

# The Interacting Places Framework – Conceptualizing Public Display Applications that Promote Community Interaction and Place Awareness

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## ABSTRACT

The proliferation of public displays, along with ubiquitous wireless communication and sensing technology, has made it possible to create a novel public communication medium: open networked pervasive displays would allow citizens to provide their own content, appropriate close-by displays, and increase their own awareness of a display's surroundings and its local communities. We envision that such displays can create *interacting places*, i.e., public spaces that promote community interaction and place awareness. In this paper we describe our Interacting Places Framework (IPF), a conceptual framework for designing applications in this novel research space that we developed based on four distinct public display studies. Our IPF focuses on 4 elements: 1) *content providers*, i.e., entities that will supply content; 2) *content viewers*, i.e., people who are addressed by the content; 3) *communication channels* that deliver the content and range from *inclusive*, i.e., open-for-everyone, to *exclusive*, i.e., closed-group channels; and 4) an *awareness diffusion layer* that describes how community awareness building happens both *explicitly*, i.e., through content tailored towards a specific audience, and *implicitly*, by observing output for other people.

## Categories and Subject Descriptors

H.4.3. [Communications Applications]: Bulletin boards; H.5.2. [User Interfaces]: User-centered design; H.5.3. [Group and Organization Interfaces]: Theory and Models;

## Keywords

Community interaction; Interacting places; Public displays; Urban computing; Urban informatics;

## 1. INTRODUCTION

Public spaces form an important part of our everyday life – they create a sense of belonging, provide a place where we can socialize, relax, and learn something new [5]. Because of these properties, and many others, these spaces often form an important building block in creating local communities: people with common interests and values that share an emotional connection to each

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other, based on their sense of belonging to a place.

We are interested in exploring the role that pervasive open displays may play in such community building processes. Due to significant price drops of LCD screens, public displays are becoming a ubiquitous resource in urban environments. While most of these displays are still singular installations that run locally stored slide shows or videos, it is not hard to imagine that these displays will be networked in the near future [7][26]. Networked and empowered with rich interaction capabilities, e.g., touch [27], gesture [30], or mobile phone interaction [8][18], public displays have the potential to become a global and powerful communication channel. We envision such a channel to be very beneficial for promoting people's values within a display's vicinity, and hence create awareness about a particular *place and its communities*.

We call such places "*interacting places*" – public space that uses networked public displays to stimulate community interaction (i.e., interaction between members of the same or distinct community residing within and without public spaces) and place awareness (i.e., knowledge about the place through people who occupy it). In our previous work we created a set of scenarios that illustrate the potential of such spaces [22][23]. However with this plethora of opportunities to start from, how would one decide what features an application<sup>1</sup> should support? Where would the content come from? Who would it address? How would the content be communicated? How would it affect and stimulate community interaction? How would it convey place awareness?

Most of the work carried out in this space covers only parts of the posed problems: it is either focused on content production [6][14][20][26][27], means of publishing information on a display [7][8][9][16][17][31], and awareness and behavior around the display [4][11][25][27][34]. Although the above-mentioned work covers their respective areas in details, we wanted to provide an integrated framework that would cover overall aspects of applications that would stimulate community interaction and place awareness (in the following abbreviated "CIPA") through networked public displays. This would allow designers and developers of future networked public display applications to have a holistic view on the possibilities involved around developing applications that would stimulate CIPA and would also allow them to position and focus their work and efforts.

<sup>1</sup> Note that such an application does not have to be a "community" app, such as a digital notice board. Even showing a user's personal calendar on a public screen could stimulate community interaction, simply by virtue of sharing the information with other people present.

For the above-mentioned reasons we have created the *Interacting Places Framework* (IPF). We complement the current body of work on pervasive displays by *describing a conceptual framework that can be used for the design of networked public display applications that convey community and place awareness*. In this paper we will describe the IPF framework in detail and will summarize our efforts from four studies that were conducted to derive it.

We will begin by presenting related work. Then we describe our methodology used to derive the framework – action research – and more specifically the “nested action research cycle” with its set of studies that informed our framework. After that we will describe IPF and its four main components in details, i.e., 1) content providers, 2) the communication channel, 3) the awareness diffusion layer, and 4) content viewers. We will then discuss implications and summarize our findings.

## 2. RELATED WORK

Our work builds on three strands of research: content production for public displays [6][14][20][26][27], means of disseminating information through displays [7][8][9][16][17][31], and awareness and behavior around the display [4][11][25][27][34].

