Smart Citizen Sentiment Dashboard: A Case Study Into Media Architectural Interfaces

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ABSTRACT
In this paper we introduce the notion of media architectural interfaces (MAIs), which describe the relation between users engaging with dynamic content on media façades through tangible artifacts on street level. Firstly, we outline existing research concerned with public displays, urban screens and media facades, secondly we summarize related works that explore mediated urban interactions in connection with MAIs. We report on the technical set up of a field study, in which we deployed a novel tangible user interface (TUI), called the Smart Citizen Sentiment Dashboard (SCSD). This device gives citizens the opportunity to express their mood about local urban challenges. The input from this TUI is then instantly displayed on a very large (3700 sqm) media façade. The installation ran for three weeks during a media arts festival in Sao Paulo, Brazil. During this deployment period, we were able to gather data to help us understand the relationship between passers-by, participants, the TUI and the media façade. As a result we identified emergent behavior in the immediate space around the TUI and the wider urban space. The contribution this paper makes is in highlighting challenges in the design and deployment of large-scale media architectural interfaces.

Categories and Subject Descriptors
H.5 [Information interfaces and presentation]

General Terms
Design, Human Factors.

Keywords
Urban screens, media facades, tangible interfaces, media architectural interfaces, media architecture.

1. INTRODUCTION
Media façades are very large programmable screens that are usually affixed to the front of a building. For instance, the FIESP building in Sao Paulo, which is shown in Figure 1, has a three-folded LED display 3700 sqm in size, which can be seen from several hundred meters away. Because of their sheer scale and size, media facades like this offer a unique and compelling way to design interactive public displays. But how does one go about designing for an interaction with such a large public display? Part of the challenge here is that there are currently only a few of these kinds of large displays in existence and so there is much to learn from each attempt to deploy an interactive installation.

Understanding how people interact with small-scale public displays has been thoroughly explored within the area of Human-Computer Interaction (HCI) [5] and also within the domain of architectural research more broadly (e.g., [8]). Together, these lines of work provide frameworks to describe technologically mediated human interactions and their spatial configuration in public space [5, 8, 9, 11]. However, the shift from small-scale public displays to large-scale media facades marks a significant shift in scale. We argue that this change in scale will lead to many novel challenges for understanding how people will interact with large-scale media facades. This is because people will no longer be only influenced by the direct space around the display (i.e. the interaction space). Instead, their interactions will be amplified by large-scale multi-dimensional media facades and have an effect on the wider urban space. Passers-by in the surrounding space and onlookers afar might move, occupy or encounter each other differently. A larger audience becomes part of this experience.

Figure 1: Social interactions around a large multi-dimensional media façade displaying user generated dynamic content (SCSD project, FIESP Building, Sao Paulo).

In this paper, we describe the deployment of a MAI that was designed and deployed in Sao Paulo during a 3-weeks media arts festival in September 2013. We captured data whilst participants interacted with a TUI that was connected to a large media façade, as well as social interactions in the wider spatial surrounding.

Through our case study we aim to develop the concept of a MAI. We shall take an interdisciplinary approach, combining knowledge from HCI research and architectural research, as well

PerDis '14, June 03 - 04 2014, Copenhagen, Denmark

http://dx.doi.org/10.1145/2611009.2611036

as applied experiences from media art and architectural practice. In the following we shall therefore review literature relevant for understanding technologically mediated behavior in the fields of public displays, urban screens and media facades and their implications on the spatial layout of a given urban setting. With this framing in mind, we shall then go onto further refine and develop our notion of an MAI.

2. Public displays, urban screens and media facades

The built environment plays a key role in the construction and support of social behaviors. It is well understood that architectural spatial configuration gives rise to movement and encounter patterns, which directly influence social life [13]. In the mid-1990s, Mitchell predicted that future computer technologies would affect most of the built environment to the extent that buildings will turn into computer interfaces [21]. Indeed, urban screens are increasingly common and can be considered a way to integrate architecture and ubiquitous computing technologies [10]. However, there are only a few examples of media facades, which involve large programmable displays [12].

