

StreetTalk: Participative Design of Situated Public Displays for Urban Neighborhood Interaction

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ABSTRACT

As modern information communication technologies are increasingly integrated in our public environment, challenges arise to render them locally relevant and meaningful. In this paper, we describe the design and evaluation of *StreetTalk*, a set of situated public displays attached to house facades that were specifically designed to facilitate communication and interaction between households and their local neighborhood. We report on a participatory design process that resulted in a range of neighborhood communication concepts that reached beyond the traditional screen-based notion of public displays. Accordingly, three unique displays were deployed and critically evaluated during an eight-week in-the-wild field study, which aimed to describe the potential usefulness of making public displays more situated, such as by taking into account the individual preferences of households in terms of design and functionality, by exploring alternative means of public communication, and by facilitating content creation by lay households.

Author Keywords

Media architecture; public display; urban informatics; ludic design; participatory design; community; methods.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

The field of *urban informatics* focuses on the potential of ubiquitous computing within the semi-public realms of our cities, such as streets, squares, pubs, shops or buses, [17, 21]. While most commercial initiatives in the context of *smart cities* focus on improving efficiency and productivity of activities in the city by provisioning and integrating locative services, there is a recent understanding that

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contemporary urban life consists of a much wider range of emotions and experiences that should be addressed by technological advances [31], such as the augmentation of social cohesion and local interactions [14, 33].

The shared, opportunistic and situated characteristics of public displays seem ideal to tackle such challenges, in particular as technological advancement has made the necessary screen and networking capabilities increasingly accessible and affordable [26]. Yet still much is unknown in regards to the social and societal integration of public displays within the fabric of the city or a neighborhood [41]. For instance, how would local residents envision the functionalities and design characteristics of a public display? What would be the impact of deploying public displays in a residential neighborhood, rather than a major point of human convergence, and how does it contribute to local concerns and qualities? As a result, we believe that the design of more socially and locally situated public displays would benefit from bottom-up, qualitative input from local inhabitants who actually have to closely coexist with this communication medium.

This research took up these challenges by questioning several prototypical and canonical characteristics of a public display, in terms of: a) its physical screen-based shape and form; b) its generalized, communal and austere content; and c) its lack of user involvement in terms of its design, location or content. In order to entice sufficient enthusiasm and open-ended reflection on these issues, we exploited the playful and openly interpretive qualities of ludic design [15]. Our study reveals some latent communication needs and expectations within an urban neighborhood, and provides new ideas towards alternative forms, functionalities and integration of more situated public displays. We believe this knowledge is required to better understand the still largely untapped potential of public displays in supporting and engaging the urban and social fabric they are located in, so that their further proliferation in our built environment will not suffer from the visual blindness and emotional disconnection that we know from current forms of public advertising.

RELATED WORK

Previous research has recognized the advantage of deploying technological artifacts in the urban environment to mediate the interaction with the city and its citizens [44],



Figure 1: *LocaLudo* game with participant household; game board with cards and pawns in foreground. Participants individually collect responses to questions.

such as to facilitate public deliberation [19], promote collective behavior [23] or extend the visibility of social civic issues [34].

Public Displays as a Platform for Interaction

Public displays have become commonplace in the cityscape of today, as they are particularly appreciated for their ability to present inhabitants, commuters and visitors with dynamic content in the context of advertising, entertainment or communal information (e.g. [37]). However, in order to motivate sustained interaction, public displays must raise curiosity while engaging imagination and fostering collaboration [27], such as by offering playful experiences [12], increasing the awareness on socially relevant topics [30, 40], or enabling citizens to create content themselves [45].

Recent studies have demonstrated the opportunity for public displays to augment social interaction in urban neighborhoods, ranging from the integration of a single small display [8], over media facades [13], to a distributed network of interventions across several neighborhoods [24]. The resulting design guidelines highlight the positive influence of embedding playful and imaginative values, and providing possibilities for people to contribute to the content that is shown. In spite of their apparent success, the optimal and sustainable integration of public displays within the urban fabric still poses several challenges [29], including their spatial configuration [12], the creation of suitable content [10], or facilitating individual sense-making towards displays [6]. Within this context, studies have revealed the potential of public displays to engage communities, by extending their design space beyond traditional, rectangular, screen-based formats [22].

Designing Technological Artifacts with Citizens

Informing the design of technological artifacts with cultural values and personal needs from citizens has already been investigated in the context of the home (e.g. [3, 11]). The domestic environment is recognized to include rich meaning and nuances [2], hosting activities that are not always clearly utilitarian. Therefore, the design

of domestic technologies can benefit from ludic values [16], such as to promote reflection or interpretation, or to allow unpredictable usages to emerge (e.g. [35, 42]).

