In order to elaborate on this, we designed and implemented Digifieds, a digital public notice area that can be deployed on any networked public display. Nowadays, platforms such as eBay or Craigslist offer similar services. However, we believe that besides their high usability, the opportunity of reaching a community is one of the key factors that make public notice areas successful. Consequently, Digifieds has been designed in a way that allows the content to be targeted to communities (e.g., geographic communities by specifying the area on displays in which content is being posted, such as university or the market square). Note that the implementation is not limited to location, but public notice areas can be grouped based on arbitrary criteria, which allows also remote communities to be connected (e.g., two skater communities in neighboring cities that both deploy a public display). In the context of the UbiChallenge 2011 in Oulu, Finland, we deployed Digifieds on a citywide public display network where it is available until the end of the year (see Figure 4). We conducted interviews, observations, and a field trial in order to identify the most suitable content and the motivation of people to share content. As in the case of FunSquare, all interviews and observations were manually transcribed, coded, and analyzed. To preserve the community character of such public notices areas we designed Digifieds in a way that requires people to physically approach a display, though content can be generated at home or on the mobile phone. The results of a questionnaire we had users fill in during the field trial indicate, that the envisioned content has a strong relevance for the local community. People envision information on events, community-related information, sales, and local news. For a comprehensive overview of Digifieds and the study results we refer to (Alt et al. 2011b).

Besides informing the design of content for interacting places based on current routines around PNAs, we also wanted to include desires and needs of the community for whom we are planning to build interacting places (Memarovic et al. 2011). For this purpose we decided to investigate our own University's community (University of Lugano, Campus Lugano), comprising three faculties (Informatics, Communication Sciences, and Economy) with people from diverse cultural and religious background (out of 2852 students in both campuses, 798 are from Ticino, 241 are from other regions of Switzerland, but the majority, 1086 students, is coming from Italy. The remaining 727 are from more than 30 other countries). In total, we recruited 17 people: 7 from the Informatics Faculty, 5 from the Economics Faculty and another 5 from the Communication Science Faculty. They came from different geographical regions and cultural backgrounds (Swiss students from cities such as Geneva, Luzern, Lugano etc., foreign students from Germany, Luxemburg, Italy). We observed some overlap in

content from our previous study: 1) students wanted to find official information from the University and about their topics of interest, mainly related to their studies/faculties (information displays), 2) they also wanted to receive information about student-organized events, but also about other cultural events in the locality (events display), and 3) students also wanted to be able to post their own content (scaffolded and unscaffolded displays).

Based on our two studies we see that explicit identity cognition content can be represented through: 1) official information from the community authority, 2) information about significant topics for the community, 3) information about the events of interest, and 4) user/community member contributed content.

Discussion

While our initial deployments have been successful, we also encountered a number of challenges when following our two strands of investigation. We will briefly discuss these below.

Although the triangulation effect was observed in multiple instances during our FunSquare trial, we were faced with several difficulties that might have lowered the expected impact of the application. Prior to our application deployment in Oulu, we noticed that most people would not pay attention to these displays (as previously observed by Huang et al. 2008). Müller et al. (Müller et al. 2009) call this effect “display blindness”. Even though the public displays in Oulu supported a large variety of interactive content, a “screen-saver” app would by default show an advertising slide-show on them (the ad revenues support the operation of the screens). Only if a person approaches the display, a small indication that the display is interactive appears (an image ‘folds’ in the lower left corner, provoking the user to ‘flip’ it). Consequently, Oulu’s UBI-displays were often ignored by passers-by, making it difficult to observe many interactions with our content.

Furthermore, difficulties arose when deploying and running evaluations in a foreign country. All the people involved in the FunSquare development and deployment were non-Finns. For FunSquare, this created difficulties in deciding on the topics that would comprise the content fragments, i.e., information from outside the display locality. As we were visiting the country for only a short period of time, we tried to educate ourselves on topics of interest in Oulu and Finland in general. One of the topics that emerged as a strong candidate was ice hockey. While our interviews later revealed that some people did enjoy reading information about ice hockey, there was a bigger group of people who did not. This shows that creating this type of content requires comprehension and understanding of the local community’s values.

Last but not least, in cases when the effect of triangulation did occur and when people did start interacting, it was hard for us to understand the topic of conversation. In a couple of cases we were lucky that our Finnish colleagues overheard the topic. Instead of just comprehending that people are interacting, it would have been even better if we could have understood the entire conversation.