The monochromic 'Spectacolour Board' at the New York Times building, set up in 1976, is considered to be the first large electronic display in urban space [19]. This technology can be thought of as an advancement of the billboard, in that it is used to broadcast mainly commercial content [16]. Meanwhile, digital media technology has been weaved into buildings' surfaces. For instance, visually animated surfaces, such as dynamic light facades, have been equipped with numerous addressable light-emitting diodes (LED). The FIESP building in Sao Paulo, which will be discussed in detail in the case study, is fitted with such a façade (see Fig. 1). Only recently the iconic 1970s building on Avenida Paulista was extended by a large programmable pixel matrix, which displays animated visual patterns. From a technical perspective there are other types of artificial light based media facades as well, such as projections onto facades, back projections through glazed facades, or three dimensional media facades (i.e. voxel facades) [12].

Others consider the potential of media architecture for media art (e.g. Lozano-Hemmer's work [18] or the Connecting Cities network [6]), community and culture (e.g. BlinkenLights [4]) or for community purposes on a neighborhood level (e.g. Screens in the Wild [24]).

Despite the rapid development and deployment of screen technologies in urban spaces and the design of media architecture there has been very little research concerned with understanding this interactivity. The next section will review the mediated urban interactions .

2.1 Mediated urban interactions through tangible interfaces

With the advent of ubiquitous computing [29] and its application in urban space (i.e. urban computing [17]), novel technologies support 'tangible interactions' [15]. These technologies provide new opportunities to enable technology-mediated encounters of people in urban space [26]. 'Tangible User Interfaces' (TUIs) "give physical form to digital information, employing physical artifacts both as representations and controls for computational media" [27]. 'Tangible interactions' evolved from research in Tangible User Interfaces (TUIs) and rely on "embodied interaction, tangible manipulation, physical representation of data, and embeddedness in real space" and "give computational resources and data material form" [15]. The purpose is to surround our everyday activities with computing. Having this in mind, various projects have explored, how users could connect to media facades. Mostly through mobile interfaces such as mobile phones or tablets [3]. One TUI in public space, the Reactable has been used in connection with media façade (FIESP in Sao Paulo and Torre de Aqua in Barcelona), however the set up has not been studied systematically.

In HCI research, Brignull and Rogers [5] have described a framework for understanding the movement flow of people around public displays. Activity spaces were identified to categorize human behavior into peripheral, focal and direct awareness. At the same time, technology-mediated phenomena were acknowledged, such as 'honey pot' effect [5] or 'display blindness' [23].

A framework for urban HCI has grown from the SMSlingshot project [11]. The SMSlingshot is a shared TUI that lets participants shoot individual messages onto a media façade. This set up was studied thoroughly for the purpose of exploring the spatial zoning of people's actions in relation to the spatial layout during installation. As a result Fischer et all identified amongst others zones such as: 'Display spaces' in which one can see the media screen, 'Interaction spaces' in which participants directly interact with the installation or 'comfort spaces' that allow passers-by to watch the scene without being dragged into any actions.

We contribute to this body of research by exploring specifically the relation between passers-by and users, a tangible interface and a media façade in a given spatial layout through deploying a case study. In the next section we introduce the notion of MAIs, which aims to clarify the aforementioned relationship.

3. Media Architectural Interfaces (MAIs)

We introduce the notion of Media Architectural Interfaces (MAIs). We consider MAIs as the synthesis of situated 'tangible user interfaces' (TUIs) connected to media façades in urban space. These TUIs are generally located on street level, whereas media facades are mostly vertical surfaces attached to buildings. At the same time MAIs act as Attractors, which means they potentially entice people to step out of their routine and perceive urban space differently or act differently within it. In this paper attractors are studied as a combination of 1) a Mediator (i.e. situated TUI) and 2) a Carrier (i.e. media facade). Further, the triangular relationship between the Spatial Layout, the Attractor (i.e. Mediator and Carrier) and Movement (i.e. human-computer interaction, social interaction and social encounters) are interdependent key properties of what we define in this paper as socio-spatial configurations.

To explore the relevance of the notion of MAIs, in the next section we report on a case study, which describes an example of a MAIs consisting of a Mediator and a Carrier.