Urban environments present a rich environment for understanding the inherent challenges of information communication technologies in the public realm [7], such as avoiding digital exclusion and meeting individual needs. The potential of involving citizens in the development of public displays has been demonstrated (e.g. [20, 38]) but, to the best of our knowledge, opportunities still exist to open up the design space of public displays and motivate citizens to design these themselves. Such an open approach may empower individual citizens to become proactive in their involvement with the city and neighborhood [32].

DESIGN PROCESS

In order to facilitate the creation of novel urban technological interfaces with the active participation from households, we have developed *LocaLudo*. A card-based design game was chosen as the most appropriate format as previous research has highlighted the value of games to serve as a catalyst for participation [4], and card-based workshops have proven to be successful conduits to generate ideas and design new concepts (e.g. Ideation Decks [25], Inspiration Card Workshops [18]). In *LocaLudo*, several households were invited to develop alternative forms of public displays that could be attached to their house facades for communicating with their neighborhood. In order to inform the design space with meaningful inspiration, the households were encouraged to reflect on their perception of the neighborhood (e.g. qualities, concerns) and how technological means could mediate between their everyday life and the neighborhood in a physically, socially and culturally considerate way.

Home Visits

We undertook *LocaLudo* game sessions with 10 individual households living in 6 distinct neighborhoods in and around Antwerp, a medium-sized city in Belgium. On average 3.5 household members joined each game session, with ages ranging from 6 to 65 years old. These households had voluntarily indicated their willingness to participate, after being approached during local summer festivities in their street. All *LocaLudo* game sessions were conducted at each of the participants' private residences, with assistance from one or two researchers (see Figure 1).

The custom gameplay was inspired by *Game of the Goose*, a classic European game that allowed easy customization according to our specific participatory needs. It consisted of a physical game board with tiles that participants traversed in chronological order. A collection of questions formed the heart of the game, which was presented as stacks of cards that asked participants to reflect on: 1) their neighborhood (e.g. “*What characterizes your neighbor’s house?*”); 2) local social interactions (e.g. “*How would you welcome new neighbors?*”); and 3) the household itself (e.g. “*What is commonly discussed during family*

dinner?”). As a participant’s pawn entered a color-coded tile, a random card had to be drawn from the respective question stack. The according participant was then asked to answer the question printed on the card by sketching, writing down individual keywords, or noting a more descriptive sentence (similar to *Instant Card Workshops* [1]). In order to add excitement, *surprise tiles* introduced a gameplay action (e.g. “Go back two tiles”). Researchers observed and recorded all relevant insights, which were analyzed later to create a unique profile of each household.

At specific intervals, the gameplay was halted to collaboratively develop imaginary concepts for novel kinds of displays that facilitated diverse forms of interaction with the neighborhood. Next to the answers that had been collected up to that point in the game, additional sources of inspiration included technologies (e.g. lamp, motor) and architectural elements (e.g. front door, mailbox), which were randomly drawn from a stack. These inspirations encouraged participants to think beyond existing technologies or locations, similar to how ludic interfaces stimulate exploration and reflection [15]. Participants were required to use at least one source of inspiration in the development of each concept, which were summarized in an “if... then...” structure, such as “[if] neighbor Albert passes by the house talking loudly, [then] his movements are followed by a light attached to the outside wall”.

Results and Discussion

In total, 38 concepts were developed during 10 *LocaLudo* workshop sessions. While some of the resulting concepts were deemed infeasible in terms of technical or financial effort, they still offered a valuable perspective on how households perceived their neighborhood, and how they wished to communicate with it. All resulting concepts were analyzed according to the categorization methods used in Grounded Theory [36], which allowed us to distinguish four important themes:

- **Social concepts** aim to create new opportunities for social contact with neighbors, such as highlighting specific skills (e.g. by way of projections) to start conversations or share expertise with others.
- **Informative concepts** enable announcements among neighbors in abstract (e.g. light) or concrete forms (e.g. text message), such as a colored light in the doorbell to symbolize the mood of the residents.
- **Critical concepts** formulate an answer to local concerns, such as a kinetic system that launched water balloons to speeding car drivers.
- **Pragmatic concepts** aim to provide functional solutions to practical problems encountered in the street, such as an ambient light to share private parking spaces with neighbors.

We observed that local issues, qualities and concerns often coincided across neighborhoods (e.g. nuisance of speeding cars, absence of available parking space, the need for more local activities). Nevertheless, the resulting concepts

differed between households both in their technical and structural nature, making them unique and personally meaningful to the household that designed them. Moreover, the playful gaming aspect created an open and creative atmosphere that motivated collaboration between different household members. For instance, a teenage daughter accusing her mother to often gossip in front of the house imagined a lighting system that enabled other neighbors to follow or join the conversation.

