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A Case Study of Media Architectural Interfaces

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ABSTRACT

Media Architecture is uniquely positioned to merge built form and digital information, which can augment existing architectural contexts with socially relevant digital information. This paper presents a design case study to illustrate exactly how this merging can happen in the progression of a Media Architecture design process within different city contexts. By outlining the steps in the [redacted] project from design intent to realisation we will show how the objective to bring real time human emotion into architectural context influenced each stage of the design. We explore emergent interaction patterns and behaviour. The role of prototyping interactive systems, algorithm development for data visualisation, light and material interactions, structural design and site context are evaluated in terms of how they serve to merge information and built form with the social core of a busy engineering office space.

CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability;

KEYWORDS

Design Explorations, Media Architecture, Interaction Design, Data Visualisation, LED lighting systems

ACM Reference Format:
XXX XXX, YYY YYY, and ZZZ ZZZ. 1997. XXX: A Case Study of Media Architectural Interfaces. In *Proceedings of Media Architecture Biennale 2018 (MAB18),* XXX X. XXX, YYY YYY, and ZZZ ZZZ (Eds.). ACM, New York, NY, USA, Article 4, 9 pages. https://doi.org/10.00/123_4

1 INTRODUCTION

Recent digital technologies and interfaces such as mobile phones, tablets and the applications running on them challenge the way we maintain social interactions in the built environment, ultimately this has effects on the notion of architecture (1)(2). Responding to this, Media Architecture in recent years evolved into a field where Media Architecture is uniquely positioned to merge built form and digital information. Where the means of displaying the information (programmable LED lighting units, or LED/LCD displays) are designed into the architectural form itself (3)(4). This paper continues with the exploration into what we call Media Architectural Interfaces (MAI)(5). MAI describe the relation between people engaging with dynamic content on large electronic surfaces (i.e. urban screens or media facades) through tangible artefacts on street level enabled through novel digital technologies (6). So far we have investigated MAI on DIY displays (7), existing public displays (8) and media facades. Consequently we aimed to develop MAI where we were able to design and control the form factors of the carrier as well as the tangible interfaces. This paper presents a design case study to illustrate exactly how this merging of built form and digital information can happen in the progression of a Media Architecture design process through our iterative implementation, illustrated through two different contexts. We show how the iterations in a design project relate and respond to our initial design intent, which is influenced by both research and experience.

By outlining the steps in a specific project from design intent to realisation, we will demonstrate how the objective to bring real time human emotion into an architectural context influenced each stage of the design and relate them to emergent interaction patterns and behaviours in two manifestations of the project. The case study focuses on a design project, which produced two versions of a manifestation of Media Architecture situated in two distinctly different architectural and spatial contexts. In both situations, the so-called media architecture interfaces offer playful interaction modalities delivered through digital technology that connect social

Figure 1: The (VSC) during the light festival in 2016.

MAB18, November 2018, Beijing, China

ACM ISBN 123-4567-24-567/08/06.
https://doi.org/10.00/123_4

interactions to electronic surfaces such as urban screens or media facades. Our first project, the [redacted] (ASC), focused on the well-being of employees at a busy engineering office in London, as the design concept. The second project, the [redacted] (VSC), in Sydney, is a further iteration where the modalities have been simplified for engaging with a much larger public.

In the next section, we briefly introduce the emerging field of Media Architecture and related research, followed by an explanation of our framework for Media Architectural Interfaces (MAI). In the case study section, we describe the design process including socio-spatial aspects and map them towards our framework in a taxonomy. The results show novel interaction patterns and behaviours and give a hint towards longitudinal aspects of Media Architecture. In conclusion we discuss the implications of our results in relation to an iterative Media Architecture design process.

Figure 2: The lightweight xxx (ASC) suspended from the roof.