4. Case Study: Smart Citizen Sentiment Dashboard

The case study took place during the Viva Cidade Festival in September 2013 in Sao Paulo, Brazil. The proposed MAI is called Smart Citizen Sentiment Dashboard (SCSD) and has been commissioned by Verve Cultural and Galleria de Arte Digital do SESI-SP to be produced for the media facade festival. We employed this project for this research as it may provide useful

insights into how to design interactive installations for such large architectural displays.

The Setting

Avenida Paulista is the main Avenue of Sao Paulo and the most important financial centre in South America. Large crowds of people from all parts of the city pass the FIESP building's facade daily on its broad sidewalks. During the day the façade appears in a grey mash (fig. 4 right), whereas during darkness the illuminated windows behind the façade create a depth in the façade. Occasionally the LED media façade is turned on and displays colorful content, which can be seen from afar.

During the Viva Cidade Festival the SCSD feedback device was set up in between a newspaper kiosk and the underground station on the pavement of the opposite side of the eight lanes Avenida Paulista. The device was set up on the other side of the street as it was not possible to see the content on the façade from the pavement below the façade. This created a spatial segregation. Our aim was to place the device as close as possible to the underground station as people may already be in the stage of holding their transport cards (i.e. Bilhete Unico) or searching for it in their bags. Consequently, they may understand easier the way they can interact with the TUI.

3.1 The Attractor

The Mediator

The motivation was to develop, design and deploy a situated system that mediates collaborative interactions in public spaces whilst focusing on accessibility and affordance. In other words, the interface should be understandable and easy to use for people.

Figure 2: left – The mediator (SCSD) in front of the carrier; right – ambient perception seen from a nearby bus stop. (image courtesy Verve Cultural)

In this case the *Mediator* is a TUI, which has been originally developed for engaging the public in a museum with artifacts [2]. Based on the previous success we then deployed and tested-out the TUI in various occasions and iteratively improved the system [1].

The employed technology makes use of existing 'Radio frequency identification' (RFID) as known from smart card technology. We build on the widely spread use of these unique ID tags for payless travel purposes or building access, as a large proportion of city dwellers carries a RFID tag in their pocket. Consequently the use of these cards is a recurring embodied interaction in the smart city. At the same time every interaction is uniquely identifiable and therefore traceable. Our aim was to allow people to use their ID tags beyond technical purposes and express their mood and opinion about specific issues in the technology mediated urban realm.

Hence the Smart Citizen Sentiment Dashboard (SCSD) (fig. 2, left) enables participants to express their mood about urgent urban challenges in the city of Sao Paulo. Upfront we were running four design ethnographical workshops amongst various social groups in Sao Paulo with the aim to learn about citizens' urban challenges. As a result of the collaboration five categories were established: 1) environment, 2) mobility, 3) security, 4) public space and 5) housing. By switching a knob on the device participants are able to choose one of the aforementioned categories. By swiping their RFID token (i.e. Bilehtte Unico) across one of the three emoticons (happy, indifferent, sad) their mood was transmitted on to the media façade (i.e. carrier) (fig. 3).

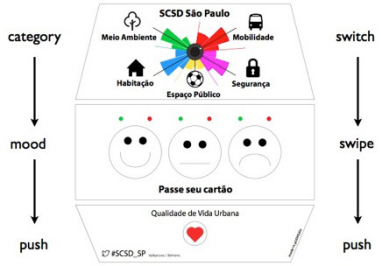

Figure 3: The SCSD affords three folded interactions: 1) switching: 5 categories can be selected through a rotary switch; 2) swiping: after choosing the category, the electronic ID card needs to be swiped over one of the three mood states (happy, indifferent, sad); 3) pushing: finally a simple push-button allows users to view the overall feedback of all collected moods (fig. 2, right).

The Carrier

The mood expressed by the user (i.e. happy, indifferent or sad) is then projected onto a huge LED media façade, which is incorporated in the existing honeycomb façade of the pyramidal FIESP building. The media facade is divided into three parts, which are situated on three different sides of the facade. The biggest and main display faces to the opposite side of the street, whereas the two smaller screens are directed to display to both directions of Avenida Paulista. The three-folded low resolution LED facade is weaved into the existing honey comb facade and is formed by a network of approximately 26000 LED Clusters (pixels) embedded in 3700 sqm metal structure that covers the pyramidal FIESP building. The grid is approximately 13x13 cm. Each Pixel is formed by a module of four LEDs: 2 x R, 1 x G, 1 x B the luminous intensity is 4.5 cd / module.