Concept Selection

After this ideation phase, we selected three design concepts to further develop into a suitable public display, in collaboration with the households that developed them (i.e. KD, BS and BB, see Table 1). This final selection was determined by: a) differing technological means to communicate with the neighborhood (e.g. light, audio and text); b) technical feasibility; and c) the opportunity for an intriguing architectural integration. By coincidence, the three participating households were located in the same residential street, which was characterized by a broad sidewalk and a lack of front yards, causing house facades to directly demarcate the sidewalk. Notably, this particular spatial layout facilitated more spontaneous interactions by passers-by, who could approach the house façades without feeling restrained or having to enter private property. The economic, demographic and cultural characteristics of this street approximate the citywide average (e.g. 72% employment vs. 65% citywide, 2011; 14% immigrants vs. 20% citywide, statistical data from 2014).

Table 1: Details on participating household compositions.

	Adults	Children	Participants
KD	2 Late 40's	3 Teens	2 Adults, 3 Children
BS	2 Early 50's	3 Teens	1 Adult, 2 Children
BB	2 Late 30's	2 Preteens	2 Adults, 1 Child

IMPLEMENTATION

The collaboration process involved several returned visits to each household, email communication and phone calls, in order to iteratively fine-tune each concept according to wishes and concerns. Based on sketches that visualized the design ideas, aspects such as the look-and-feel of public displays, their functional possibilities, and integration with other elements of the façade were discussed. Ultimately, all households collectively agreed upon an overarching material and color scheme.

Technical design

All displays were custom-built with off-the-shelf hardware components (i.e. *Arduino* and *UDOO*) and designed to be robust and maintenance-free over a long period (see Figure 2). Connectivity was provided via *Power over Ethernet* injectors, with receivers as close as possible to each individual display (i.e. basement, entrance hall). Industry-grade red mushroom pushbuttons were integrated to allow passers-by to interact. The firmware was thoroughly tested before deployment, especially in order to cope with

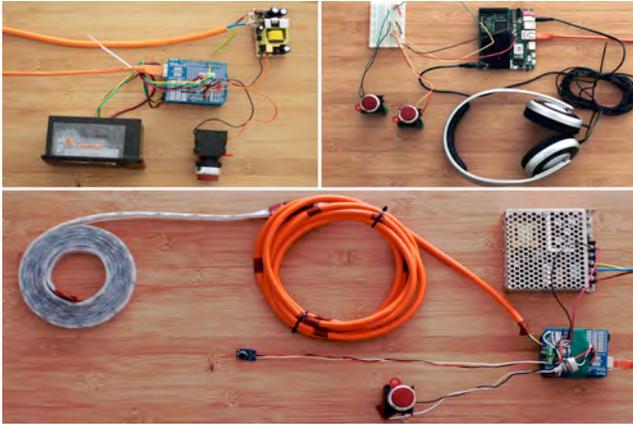


Figure 2: Close-up of technical infrastructure for the public displays. Top left: *Readl*, Top right: *Listen*, Bottom: *Shush*.

multiple successive button presses. No particular measures were taken to avoid vandalism or theft. All displays were attached to the outside of the house façades, and encased in laser-cut plywood boxes. To withstand outdoor conditions, they were assembled with watertight glue. To contrast with the bright red façade color, the encasings were spray-painted in a dark gray tint. Both power and data cables were routed along the exterior of facades, to also highlight their respective domestic ownership.

Each participant household had access to a private webpage that presented real-time information for their display, and allowed them to configure the device to some extent. These webpages were served from an external webserver and developed in HTML5 and JavaScript; PHP was used for server-side scripting. All data, including interaction with pushbuttons integrated in the public displays, was stored in an offsite MongoDB database.

Household KD: *Readl*

The concepts of the KD household focused on written communication with neighbors (e.g. addressing loitering youth with joyful messages, or revealing hidden talents of neighbors on a neighborhood public screen), as this household already acted as the administrators of a local weblog. This aspect also made them recognize communication means with neighbors that could otherwise not be reached (e.g. elderly people without internet access).

Project. Building upon their experience as weblog administrators, we designed *Readl*; a printer attached to the house as a tangible metaphor for written communication. Household members were allowed to create messages via the private webpage, including free text and questions with response options. Outside, passers-by were confronted with the custom public display attached next to the front door, displaying an engraved message saying, “*Push for news*”. This unit contained a thermal printer, button, power adapter and microcontroller (see Figure 3, left) that printed one of the most recently stored messages, along with its metadata (e.g. subject, time of publication). By default, recipients



Figure 3: Left: *Readl* with integrated house number. Engraved message reads, “*Push for news*”. Right: *Listen* with headphone. Engraving reads, “*We have something to say*”.

were given the possibility to reply or comment, by way of a dedicated area of whitespace on the printed piece of paper, which could then be ‘posted’ in the household’s mailbox. Except for creating messages, the household was asked to occasionally replace rolls of thermal paper.