Most of the work on content production has relied on user-generated content [6][14][20][26]. The type of content users were allowed to post and see on displays ranges from text [20], Flickr images [27], virtual postcards generated on the display itself [14], or social media content, i.e., text and images combined, related to specific place from Foursquare and Twitter [6][31]. However, content on the display does not have to come only from users, e.g., content can come also from a range of services such as maps, bus schedules, weather forecast, or games [26].

We complement the current body of research by providing a conceptual framework that allows developers of future networked public displays systems to choose if their application should provide content that is coming from people or services (cf. see section 4.1). We also provide means for developers to think about their target group, i.e., *viewers* (cf. see section 4.4), as well as how they want to achieve the desired effect of their application, i.e., *implicitly* or *explicitly* (cf. see section 4.3).

Once the content is produced it needs to be disseminated through a display. The plethora of different means for information distribution range from publishing information through mobile phones [8][17], instant messaging [16], email [9], social media like Twitter [31], or drop-box like approach where users ‘drop’ the content they want to appear on a display into a networked folder [7]. All these different ways of publishing content onto a display represent different communication *channels* that are being used today. Clinch et al. [7] used this notion of a ‘channel’ to allow content producers to organize and distribute their content.

We complement current body of research by building on Clinch et al.’s notion of a channel to describe a general way content would be delivered in the context of interacting places. We also extend their work by describing the range of channels that can go from *inclusive*, i.e., open-for-everyone, and *exclusive*, i.e., closed channels that are delivering message to selected recipients, and by explaining how channels could be scoped through people and places (cf. see section 4.2).

Previous research has also investigated people’s awareness and engagement around the display [4][11][25][27][34]. Many passers-by go through several stages before transitioning from somewhat passive engagement with the display, e.g., just noticing or glancing at it, towards active engagement with it, i.e., directly interacting with the content. Most of the interaction with the dis-

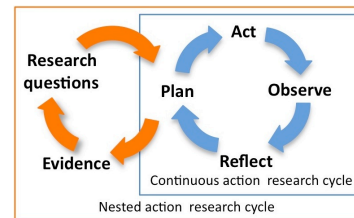
play happens in the *passive zone* (‘peripheral’ and ‘focal’ [4] or ‘passing by’ and ‘subtle interaction’ [25]) where people only glance at the content [15].

We complement prior research by providing insights into ways *awareness would be diffused implicitly* in the passive zone, i.e., by observing output of the others and becoming aware through “legitimate peripheral participation” [19] (cf. see section 4.3). Additionally, we describe how awareness can be achieved *explicitly* by tailoring content towards specific groups of people. We also describe four types of awareness public displays can support, namely, awareness between members of the same community *within* and *without* public spaces (*identity cognition* and *remote connectivity*), awareness about the diversity of communities in the locality (*local connectivity*) and infusion of diversity within the local community (*identity infusion*).

Overall, we complement work on pervasive displays by presenting an integrated framework that provides a holistic overview of possibilities when creating applications aimed at stimulating CI-PA through displays.

## 3. APPROACH

We grounded our approach in action research [13] to derive the IPF conceptual framework. Action research can be simply seen as an approach that ‘focuses on simultaneous action and research in a participative manner’ [10]. More specifically our approach followed a *nested action research cycle* that has three main elements: 1) *identifying research questions*, 2) a *continuous action research cycle* that is used to approach the questions, and 3) *examining evidence* that comes from the continuous action research cycle [13]. The continuous action research cycle is *nested* between the research questions and evidence and contains four elements: 1) *planning* of actions to be taken to tackle the questions, 2) *acting* according to the plan and testing research questions in practice, 3) *observing* the effects of the actions and collecting data, and 4) *reflecting* on the data collected and coming up with findings.



**Figure 1 - Nested action research cycle. Action research is an approach that ‘focuses on simultaneous action and research in a participative manner’ [13].**

With the plethora of opportunities for networked public displays our first question was: *what problems should networked public displays address?* We started by looking into *problems that communities face in public space* and – based on an extensive literature review [22] – defined a research agenda for interacting places with four opportunities for public displays in supporting community interaction: (a) *identity cognition* addresses the problem of weakening connections in local communities (due today’s hectic life and relocation); (b) *local connectivity* addresses the problem of community avoidance in public spaces (e.g., elderly vs. teenagers); (c) *remote connectivity* addresses the problem of distributed communities (people who share the same values and interest scattered across public spaces); and (d) *identity infusion* addresses the sense of isolation in remote communities (e.g., communities in rural villages often feel left out and want to see what lies beyond their premises).