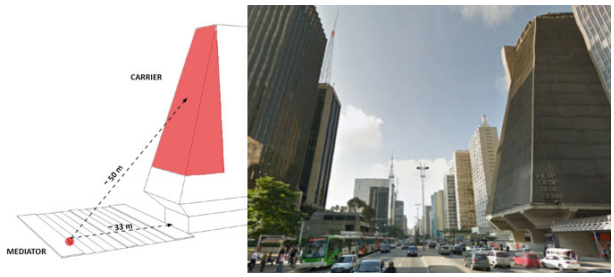

Figure 4: (left) the distance between the Mediator (small dot) and the Carrier (three folded media façade) 33m; (right) the spatial setting and the media façade during daytime.

The Content

We chose a visualization technique that combines the "seriousness" of the topic with the more accessible style of popular info-graphics. The visualization consists of an abstract sunburst representation [25], of which each burst corresponds to the sentiment of an individual participant towards the currently

selected urban challenge (fig. 2). Each urban challenge is encoded by a different color and an icon representation. Upon switching the rotary knob (fig. 3), the sunburst visualization corresponding to the specific urban challenge, and colored accordingly appears on the facade.

The sentiment 'value' for each participant (happy, indifferent, sad) is graphically encoded through the length of the corresponding burst: the longest burst represents a positive sentiment towards the urban challenge at hand, while the shortest corresponds to a negative statement. Our choice for this circular visualization technique was also motivated by its scalability, which allows for an arbitrary number of people to participate and be visually represented. We considered this flexibility a desirable feature in the context of urban environments, often characterized by highly variable and open-ended, and unpredictable flux of people and interactions.

Animations

The integration of dynamic visual cues can make visualizations richer, more vivid and therefore easier to understand [28]. Accordingly, our visualization shows a dynamically animated circle over the sunbursts in order to convey the average participants' sentiment for the given urban challenge. Each new burst from a participant visually appears with a smooth animation and bouncing effect, to highlight the recording of fresh data. A new entry is displayed in a white color to unambiguously distinct it from the rest of the graphical representation. Shortly after it is smoothly taken over by the color of its respective urban challenge (fig. 7 right).

Heart Mode

In order to provide citizens with an overview of previously submitted sentiments, and a more interactive approach to exploring the installation, we integrated a 'heart' button at the bottom of the interface (fig. 3). When pushing this button, a dynamic visualization of the average feedback for all available urban challenges is represented on the facade. As mentioned above, each urban challenge is represented by its corresponding color, and occupies a different part of the circular shape proportionally to the relative participation rate of the according challenge. We aimed to create a simple, playful, yet meaningful approach to enable citizens and participants alike to make a deeper sense of the installation, and the underlying participation results: people can gain insight about which urban challenge is most attractive to vote for, and what is the average sentiment about it of fellow citizens. This, beyond being an overview, the heart visualization symbolizes the overall 'sentiment' of the city towards its urban challenges.

3.2 Data capture and results

The installation ran daily from September 12 until September 30 in the evening. Many people on their way back home from work either engaged directly with their Bilhete Unicos (i.e. RFID transport cards) (Fig. 2) or simply enjoyed the colorful and dynamic visualization on the media façade (ambient interaction) (Fig. 7). However, most interaction took place during the opening event of the media festival.

The MAI was running only for 7 days because of technical difficulties with the equipment and also because of severe weather. During the deployment period we captured 588 separate interactions with the TUI.

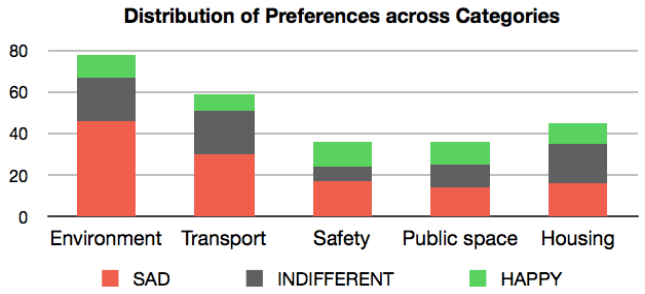

Figure 5: the 5 selected urban challenges (categories) in this diagram show the distribution of interactions and the according preferences (sad, indifferent, happy).