Household BS: *Listen*

The shared interest of the BS household in music, also exemplified by their enormous personal CD collection, proved to be essential in symbolizing their external identity. Their design concepts contained references to more abstract concepts of interaction among neighbors, such as networked displays deployed by multiple households for sharing news and facts, or an integrated audio system to help people relax as they arrive home after work.

Project. Their music interests led to *Listen*, an audio interface between household and neighborhood. Household members were able to record audio fragments via the private webpage, and indicate a positive or negative emotion. Passers-by on the sidewalk were confronted with a control unit that contained two pushbuttons, a message saying, “*We have something to say*” and two emoticons in the shape of a smiley and a frown to indicate button functionality. A headphone was visible underneath the display (see Figure 3, right). As such, neighbors were invited to put on the headphone and select the type of message to listen to. *Listen* was attached to the mailbox, as it was considered the most personal element of communication on a house façade. It also offered a poetic connotation of listening to what happens inside the house.

Household BB: *Shush*

This household was particularly interested in the concept of ambient and dynamic lighting as a way of public communication. During *LocaLudo*, this resulted in ideas to illuminate the pavement tiles in response to people passing by, or to integrate neon lighting in the curb to make motorists visually aware of their speed.



Figure 4: *Shush*. Top: LEDs on second floor. Bottom: control unit next to front door. Engraving reads, “Enjoy the silence”.

Project. Household members specifically mentioned that street noise occasionally disturbed their daughter’s sleeping pattern at night. This provided a design basis for *Shush*, i.e. a lighting element that represents ambient sound levels. It consisted of a 2-meter long RGB LED strip, attached to the windowsill of the daughter’s bedroom on the first floor. A control unit was attached next to the front door (see Figure 4), containing a pushbutton, power adapter, electret microphone and microcontroller. As the microphone measured low sound levels, LEDs in the middle of the strip were colored green, smoothly evolving to bright red LEDs on the strip’s ends at higher measurements. When a predefined maximum measurement was reached, the LEDs pulsed. The push button invited passers-by to register their enjoyment of silence, which resulted in a gentle pulsating light effect on the LED strip in random colors. In contrast to the two other displays, the BB household was not able to manipulate any characteristics of the device, such as colors and sound sensitivity. However, the personal webpage allowed them to explore graphs of real-time, hourly, daily and weekly volume recordings.

IN-THE-WILD FIELD STUDY

After construction, we attached the public displays to the respective house facades of the participant households. On average, each installation took about 1.5 hours by two researchers. During this time, neighbors became curious about our activities, the inner workings of displays and overall objectives. However, in order not to influence them in terms of appropriation of the displays, we refrained from informing them about the expected content and aspired impact of the displays, and as such did not illustrate any exemplary usage scenarios.

Evaluation Methodology

The displays were deployed for 8 consecutive weeks (i.e. 56 days), which occurred in between two major holiday periods. During this period, researchers observed each display remotely (e.g. number of daily interactions, chosen configurations) as well as onsite. Local interactions were observed at various points in time and on multiple days in

order to cover a representative spectrum of days and times of day. On these occasions, particular interaction patterns were noted down and photographed, and neighbors and passers-by were briefly asked about their motivations and opinions. Observations usually occurred for short periods of time (40 minutes) as observing the calm street felt invasive to privacy.

Four weeks after installing the displays, researchers distributed approximately 280 flyers among neighbors in the immediate vicinity of the participant households, which included invitations to take part in an interview in return for a small financial reward. After concluding the study, each participating household was given a financial reward to cover the additional cost of electricity.

Technical Observations

Despite extensive debugging, *Listen* was affected by a range of technical difficulties during Week 2. First, some Internet disconnections were traced back to the household sporadically turning off its cable modem at night. While this did not affect interactions, no logging occurred during these time periods. Second, the system audio process sporadically shut itself down without any possibility to automatically reinitialize it. As this issue could not be resolved quickly, we replaced the mini-computer with a small portable computer concealed in a cardboard box. *Shush* was involuntarily deactivated on three occasions, as the combined usage of a washing machine and tumble dryer caused a failure in its circuitry.