After we defined the research agenda we identified three key challenges, i.e., research questions, for interacting places: uncovering the *stakeholders involved (who)*, i.e., the group of people who would be affected by interacting places and who would benefit from it; identifying *suitable instruments (what)* for accomplishing CIPA (community interaction and place awareness); and understanding the *basic use (how)* of those instruments to achieve the desired goal. Overall we conducted four studies to answer the three challenges. All the studies followed the continuous action research cycle and gave us evidence for the IPF.

In our first study we aimed at *uncovering the stakeholders involved around interacting places (who)*. Consequently, we conducted a study on current practices around traditional, analog displays used for community communication, i.e., notice boards [2]. We performed a two week photo-log study of twenty-nine diverse locations (e.g., retail stores, universities, and cafes) that deployed notice boards, and conducted a number of in-depth interviews. The study took place in four different cities in two countries. In particular, we looked at content, different ways of posting (i.e., forms of content control), and the motivation for having the notice board. Our study revealed three key parties involved: 1) *display providers and managers*, i.e., people who are providing the notice boards, 2) *content providers*, i.e., people who are supplying/posting the content, and 3) *content viewers*, i.e., people who are consuming/viewing the content. In our first version of the IPF, we decided to focus on those parties directly involved in production and consumption of content, i.e., *content providers* and *viewers*. However, future versions of IPF will need to take the regulative role of *display providers and managers* into account.

Our second study tackled the question of identifying *suitable instruments (what)* for achieving CIPA. To discover such instruments, we conducted a study on current communication practices surrounding today's ICT technologies, i.e., email, instant messaging, and social networking services, within our own student community. The study was based on seventeen semi-structured interviews and analyzed ICT use through the "communicative ecology lens" [12] – a methodology used in media and communications research to represent the technical, social, and discursive contexts in which communication processes occur. Echoing similar findings by Subrahmanyam et al. [33] and Barkhuus and Tashiro [3], our study revealed the two types of communication channels: 1) those that allow community members to develop new ties by displaying content that is open-for-everyone, i.e., includes also hitherto unknown community members, and 2) those that allow community members to strengthen existing ties with others, i.e., channels that are more oriented towards closed-group communication with content that contains meaning only to a certain group of people and excludes others. We call these two types of channels *inclusive* and *exclusive channels*, respectively.

Our study on today's ICT use practices also informed our *understanding of instrument use (how)*. Both inclusive and exclusive communication channels were used to *explicitly* express community interests and values, e.g., by cheering a local soccer club on one's own Facebook page, or by sharing a YouTube video link with close friends. This was also apparent in our study on traditional notice boards [2], where classifieds, event announcements, and posters would often directly express local community values. In addition, such public displays would also support what we call *implicit* awareness diffusion: by publicly posting information to few or many, even visitors would implicitly learn about a local community through their interests and postings.

Our third study and fourth study were undertaken with the goal of gaining a deeper understanding of the *instrument (what)* and its *use (how)* to achieve the desired goal. We designed, developed, and deployed two applications for interacting places. Digifieds [1] is an application that allows *people* to create and distribute content. With this application, users can post advertisement on networked public displays. They can do so in three ways: directly on the touchscreen-based display, on their mobile phone, or from a dedicated website. We have designed Digifieds based on our study on traditional notice boards [2]. FunSquare [21] is a *service* that dynamically connects information sensed from within a display's surroundings (e.g., the number of people in the space, the current weather, or the number of connected Bluetooth devices) with fixed facts, e.g., the population of Pitcairn Islands, the coldest temperature ever measured in Sao Paulo, or the number of MacBooks produced by Apple every minute. By connecting fixed facts with local, dynamic information, FunSquare ties local events and situation to a wider context in a playful manner. Both applications were deployed for 4 weeks on a networked public display system in Oulu, Finland. Detailed results for Digifieds and FunSquare can be found in [1] and [21], respectively. Besides providing information about the *instrument (what)* and its *use (how)*, studies 3 and 4 also helped us to better understand content providers and viewers, i.e., *stakeholders (who)*.

In the spirit of the nested action research cycle, IPF was built iteratively where evidence coming from each study helped us to refine the framework.