We conducted a preliminary data analysis of the 560 valid ID card interactions logged on our database. The aim was to understand how participants use the dashboard. For each unique card ID that has been used, we looked at the logged data sets within a time-range of 3 mins (the average observed time for a person to engage with the device), and extracted the specifics of the submitted sentiments (which category, and which preference to this category). The data revealed three different major participation patterns: 1) the "serious" behavior. This was the least frequently identified participation pattern (17%). The participant (card ID) has submitted exactly one sentiment for each of the explored categories. This pattern would reflect how we expected the interaction mechanism to work - i.e. a person would explore the categories by rotating the knob and would submit one sentiment for a specific preference. 2) the "repetitive" behavior - This was the most frequently extracted participation pattern (55%). The participant (card ID) has submitted the same sentiment (same preference for a certain category) several times within the considered time range. The occurrence of this pattern can be explained with our frequent observation of participants holding their card over the RFID reader (for a certain preference) for several seconds. Thus the system to registered several submissions (although our system had restricted votes not to be registered within 5 seconds after each given participation). This behavior might be due to a usability flaw of our installation - the participating person did not realize the effect of her participation in the visualization, hence tried several times. Another explanation might be the manifestation of a particular sentiment towards one urban challenge: by holding the card over the reader, the user might have wanted to reassure herself that her opinion would be registered by the system. 3) the "playful" behavior - There were 158 occurrences of this behavior (28%). The participant (card ID) has submitted several different preferences for the same category within the considered period of time. This might indicate that s/he did not really want to express an opinion, but rather explored how the installation and the visualization work.

After eliminating the repetitive submissions (see previous paragraph), we extracted the distribution of submissions across the five categories (see Fig. 5). The category "Environment" was the most popular (with 31%) of all submissions, followed by "Transport" (23%). Furthermore, from the distribution of preferences for each category, we can also observe that within those two categories, the negative sentiments were predominant. This preliminary analysis coincides with comments of participants, which indicated that those are the urban issues, citizens of Sao Paulo felt as most pressing. While we cannot account for representative polling results, the findings indicate the

installation fulfilled its intentions as a urban feedback platform, where people engage meaningfully with locally relevant topics.

Besides the data captured through the TUI device (Fig. 5) we observed interactions around the façade in the close interaction space as well as in the wider ambient space. Although these observations were not rigorously conducted, we did notice a few recurring behaviors. In particular, we frequently saw people taking pictures of the media façade with their mobile phones or taking pictures of each other in front of the façade (Fig. 6). These informal observations would suggest that people liked the media façade visualization and the heart icon it used.

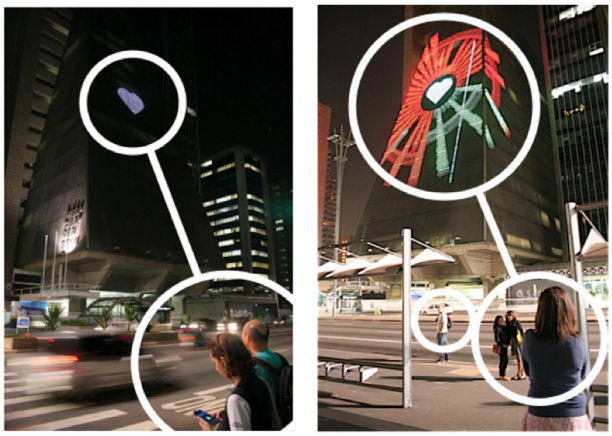

Figure 6: Ambient experience in the wider space around the Carrier: passers-by stop and take pictures of each other (right); onlookers waiting at the pedestrian crossing, taking pictures with mobile phones and sharing them (left).

During our study, we observed participants directly interacting with the TUI. As can be seen in Figure 7, participants tended to start by looking at the TUI, swiping their card, turning the dial. After expressing their feelings towards a local issue on the TUI, we saw that participants would then frequently lookup to the media façade to see what impact their input had on the visualization.