RESULTS

A total of 5,493 button presses were registered, averaging 98 daily. Most interactions took place during Week 1 (see Table 2). On a per-hour basis, buttons were pressed mostly during rush hour (i.e. 8 to 9 AM and 3 to 5 PM), together accounting for 55% of all interactions (see Figure 5). These time slots naturally correspond to local residents leaving to, or arriving from, work or school. Insights based on distinct button presses on the level of individual citizens have not been collected due to inherent privacy concerns. In fact, participant households were not open to integrating cameras in the displays, which would however have allowed the analysis of more profound research questions.

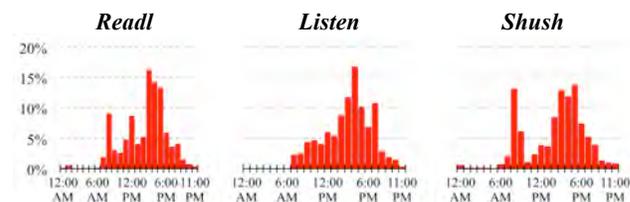


Figure 5: Distribution of accumulated per-hour button presses per public display.

Soon after the study had ended and the displays had been removed, we conducted a collective semi-structured interview (180 minutes) with the three participant households. In addition, neighbors that responded positively to the interview invitation (N=10; 6 living in the

same street (K), 4 living in surrounding streets (R)) were visited at their homes for a semi-structured interview (60-90 minutes) containing 30 half-open questions about various topics related to the displays and the neighborhood, including their personal opinions, usage patterns and interactions with the participant households.

Table 2: Amount of stored messages and registered button presses per week for each public display.

	<i>Readl</i>	<i>Listen</i>	<i>Shush</i>
<i>Week</i>	<i>Published messages</i>	<i>Recorded audio fragments</i>	<i>Logged volume exceeders</i>
	114	40	9031
1	39	11	1264
2	18	11	2180
3	7	0	688
4	10	7	283
5	8	0	260
6	14	4	3343
7	5	0	381
8	13	7	632
<i>Week</i>	<i>Registered button presses</i>		
	890	776	3827
1	191	213	760
2	132	83	686
3	124	77	456
4	67	118	285
5	89	105	334
6	114	97	371
7	89	47	326
8	84	36	609

Readl. [KD] published a total of 114 messages, 83 of which contained free text, while 31 contained questions. Typical free text messages contained local information (N=38, e.g. “On Friday [...] organizes a neighborhood quiz. Come join us at [...].”), jokes (N=14, e.g. “What is blue and not heavy? Light blue.”), references to time of day or year (N=13, e.g. “Good morning, I hope you slept well. [...] In the afternoon rain is expected!”), references to *Readl* itself (n=11, e.g. “Hello! These messages contain short local announcements [...].”), or ads (N=7, e.g. “Who wants to host a mini-concert at home on Sunday [...]? More information at [...].”). Questions let neighbors formulate opinions about topics such as television shows, holiday destinations or sports (e.g. “What sports do you prefer to watch during winter?”). Out of the 890 requested prints, 143 were deposited back in the mailbox of [KD], containing written answers to questions (N=76, e.g. “Today we will install remaining windows”, workers from nearby construction yard, replying to “What will you do today?”) or general remarks (N=38, e.g. “I for one know that some sweet neighbors live in this street”, in response to an activity announcement). 29 returned notes were blank.

Listen. [BS] published a total of 34 positive and 6 negative messages, which typically contained local information (N=19, e.g. “Our street’s summer party will be held on

August 16. [...]”), poetry and philosophical musings (N=9, e.g. “Taming fishes is more difficult than swimming with fishes.”), musical preferences (N=7, e.g. a song that sings the praises of beautiful weather), jokes (N=5, e.g. “Good news for fans of [...]. They won! Because they haven’t played.”), or reflections on *Listen* itself (N=4, e.g. “All good things come to an end. Next week our headphone will be taken away. [...]”). The button for positive messages was pressed 523 times, while negative messages were requested 253 times. Some negative messages informed about the passing of neighbors and musicians, or the technical issues *Listen* was confronted with. [BS] indicated feeling less motivated to publish negative messages, as “negative news is real news, while positive news allows for multiple interpretations” [BS].

Shush. Over the course of eight weeks, the preconfigured maximum volume as measured by the electret microphone was exceeded over 9,000 times. In stormy weather the microphone also responded to strong winds, which explains the large amount of maximum volume readings during Week 2 and Week 7. In contrast to *Readl* and *Listen*, observations revealed that passers-by tended to press the button multiple times in rapid succession, to trigger new animations to commence with random colors.

DISCUSSION

In this section, we describe how each public display was controlled by the household and used by neighbors and passers-by, which leads to design recommendations for further endeavors in the realm of situated public displays.