## 4. INTERACTING PLACES FRAMEWORK

Our current IPF comprises four components that cover the key elements of interacting places: stakeholders, i.e., *content providers* and *content viewers*, the instrument used for achieving CIPA, i.e., the interacting places *communication channel*, and its expected impact through the *awareness diffusion layer*. Each of them is described in the sections below.

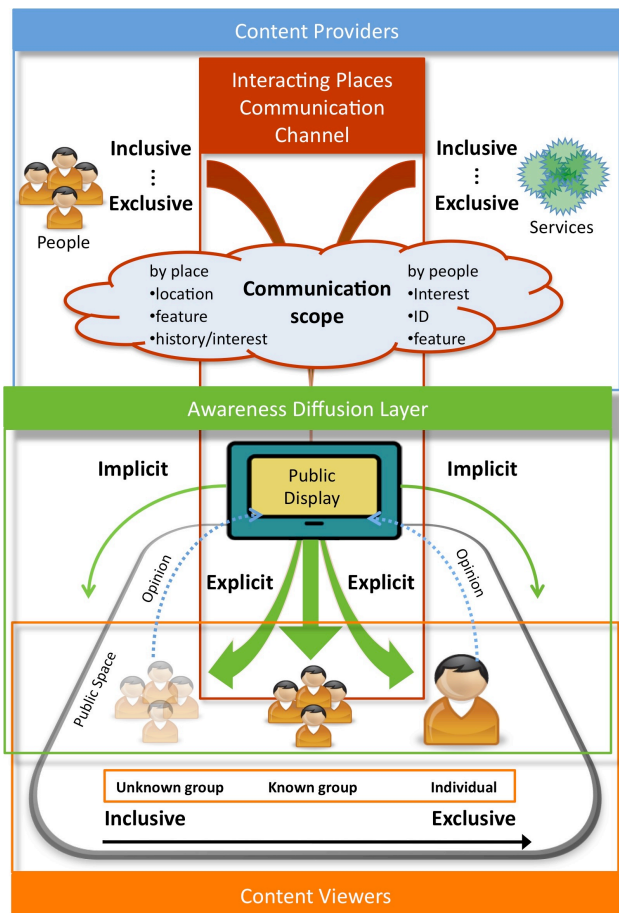
### 4.1 Content Providers

While content providers in our traditional notice board study were only people, we envision that interacting places content can be provided by both *people* and *services*. This is similar to the Web, where both user-generated content (e.g., Facebook, Craigslist) and service-generated content (e.g., weather.com, finance.yahoo.com) can be found.

The two types of providers were also confirmed in our study on student's communicative ecology, i.e., current practices surrounding today's ICTs: students either saw content as coming from *people*, e.g., Facebook postings, email and IM exchanges, or they saw it as coming from a *service*. However, even though many sites actually feature user-generated content (YouTube, Twitter, or SlideShare), students perceived these as being distinct from, e.g., Facebook postings or IM chats, and rated these as *service-originated* content. In this categorization, Digifieds can be seen as an example for application that allows *people* to provide content for public displays, while FunSquare is an example of a *service* generated content.

### 4.2 Communication Channel

No matter where the content is coming from, may it be people or services, it is distributed through a networked public display *channel*. We define a networked public display channel to be a uni- or bidirectional medium/carrier for transmitting multimedia content to its intended audience. While existing ICT channels are typically structured around protocols (e.g., email, IM) or individu-



**Figure 2: Interacting Places Framework (IPF).** Content providers can be seen as both people (i.e., individuals) and services (e.g., Facebook). A communication channel carries content that is either open/understandable for everyone (inclusive) or only for a few people (exclusive). However, even if explicit communication takes place, the nature of a public display will implicitly diffuse awareness of even opaque content to local bystanders. The explicit recipients of content may be individuals, known groups, or even unknown groups.

al services (e.g., Facebook, Skype), channels are characterized by a particular set of features that support conveying content from a source, i.e., provider, to a destination, and optionally preferences of the respective communication partners for doing so.

An *inclusive channel* carries content that is *open-for-everyone*, i.e., anyone can understand the meaning of the content. Both FunSquare and Digifieds portray information through the inclusive channel: classifieds and information about display surroundings are meant to be seen by anyone. According to Brignull and Rogers, this channel should also allow users to “express their opinions towards the content” [4]. In case of Digifieds, people can report inappropriate content through an *abuse* button and they can also indicate their preference towards certain classifieds through a *like* button. Similarly, FunSquare also allows people to like or dislike content thus expressing their opinion towards different content categories (e.g., weather, history, science, etc.). Additionally people can also leave more detailed opinions through comments that are related to specific information.