Figure 7: when participants approach the device they first chose one of the 5 categories (mobility, public space, housing, safety, environment) by switching manually the rotary knob (far left); they then double check if the façade changed accordingly (left); after this they use their RFID card to express their opinion about the urban challenges by swiping the card (right); they check again how the façade reacted to their actions (far right).

4. Discussion

The case study described in this paper followed the notion of 'media architectural interfaces' (MAI). The MAI, which was designed, deployed and evaluated during a media art festival in Sao Paulo, created a social encounter stage in urban space. Passers-by stopped, looked onto the dynamic visualization on the media façade or learnt how to actually engage with the façade through the Smart Citizen Sentiment Dashboard (TUI). At the same time people discussed about the notion of this project and its implications on urgent urban challenges or simply took pictures from each other in front of the colorful façade (Fig. 6, right).

Ambient versus explicit

The three-folded pyramidal shape of the LED media façade was challenging: when interacting with the device participants could only see the main screen in the middle, the two minor displays were not easily visible to them. However, the visually most powerful parts of the media façade were the two minor parts, which are facing down Avenida Paulista in both directions. Onlookers from afar could see two sides of the facade. It was not possible to see all three sides of the media facade at the same time.

People who were looking for the Mediator to interact with could not easily find the location as the device was situated on the opposite side of the heavily frequented street. People mostly seemed expecting the Mediator to be on the side of the street where the façade is. We argue that a critical dimension to consider in the design of an MAI is the size of the mediator in relation to the size of the direct interaction space.

It was difficult to identify the zones in which the content is perceived as ambient or as meaningful. Fischer et all's framework of interaction zones [11] was be partially identified, although the boundaries were blurry. We assume that the ambient space is much bigger than the content aware space. This needs to be researched in the future.

We assume that people in the direct interaction space around the TUI will understand the meaning of the displayed content on the media façade. In contrast, people in the wider surrounding area (but who are not close to the TUI), will only have an ambient perception of the visually colorful content but will not be able to contribute to it directly. We observed that the content on the façade was nice to look at, but without actually knowing about the existence of the Mediator the visualization turned out to be only a nice ambient visualization, rather than a socially meaningful representation of people interacting and expressing their sentiments instantly and in situ about urgent urban challenges.

Mobile versus situated

Regarding the research of shared user interfaces in urban space, we are aware of the fact that there are indications that situated and shared interfaces in urban space are currently experiencing a decline in usage [30] and individual mobile interfaces such as mobile phones or tablets are becoming ever more popular. We would like to point out that urban space has always been a space were collaborative and shared actions took place which constitute urban life. Hence, we argue that well designed and deployed MAIs with a strong focus on the given spatial layout might be able to increase the value of situated media, such as media architecture.

Another aspect we noticed is the visually dominant media façade during night times. In contrast, during the day all neighboring

buildings seem to have similar visual significance, whereas during hours of darkness buildings that are not illuminated step back or disappear and media facades come closer to the eyes of onlookers. At the same time the actual shape of the building becomes diffuse and parts of the building that are not illuminated at a particular moment vanish in darkness. In other words, the FIESP building appears in a strong archaic and monumental pyramidal form during the day, but during darkness when the media façade was displaying our Smart Citizen Sentiment Dashboard (SCSD) project, the archaic perception vanished and the light and dynamic sun bursts rushed across the façade adding an organic structure onto the building's façade.

5. CONCLUSION

In this paper we have introduced the notion of media architectural interfaces (MAI) and reported on a study, in which we designed, deployed and observed an MAI in an urban space. We observed people interacting with the TUI and looking at the media façade visualization. In future studies we aim to explore other MAIs, study their spatial relation between human behavior, the Mediator and the Carrier in a given spatial layout and eventually suggest a framework for classifying these novel interfaces.

6. ACKNOWLEDGMENTS

Our thanks to the amazing curators Marília Pasculli and João Frugiuele as well as to the incredible support by our producer Chantal Goldfinger from Verve Cultural, who invited us to work with the LED façade during the Viva Cidade Festival at the FIESP building in Sao Paulo. The installation was funded by Verve Cultural and Galleria de Arte Digital do SESI-SP, and the research was partially supported by the UCL VEIV Centre.

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