Engaging Households in the Design of Public Displays

While games are not new in collaborative design contexts (e.g. [4, 39]), we particularly exploited their playful qualities to augment the creativity of household members in imagining novel ways of community interaction, and to overcome their lay expertise. *LocaLudo* has thus provided a participative medium to capture a particular context, including its qualities, concerns and values. Even though we were forced to reinterpret some of the concepts generated during the game, neighbors still indicated that they recognized some characteristics of the participating households: “I am sure [KD] had this printer, as he already manages our street’s weblog.” [K2]. However, for some, the external identity of households came with explicit expectations to the design of the displays that were not fulfilled: “I was looking forward to hearing some music, as I once already enjoyed beautiful music while walking past [BS]’ house. When listening however, I was disappointed to hear nothing but a joke.” [R2]. When asked about her opinion about *Shush*, she imagined it to be designed “in response to an annoyance, felt by the household living there”.

Naturally, the founding relationship with the displays encouraged households to sustain the content creation in so far that even various explorations occurred. For instance, as [KD] became increasingly experienced in recording voice

messages for *Listen*, he also wanted to communicate music fragments. As audio could only be recorded via the webpage, he iteratively fine-tuned the appropriate volume of his Hi-Fi system. Similarly, while *Shush* had very limited configuration options, its private configuration webpage was still used to analyze the sound measurements and to recognize potential patterns, such as the engine of a waiting school bus, passing garbage trucks, or people clapping hands.

We learned that neighbors, including residents from distant streets and several local cultural organizations, expressed interest to be actively involved in future endeavors (“*This would be great to have in [...] Street too!*” and “*Fine initiative! Feel free to come to [...]*”, both in response to *Readl* messages). Some neighbors also personally identified themselves with the displays, such as [K2] who gave a visiting grandfather and friends a brief guided tour.

Design recommendation. Providing local inhabitants with opportunities to participate in the design of public displays has the potential to encourage ownership and render the displays more situated, in terms of relevancy, usefulness, sustainability and the resemblance of unique characteristics from involved local inhabitants. By taking into account the surrounding cultural, social, spatial and architectural context, the prototypical design space of public displays expands, such as by reconsidering content- and form-specific aspects.

Engaging Neighbors in Interacting with Public Displays

The situated public displays provided neighbors with an additional yet easily accessible opportunity to interact with the participant households. Soon after the initial deployment, one neighbor [K1] replied on a printed message from *Readl* by asking [BS] permission to record an audio fragment of his own (announcing a fundraising sale in the near future for the illness of one of his family members). [K1] appreciated the public display communication channel due to its unobtrusive yet alternative way for campaigning. Two days later, [BS] invited [K1] over to make the recording. Occasionally, others also suggested new content, for example by leaving remarks on printed *Readl* messages: “*Tai Chi for beginners. Free trial lesson [...] in [a nearby park]*”.

Our observations as well as the returned *Readl* messages show that both occasional and repetitive interactions with the displays took place. Occasional interactions mostly involved people external to the street, as they irregularly passed by. For instance, while an environmental organization was raising funds in the neighborhood, one of their representatives replied, “[...] *We can taste the enjoyable atmosphere in this neighborhood*”. However, the vast majority of interactions with the displays were repetitive. For instance, one neighbor mentioned stopping by *Readl* on his way home and printing one message daily as it “*provided an opportunity for discussions during family dinners*”. Others occasionally took their prints home



Figure 6: Common examples of interaction with *Readl* (top left, group of local school children), *Listen* (bottom left, city workers), and *Shush* (right, neighbor walking past).

and replied at a later time [K2, K3]. The abstract, real-time message of *Shush* also proved successful in promoting recurrent interaction, as exemplified by the many school children making noises in front of the display [K2, R1], or neighbors liking to walk past the house on their way to work or school louder than usual in order to observe the lights respond [BB, K2, K4, R2] (see Figure 6).

Design recommendation. The motivations for interacting with our situated displays were diverse, ranging from predominant leisurely and opportunistic interests (e.g. simply triggering a colorful effect), to more social grounded intentions (e.g. printing news to discuss at home). Therefore, public displays have the potential to stimulate engagement if more considerations will be paid in incorporating a range of inherent interaction motivations, which commences from entertainment to more personal or strategic reasoning. The challenge then still remains on how to engage and include ‘everyone’ in interacting with displays, especially in terms of sustaining this engagement into potentially useful activities and habits (e.g. interacting daily when leaving for work).

Engaging with Hyperlocal Content on Public Displays

We noticed that bi-directional public messaging was characterized by specific qualities, of which hyperlocality seemed the most promising in the context of public displays. We have analyzed hyperlocality in three ways: the specific content and relevance of messages, their ‘success’ in terms of engaging locals and passers-by, and their physical reach.