2 BACKGROUND

Media Architecture manifests the idea of incorporating media systems into the initial process of architectural designs by architects, interaction designers and media artists. In other words, Media Architecture involves multi-dimensional media systems from the very beginning, where electronic surfaces become part of the architectural repertoire (5). However, the content on large programmable surfaces need to go beyond commercial purposes such as dazzling advertising displays in order to sustain the purpose of a building envelope within the city creating a sense of place and an identity [1]. A growing number of initiatives are currently exploring how urban screens and media facades can be used for engaging with communities and neighbourhoods in dense cities (9)[2]. The EU-funded Connecting Cities Network [3], for example, aims to establish a global network of media facades, urban screens and projection sites to spread artistic and social content for the good of liveable future cities. Within this network, the emblematic building of the Ars Electronica Centre [4] incorporates this approach towards a museum that offers artists the platform to explore the technology-mediated future, not only within the building, but also on the outer interactive building envelope (10)(11). Within (and way beyond) the city the Ars Electronica Centre became a city landmark that forms the identity of the city of Linz.

The city can be considered as an arrangement of architectural layouts that are defined through their relationships between physical space and social life reflected in movement patterns and activities of its inhabitants (12). Social encounters can be seen as planned or unplanned gatherings amongst strangers or people who know each other. In this respect, *shared encounters* are mostly context related, and hence the types of *encounter stages* on which people negotiate boundaries of a social and cultural nature (13), and their context (such as the bus stop or museum plaza), enables various kinds of shared encounters. On the other hand, programmable electronic surfaces (media architectures) confront us with novel types of interactions between humans and technology by creating platforms for social interactions, which are mediated by interactive systems.

We have previously reflected on four existing spatial interaction frameworks (6): *Awareness Space* (14), *Actor Space* (15), *Action Space* (16) and *Physical Space* (17). These can be considered as important milestones towards an integrated media architectural design. Each framework describes the relationship between humans and their actions in the presence of programmable electronic displays and in relation to the surrounding space.

Within this line of thought we have developed the notion of Media Architectural Interfaces (MAI) describing an ecology of tangible and non-tangible interfaces together with architectural surfaces within a given socio-spatial context. They can be considered as interactive systems in urban space, which potentially entice people to step out of their habitual routine and perceive urban space through a new lens or act differently within it. In more detail, we consider MAI as the synthesis of situated and shared interfaces interwoven into the built environment. They mediate participants engagement with large programmable electronic surfaces such as Urban Screens, Media Facades or Media Architecture. Those interfaces are generally located on a street level, whereas the electronic surfaces are mostly vertical and attached to buildings or are the buildings themselves such as the case with Media Facades. Eventually, they may disrupt movement and behavioural patterns in the given spatial setting. MAI are based on the triangular relationship between interfaces, electronic surfaces and the surrounding context. Large electronic surfaces amplify participants interactions through interfaces, which depend on technical properties of these surfaces such as type, shape, material, size and resolution of the surface. The distance between interfaces and surfaces can vary, but they are strongly dependent on the given context. The context is constituted by socio-spatial settings whose properties (i.e. urban plans, functionality and design of public space) form pedestrianized places, busy high streets or transport hubs and the human activities that afford these spaces. Furthermore, when changing the properties within one of the three constituent elements (Mediator, Surface or Context) the two other elements are directly affected.

[1] A classic example of a facade that provides information to the public and eventually creates a sense of place in the city is the Casa Omenoni in Milano, a remarkable facade that tells the public something about the owner www. [accessed 30.05.2018]
[2] Screens in the Wild research project www. [accessed 30.05.2018]
[3] www. [accessed 30.05.2018]
[4] www. [accessed 30.05.2018]

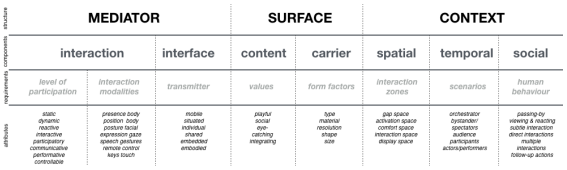

Figure 3: Table showing the initial structure that constitute the MAI framework (Mediator, Surface, Context), its requirements that describe the components and finally some attributes (5).