During the deployment and evaluation of Digifieds (and thus of people-generated content) we discovered that the chosen medium (i.e., displays) might be a discriminating factor with regard to the audience, and hence the community. Whereas younger people were keen on using the new technology and were able to easily use the provided application, older people showed interest, but felt that ‘this [Digifieds] is something for the younger generation’ – or put in other words “for the early adopters”. This might change in the future, as interactive public displays become a well-established element of urban spaces.

Conclusion

Significant price drops of large LCD panels have led to a massive proliferation of displays in public spaces. Right now, these displays are singular installations that run locally stored advertisement as slideshows, videos, or even still images. However it is not hard to imagine

that these displays will soon be networked and connected through the Internet eventually forming a novel and powerful communication medium.

We believe that such a medium could be beneficial for connecting communities. In this paper we presented a research agenda for “interacting places”, i.e., public spaces that promote community interaction through public displays. Our research currently focuses on one item from this agenda, namely, *identity cognition*, which aims at connecting community members in public spaces. We presented research investigating two types of content that could be used for this purpose: 1) *environment-originating content* that sources information related to a display’s surroundings and creates *autopoiesic content* to *implicitly* connect community members through the effect of triangulation, and 2) *people-originating content* that encourages user-contributed content that reflects the ideals and aptitudes of people in the space, thus stimulating identity cognition *explicitly* by portraying community values. Our initial deployments have shown the potential of these two options for stimulating community communication, and we plan to use the insights from our trials to further design and deploy networked public display systems that will stimulate identity cognition.

Acknowledgments

We would like to thank Timo Ojala, Simo Hosio, Marko Jurmu, Hannu Kukka, Mattias Kukka, Jarkko Lisakka, Joonas Sotaniemi Tomas Lindén, Tommi Heikkinen, Daniele Zanni, Marika Leskellä, Fabio Kruger, Antti Ikonen, the UBIGuides, and everyone else involved with organizing and helping the UBI Challenge competition.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 244011.

References

- Alt, F., Memarovic, N., Elhart, I., Bial, D., Schmidt, A., Langheinrich, M., Harboe, G., Huang, E., & Scipioni M.P. (2011a). Designing Shared Public Display Networks - Implications from Today’s Paper-Based Notice Areas. In Proc. of the 9th Int. Conf. on Pervasive Computing, San Francisco, CA, USA, June 12–15 2011, Springer, 258-275
- Alt F, Kubitzka T, Sahami Shirazi A, Zaidan F, Ortel M, Schmidt A. (2011b, to appear) Digifieds: Insights into Deploying Digital Public Notice Areas in the Wild. In Proceedings of the 10th International Conference on Mobile and Ubiquitous Multimedia (MUM 2011), Beijing, China, December 7-9, 2011.
- Ballagas, R., Borchers, J., Rohs, M., and Sheridan, J. (2006). The Smart Phone: A Ubiquitous Input Device. *IEEE Pervasive Computing*, 5, 70-77
- boyd, d. m. & Ellison, N. B. (2007) Social Network Sites: Definition, History, and Scholarship. *Computer-Mediated Communication*, 13(1) 210–230
- Carr, S., Francis, M., Rivlin, L.G., & Stone, A. (1992). *Public space*, Cambridge Univ. Press.
- Clark, A. (2007). Understanding Community: A review of networks, ties and contacts. Available at: <http://eprints.ncrm.ac.uk/469/> [Accessed June 23, 2010]
- Clinch, S., Friday, A., Davies, N., and Efstratiou, C. (2011). Reflections on the Long-term Use of an Experimental Digital Signage System. In Proceedings of the 13th international conference on Ubiquitous computing, Beijing, China, September 17-21 2011. ACM, New York, NY, USA, 133-142
- Gehl, J. & Matan, A. (2009). Two perspectives on public spaces. *Building Research & Information*, 37(1): 106-109
- Gil-Castineira F., Costa-Montenegro E., Gonzalez-Castano F.J., Lopez-Bravo C., Ojala T., & Bose R. (2011). Experiences inside the Ubiquitous Oulu Smart City. *Computer* 44(6):48-55
- Gurstein, M. (2007). What is Community Informatics (and Why Does It Matter)? Milan: Polimetrica SAS. Available at: <http://arxiv.org/abs/0712.3220> [Accessed September 7, 2010]