Message Content and Relevance

Neighbors particularly appreciated messages that took immediate inspiration on neighborhood occurrences, such as “[...] *a primary school is looking for volunteers to help in the garden*” (*Readl*), or “*tonight X, our neighbor from number 78, passed away at 91 years of age [...]*” (*Listen*), because they were considered “*a valuable source of news*” [K1, K3] and “*it allowed me to relate to each news item; as*

I most likely knew who or what it was all about” [K2]. The importance of hyperlocal relevance is exemplified by a *Listen* message that informed about the recent death of an international flamenco guitarist. Neighbors argued, “*I didn’t know that person. Though, when the death of the neighbor at number 78 was announced, then I was touched*” [K3]. However, as deployment progressed, less neighborhood-related news became available, forcing both [KD] and [BS] to publish more jokes and quizzes (e.g. “*The Tour of Flanders is on Sunday. Who is your favorite rider?*”, published to *Readl*).

[KD] and [BS] mentioned they deliberately chose to only publish messages that addressed and were comprehensible to a wide audience, rather than political content or messages that related to topical societal discussions, such as the upcoming elections or reminders of civic responsibility (e.g. encouraging people to clean up after dogs). These considerations were based on their personal beliefs that societal topics only benefit from a culture of open debate that also allows deviating opinions to be voiced (which *Readl* and *Listen* insufficiently supported). In addition, the physical attachment of displays to private facades and the identifiable content they produced (e.g. the voice of a household member) made these considerations matter even more. In contrast, *Shush* allowed for more critical and reflective messages to form, as exemplified by the underlying and potentially patronizing message that it symbolized. According to neighbors [K3, K4] and [BB] however, the few times that the volume threshold of *Shush* was exceeded, proved that “[...] *this neighborhood is in fact very quiet during most parts of the day*”.

For neighbors, the explicit physical connection between the display and a private residence, amplified by brightly colored cabling and a handmade look-and-feel, attributed to a sense of ownership, trust and credibility towards the messages that were conveyed: “*It’s attached to a house façade and I more or less know who wrote the message, so I’m sure it will be no nonsense*” [K4].

Design recommendation. The sustained creation of appreciated and understandable content on situated public displays involves providing strategies that ensure the open-ended creation of, or readily available, news that is preferably non-controversial, while always observing its (hyper)local relevance. In order to ensure trust and credibility, the physical location of public display should be carefully considered in terms of its contextual role or meaning (e.g. community center, façade of community worker’s private residence).

Success of Communication

We observed that the message contents of *Readl* and *Listen* were conceptually similar to status updates typically published on virtual social networks such as Facebook and Twitter. However, the motivational structure of both ‘social’ networks are inherently different: in contrast to virtual social networks that are built around personal

preferences, friendships or kinships, the ‘social network’ surrounding a public display tends to be determined by physical proximity, i.e. members are those people that live or work close by, and thus might not be necessarily related, alike or affiliated in any significant way. Therefore, the creation of meaningful or relevant messages is more challenging, in terms of meeting the various backgrounds and interests within this involuntary ‘urban’ network. A similar observation, especially the relation between a private display and the community it aims to address, is reported in the context of university campus deployments [9]. Here, students mentioned community-generated content to be beneficial for supporting and fostering a sense of community.

While the ‘success’ and popularity of typical social messages can be relatively well estimated by quantitative measures as the amount of *Likes* or *Retweets*, a similar metric is difficult to define for public displays. While eye tracking or interaction logging comes to mind, other aspects like neighborhood commitment, awareness enlargement or public discourse fostering seem more appropriate and representative.

Design recommendation. The success of hyperlocal communication on public displays depends on the community it addresses and reaches, which is not necessarily similar to social networks like Twitter and Facebook. Evaluating the success of hyperlocal messages involves applying metrics that are grounded in social cohesion, and can be extended with existing audience and interaction metrics. We propose further research is required to investigate these new social metrics, especially in relation to the deployment of situated public displays in urban residential neighborhoods.

Physical Proximity

We discovered that while the displays succeeded in sparking different kinds of direct interactions, neighbors from more distant streets still refrained from engaging in a dialogue with households. They mentioned, “*I saw [members of the household] frequently, but felt uneasy to start talking about Readl as I don’t know them too well*” [R2], and “*Ringling the doorbell of any of these households would definitely be a bridge too far*” [R3]. Even interacting with the display proved cumbersome, as displays were attached to houses inhabited by unfamiliar people: “*I did not print anything, because it was late and I was afraid the noise would wake the residents. I never returned*” [R2]. While qualities of the *honeypot effect* [5] have been shown to direct attention towards public displays, they seem mostly beneficial in busy urban spaces. We believe additional research is required to reveal how the engagement of a public neighborhood display can reach beyond its immediate range of local inhabitants, for example by providing additional opportunities for *landing effects* [28], further-reaching *calls-to-action* or re-evaluating the hyperlocal relevance of content.