An *exclusive channel* allows a directed message to be transmitted to selected recipients. As public displays are by definition public,

exclusivity must be ascertained through other means. For example, people could use avatars and pseudonyms to leave messages for the intended recipients (“@R2D2: meet you for lunch at the canteen. Yours truly, C3PO.”), or they could use other mechanisms to provide the *exclusive* channel. In Digifieds, on one hand people can create classifieds and also take the ones they are interested in their mobile phone, on the other hand, an internal messaging system is provided that allows people to get in contact with each other without publicly revealing the contact data (e.g., the email address). Further private interfaces have already been proposed in the literature [17][18][28].

In both cases (inclusive and exclusive), transmitted content would go to a certain place or to a certain group of people, i.e., communication could be scoped through *people* and *places*. A desired recipient for the content can be a particular person that can be reached by his/her *ID*, or a group of people who share the same *interest* or *features*. For example, we can imagine sending a message to our beloved ones (*ID*), or posting an advertisement about a stamp collection that needs to be sold (*interest*) or a new tango dance evening for the elderly in town (*feature*). Similarly content can be sent to a particular place at a particular location, to a place with particular interests (e.g., as determined by its history of local postings), or to a place with a specific feature. For example, we might want to send a “Happy New Year Tokyo” message when away from our hometown (*location*), or we might want to send a message to a place with the most FC Barcelona fans (*history* and/or *interest*), or to a place where local skaters hang out (*feature*). Interacting places could even exchange content automatically through services based on the above-mentioned parameters, i.e., location, interests, and features.

### 4.3 Awareness Diffusion Layer

To recap, an interacting places display application can transmit content over a range of channels that go from inclusive, i.e., open-for-everyone, to exclusive, i.e., one that supports communication with selected recipients. However, it is important to realize that not all potential viewers of such a display may be able to *explicitly* make sense of this content, in particular when local language, symbols, or codes are being used. While one might assume that such viewers will not be able to benefit from such content, we stipulate that in such circumstances, an *implicit* diffusion of community awareness is taking place. For example, while foreigners might not be able to understand that “Barca” refers to a football club, or even a sports club altogether, they might still realize that its community is very active in a place due to the number of messages posted bearing the “Barca” logo. Similar implications may be drawn from the artwork and typography associated with the communication: a visitor to a bar may not understand who is posting what on a screen, but might perceive the design as either very professional or very homely, thus getting a sense for a very professional or very caring community, respectively.

Digifieds is an example of an application that demonstrates the joint effect of implicit and explicit community diffusion: while it provides CIPA (community interaction and place awareness) *explicitly* by portraying information about the interests and values of individual community members, it also creates the effect of Legitimate Peripheral Participation [19], where people learn about a place and its community by observing the interests and communication patterns of others. For example, even if a visitor might not speak the local language in which Digifieds is deployed, seeing images of either hand-painted used bicycles or sleek racing bikes embedded in its notices, will still allow the visitor to get a sense of

the community: Are people obsessed with latest biking gear, or do they value individualism and recycling over novel technology?

The *implicit* and *explicit* CIPA diffusion can also be seen (a) through content that originates from the environment, i.e., from a *place*, and (b) through content that originates from *people* [24]. FunSquare is an example of an application that presents content originating from the environment, i.e., it portrays information about a display's surrounding. For this type of content, CIPA is usually being achieved implicitly by stimulating the effect of 'triangulation', an effect where particularities of the physical space act as links between people [5]. Content originating from people, on the other hand, explicitly achieves CIPA by promoting community values through content that expresses the attitudes, beliefs, and ideas of individual community members.

In addition, content on a public display provides information about the preferences and interests of people *within* and *without* the display surrounding. This will provide different opportunities for people to become aware about communities *within* and *without* public spaces as defined in our research agenda (cf. see section 3 "Approach"), i.e., it would provide awareness about the community of one's interest (identity cognition), communities in the locality (local connectivity), distributed other communities with the same interest (remote connectivity), as well as information about unknown communities (identity infusion).

Note that we did not yet take into account how diffusion would be influenced by situational and contextual challenges within the space, such as social implications of shared use [29].