- Holland, C., Clark, A., Katz, J., & Peace, S. (2007). Social interactions in urban public places, Policy Press. Available at: <http://oro.open.ac.uk/7445/> [Accessed June 17, 2010]
- Huang, E., Koster, A., & Borchers, J. (2008). Overcoming assumptions and uncovering practices: When does the public really look at public displays? Proc. of the 6th Int. Conf. on Pervasive Computing, Sydney, Australia, May 19–22, 2008, Springer, 228-243
- Jones, M., Harwood, W., Bainbridge, D., Buchanan, G., Frohlich, D., Rachovides, D., Frank, M., & Lalmas M., (2008). 'Narrowcast yourself': designing for community storytelling in a rural Indian context. In Proc. of the 7th ACM Conf. on Designing Interactive Systems. Cape Town, South Africa, ACM, New York, NY, USA, 369-378
- Langheinrich, M., Memrovic, N., Elhart, I., & Alt, F. (2011). Autopoiesic Content: A Conceptual Model for Enabling Situated Self-generative Content for Public Displays. Proc. of the 1st Int. Workshop on Pervasive Urban Applications at Pervasive 2011
- Matzat, U. (2010). Reducing problems of sociability in online communities: Integrating online communication with offline interaction. *American Behavioral Scientist* 53(8): 1170-1193
- Memarovic, N., Elhart, I., & Langheinrich, M. (2011, to appear) From Thin Air: First Experiences with Autopoiesic Content. In Proceedings of the 10th International Conference on Mobile and Ubiquitous Multimedia (MUM 2011), Beijing, China, December 7-9, 2011.
- Memarovic, N., Rubegni, E., Davide, A. & Langheinrich, M. (2011) Designing Interacting Places for a Student Community: Implications from Student Communication Practices. Submitted for publication (currently under review)
- Memarovic, N. & Langheinrich, M. (2010a) Enhancing interaction in public spaces using situated public displays, paper presented at the Social Interaction in Spatially Separated Environments Workshop, Copenhagen, Denmark, September 26, 2011
- Memarovic, N. & Langheinrich, M. (2010b) 'Your place or mine?' – Connecting communities and public places through networked public displays, paper presented at the Urban Internet of Things - Towards Programmable Real-time Cities (Urban IOT) Workshop, Tokyo, Japan, November 29
- Müller, J., Wilmsmann, D., Exeler, J., Buzcek, M., Schmidt, A., Jay, T., & Krüger, A. (2009). Display Blindness: The Effect of Expectations on Attention towards Digital Signage. Proc. of the 7th Int. Conf. on Pervasive Computing, Nara, Japan, May 11 – 14, 2009, Springer, 1-8
- Ojala, T., Kukka, H., Lindén, T., Heikkinen, T., Jurmu, M., Hosio, S., and Kruger, F. (2010). UBI-hotspot 1.0: Large-scale long-term deployment of interactive public displays in a city center. Proceedings of 2010 5th Int. Conf. on Internet and Web Applications and Services, Barcelona, Spain, May 9- 15, 2010. IEEE CPS, 285-294
- Peltonen, P., Kurvinen, E., Salovaara, A., Jacucci, G., Ilmonen, T., Evans, J., Oulasvirta, A., & Saarikko, P. (2008). It's Mine, Don't Touch!: interactions at a large multi-touch display in a city centre. In Proc. of the 26th annual SIGCHI Conf. on Human Factors in Computing Systems, Florence, Italy, ACM, New York, NY, USA, 1285-1294
- Rubegni, E., Memarovic, N., and Langheinrich, M. (2011). Talking to Strangers: Using Large Public Displays to Facilitate Social Interaction. In 1st Int. Conf. on Design, User Experience, and Usability, Theory, Methods, Tools, and Practice, Orlando, Florida, USA, July 9-14 2011, Springer, 195-204
- Storz, O., Friday, A., Davies, N., Finney, J., Sas, C, & Sheridan, J. (2006). Public Ubiquitous Computing Systems: Lessons from the e-Campus Display Deployments. *IEEE Pervasive Computing*, 5(3): 40-47
- Taylor, N. & Cheverst, K. (2009). Social interaction around a rural community photo display. *Human-Computer Studies*, 67(12): 1037–1047.
- Lave, J. & Wenger, E. (1991). *Situated learning - Legitimate peripheral participation*, Cambridge University Press.