Design recommendation. Motivating citizens to engage with situated public displays regardless of their physical proximity, involves the consideration of methods to overcome issues of unfamiliarity, in particular for sporadic passers-by that have little affinity with the environment. While hyperlocality can be considered a quality in terms of augmenting the relevance and sustainability of a display, it is also an issue when communication is sought with a broader group of users.

Engaging New Perspectives on Public Displays

By integrating ludic interfaces as a design paradigm, the situated displays have encouraged personal interpretations and reflections on the content and meaning of messages and displays. For example, some neighbors interpreted the message engraved in the control unit of *Shush* as a question (i.e. *"Do you enjoy the silence?"*) that could be answered positively by pressing the button, while others pressed the button as a voluntary commitment to encourage silence in the neighborhood (i.e. *"Others should also enjoy the silence."*). As a result, they have allowed new urban habits and behaviors to exist, as exemplified by neighbors that interacted with the displays on a daily basis. [BB] mentioned he liked neighbors to reinterpret *Shush* as a device that playfully intertwines light and sound, instead of a device that purely aimed to patronize neighbors. In addition, one of [BB]'s daughters interpreted the random colors to be a good luck charm (*"When it's yellow, I'll be lucky."*). As displays were peripherally present and created a pleasant environment, we notice similarities with 'calm technology' [43].

Households mentioned their displays to motivate a slower paced atmosphere: people were expected to press a button, wait for a printed or audible message, or make noise in front of the house while encouraging others to join: *"The displays seemed part of a puppet theater that we [as households] directed and performed for passers-by. Such slower pace is what constitutes a typical residential neighborhood."* [BB]. Also, households [BB] and [KD] indicated how they enjoyed *"watching people, standing outside and interacting with [the public display]"*. We learned from neighbors that traditional public displays unlike ours seemed more susceptible to criticism and suspicion, which was mainly attributed to their perceived dominant presence (e.g. *"You cannot ignore them"* [K4]) and tendency to communicate information with limited local relevance (e.g. *"I always forget about what they showed"* [R3], *"It always contains some form of advertising, no?"* [K3]).

Remarkably, the displays were also the subject of attention from local and national newspapers and TV stations, a phenomenon that might also illustrate some potential topics for future public display research. The attention was probably due to the 'real-world' deployment in a typical and recognizable residential neighborhood; its open-ended, rather ludic functionality; and the creative nature of the

display content that was however grounded in various urban problems that were revealed during a participatory process with common households. News reports described the physical design, but specifically featured the topicality and timeliness of such displays within the context of the changing cityscape of today, where neighborhood cohesion and communication are perceived to be under threat.

Design recommendation. The overall positive acceptance of the situated displays could push future development to consider the qualities of alternative communication media and interaction techniques, possibly away from location-agnostic electronic screens or mobile phone applications, and towards more contextually relevant and situated interfaces that allow natural or ludic forms of interaction.

CONCLUSION

We have described the participative design and subsequent development of public displays for hyperlocal neighborhood communication and interaction. We have demonstrated the potential of applying situated, ludic interfaces to open up the typical design space of the traditional screen-based and centrally controlled public displays. In particular, our study shows the positive and creative influence of involving households during the design of public displays, the various interactions from neighbors and neighboring participants, the emergence of hyperlocal content, and some possible new opportunities of public display development in terms of integrating alternative or ludic communication interfaces. Through interviews with neighbors and participating households, we have indicated the qualities and challenges of situated public displays, in terms of sustaining engagement while enticing trust (e.g. visible cabling and attachment to house in addition to identifiable content creators), warranting accessibility (e.g. big red pushbuttons that are understandable for all), arousing curiosity (e.g. impressions from neighbors and press attention) and their local situatedness (e.g. appreciation of hyperlocal content). Based on our findings, we feel encouraged to promote the notion of situated public displays by way of active participation from local citizens.

While our study has demonstrated the potential of allowing citizens to participate in the design of public displays, a challenge for future deployments remains in scaling the concept of alternative, situated public displays beyond low-resolution, temporary interventions and involvement of only a few local inhabitants. Ideally, situated displays evolve towards long-term, robust and sustainable interfaces between and among community members. Such deployments may even be self-funded by a community, or government-supported with involvement of the whole local community in terms of design, functionality and content.

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