The properties of each constituent element are derived from the following research: the characteristics of the Mediator for the level of participation amongst have been described by Fritsch and Brynskov (18) as static, dynamic, reactive, interactive, participatory, and communicative and extended by Caldwell and Foth (19) who added the terms performative and controllable. The characteristics of the interaction modalities originates from dimensions summarized by Mueller et al. (20) and uses the following interaction modalities: presence, body position, body posture, facial expression, gaze, speech, gestures, remote control, keys, touch. This may also impact the distance between the Interface and the Surface. We argue that being aware of these properties and their characteristics will help designers clarify the nature of interaction they want to design for. The properties concerned with the Surface are mostly related to the technical details of large electronic surfaces, as described by Halskov and Ebsen (21). They consist of type, material, shape, size and resolution but also of the type of content. Each of these characteristics can impact the multi-layered spatial frameworks described above (i.e. Awareness Spaces, Actor Spaces, Action Spaces, Physical Spaces). The Context refers to an understanding of the socio-spatial settings that are core properties, when locating a MAI. As previously mentioned, there is a huge difference when designing in the context of a pedestrianized city square (i.e. the renewed partially pedestrianized New York Times Square) or for a busy boulevard that is divided by car lanes such as Oxford Street in London.

Although most of requirements aligned in the framework describe the attributes of the constituent elements (i.e. Mediator, Surface, Context) from an interactional point of view, they influence the multi-layered spatial frameworks (i.e. Awareness Spaces, Actor Spaces, Action Spaces, Physical Spaces) and consequently the MAI design space for interactions in the urban setting. Through understanding the effect of the single attributes of each constituent element on the whole interactive system stakeholders, curators, artists, designers and architects may eventually be more aware of their design decisions and their implications. We will demonstrate the MAI framework in the following design case study we have continuously worked on since 2015 and outline factors that influenced the type of emergent interaction. We focus in particular on manifestation of human emotions over time as the main driver behind the MAI display content.

3 THE CASE STUDY

This paper presents a design case study of the [redacted] project to illustrate exactly how MAI can happen in the progression of a Media Architecture design process. We designed iteratively two interactive axial symmetric three-dimensional structures in two different locations. The first structure was initiated at the [redacted] engineering firms head office in London (2015) and the second one has been realized for the [redacted] 2016 light festival in Sydney, Australia. The [redacted] (ASC) proposal was an interactive cocoon woven out of a translucent material, turning the 20-metre (65-foot) high indoor atrium at [redacted] offices into a stage for social encounter. The [redacted] (VSC), was the second full scale iteration of the ASC specifically designed to adapt to an outdoor public space during Sydneys annual light festival.

3.1 Design intentions

The design intention is categorized according to the MAI framework introduced in the previous section: design, social and spatial aspects. From the design perspective we intended to continue previous design research into electronic surfaces. Further, we aimed to go beyond the use of existing electronic surfaces such as urban screens or media facades and design our own media architecture in order to fully control the MAI constituent elements: Mediator, Surface and Context. Different to common urban screens which are flat and have a limited field of view, we wanted to design a three-dimensional electronic surface that can be equally seen and experienced from all directions. At the same time we wanted to continue our design explorations into the visualization of the interactions recorded by the tangible interface (i.e. Mediator). In previous explorations we experienced that some of our information visualization have been too hard to decipher and the use of the tangible interface (i.e. interaction dashboards) was too complicated to follow without instructions. From the social point of view, we wanted to observe emergent behaviours that evolve around the installations and whilst interacting with it. The longitudinal impact of such a MAI was at the focus of our attention as well. Our previous projects have mostly lasted for a couple of days during special events with rather superficial socio-spatial dynamics and settings (media art festivals). i.e. people are visiting a festival with a special mindset. Spatially we aimed to better understand how the different interaction spaces actually apply in the context of our [redacted] structure positioned in an office environment and an outdoor public space (civic botanical garden). Particularly, understanding where the threshold between ambient perception, direct perception, and participation lies.