#### 4.4 Content Viewers

In our study on student's communicative ecology we could see that content was delivered to 1) an *unknown* group of people, e.g., through YouTube videos, tweets, and SlideShare presentations, to a 2) *known group* of people, e.g., friends, family and acquaintances, or to 3) *individuals* (directed message). We foresee that content on a public display will potentially be viewed also by the same three types of viewers. Some people might not necessarily understand the content and see it just because they are situated next to a display; others might be recipients of a message and would understand the content; and in some cases it might be a single individual who is the sole recipient of a message.

We can also connect these groups with the inclusive and exclusive channels: the inclusive channel carries content that is open-for-everyone and its designated group of viewers is *unknown*. On the other hand *exclusive* channel would allow a closed group communication with a *known group* or an *individual*. However this classification is not very strict. For example, we might use the exclusive channel to contact a known group of people, e.g., friends or family members, but we might also use the inclusive channel to contact another *known group* of people, e.g., people with whom we share the same interests. For example, we might use the exclusive channel to send a message to a close friend, "Wolverine meet you for a coffee. Xavier", having meaning only to a *known group* or *individual*, or we might use the inclusive channel to send a message "Forza Inter" to all the places that have a majority of Inter Milan supporters, i.e., to a *known group* of people who share the same values as we do.

### 5. DISCUSSION AND IMPLICATIONS

The IPF can be seen as a framework that provides a holistic view on challenges and possibilities for networked public display applications that aim at stimulating CIPA. It provides four landmarks in this area in the form of 1) content providers, 2) content viewers,

3) communication channels, and 4) diffusion layers. Future developers of networked public display applications can use IPF to both analyze existing deployments and to design novel CIPA applications.

For example, researchers and designers can examine how content is (or should be) provided, i.e., whether it is provided by *people* or by a *service*. In some cases these choices are obvious, e.g., in a notice board or a bus schedule, but sometimes it is up to the designer and the developer to make that decision: a football scoreboard may fetch results from the web or allow people to report them along with their comments. A combination of service- and people-generated content would also be possible (e.g., a scoreboard that fetches online scores but allows comments).

Choices are also apparent with respect to the channel that is used to deliver the content and that best suits the application, i.e., is it open and discussion-oriented (*inclusive*), or more delivering content for a selected group (*exclusive*). For example the football score results could be delivered in such a fashion that they spark discussion around the content, but they could be also delivered just for selected recipients (e.g., you could subscribe to the application that delivers the results only to the subscribers). Researchers and designers should also think about the scope of the chosen channel, i.e., how it is scoped through *people* and *places*. For example, in certain cases desired recipients of the content might be *people*, e.g., delivering a message for a particular person ('R2D2: Barcelona scored! C3PO'), while in other desired recipients might be *places*, e.g., delivering a message to the place that matches certain features (e.g., delivering the same message to places with the most Barcelona supporters).

Researchers and designers also have to identify the type of awareness achieved, i.e., is it geared more towards spreading awareness between members of the same community - *identity cognition* and *remote connectivity* (e.g., awareness of all Barcelona supporters within and without); spreading awareness about different communities in the locality - *local connectivity* (e.g., spreading awareness about different football club supporters within the space); or does it provide more diversity within a community - *identity infusion* (e.g., spreading awareness about other sports than football). More importantly, designers must be aware that their immediate communication - the *explicit* awareness diffusion - will always be visible to *non-community* members who might not be able to decode the specific symbols and messages within a community. For those viewers, *implicit* community awareness is taking place, in that they get a sense of the type of communication that is taking place. Designers can aid this process by carefully choosing their design language, e.g., color schemes and fonts, and the corresponding tools available to community members' messages.

Finally, researchers and designers can think about different groups of people that view the content of the application and analyze how much the content is suitable for an unknown group, a known group, or individuals. For example, in some cases content would be suitable for an unknown group (e.g., a weather forecast) while in other cases it might not (e.g., showing a football club logo in a wrong place might stir some unwanted attention). This might also influence the decisions to change the content depending on the viewers around the display (e.g., showing a message 'Barcelona 1:0 Real', instead of 'Mike! Barca just scored!!!').

### 6. CONCLUSION

We believe that future networked public displays systems will enable a novel communication channel that can be highly beneficial for connecting communities that reside within and without

public spaces. Such displays would enable what we call interacting places – public spaces that promote community interaction and place awareness (CIPA) through networked public displays. In this paper we described our effort on creating a conceptual framework – the Interacting Places Framework (IPF) – that can be used to both analyze and prepare future deployments.

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