3.2 Components to the design

The components will be laid out according to the MAI framework, respectively into Context, Surfaces and Mediator.

3.2.1 Context - spatial setting and social dynamics. The office building where the ASC was installed hosted a void space (i.e. atrium) in its centre and connects all seven floors through daylight and air ventilation from the glazed roof top. Our focus for designing the interaction was the ground floor as this space provides the most divers functionalities, whilst diverse social dynamics were observed - compared to the upper floors, that are mostly office

	MEDIATOR			SURFACE		CONTEXT		
structure	interaction		interface	content	carrier	spatial	temporal	social
components	*level of participation*	*interaction modalities*	*transmitter*	*values*	*form factors*	*interaction zones*	*scenarios*	*human behaviour*
requirements								
ARUP Sentiment Cocoon	dynamic interactive participatory communicative controllable	remote control keys touch	RFID card reader dashboard situated individual shared	playful, social eye-catching integrating sentiment data dynamic data visualisation animated	foil diffusion; cling wrap; 400 RGB LEDs; 20m high, diameter from 1.4m - 3.5m	gap space activation space comfort space interaction space display space	bystander/ spectators audience participants actors/ performers	passing-by, viewing & reacting, subtle interaction, direct interactions, multiple interactions, follow-up actions
VIVID Sentiment Cocoon	dynamic interactive participatory communicative performative controllable	remote control keys touch	pulse sensor touch pad situated individual shared	playful social eye-catching integrating sentiment data dynamic data visualisation animated	fabric diffusion; rip stop nylon diamond shaped panels; 6m high, diameter from 0.8m - 2.4m	gap space activation space comfort space interaction space display space	bystander/ spectators audience participants actors/ performers	passing-by, viewing & reacting, subtle interaction, direct interactions, multiple interactions, follow-up actions

Figure 4: Table showing the initial structure that constitute the MAI framework (Mediator, Surface, Context), its requirements that describe the components and finally some attributes (5).

spaces and not accessible for the public. Only one corner on the ground floor is accessible by staff and the public via the reception area. To get further into the building one needs to pass the entrance barriers (1 or 2) with a building access card. All other floors are connected through the elevators and fire stairs. The basement can be accessed through the spiral stairs from the ground floor. On the upper floors most of the atrium edges are directly connected to open plan offices, meeting rooms, kitchen and seating areas and elevators. The main flow of people is as follows: in the morning peak hours (8-10am) employees are entering the building through the main entrance and rush through barrier 1 in order to grab a hot drink or breakfast on their way to their desks. During lunch time (12-2pm) the flow of employees streams from the elevators towards the main entrance and back. Many employees use the cafeteria, which provides lunch meals. Here people are queuing towards the sofa area. Generally during the afternoon there is a good flow of people queuing for refreshments at the cafeteria. In the evening (5pm-7pm) employees leave the building again through the main entrance.

The area where VSC was erected at the intersection of several busy pedestrian pathways in the Royal Botanic Garden Sydney during the [redacted] 2016 light festival in Sydney, Australia. The VSC was positioned to both be a noticeable reference point (landmark) for the crowds continually walking by, as well as to encourage interaction via the MAI which would noticeably animate the vertical core of light within the [redacted] structure. Visitors to the Garden were given access and exit through one gate and guided along a path with several other light installations. The evening event was highly controlled by Sydney Police and private security. The close up diagram shows the main interaction zone, active observation zone, food area (passive observation) around the VSC.

The main difference regarding the Context in between the two implementations was that in the office environment, ASC atrium has been vertically arranged spaces with less of horizontal depth (field of view), this resulted in only ever seeing a portion of the ASC before seeing it entirely. In contrast, the VSC was visible through the trees from far away and nicely integrated itself into the skyline afar as well as specifically positioned at a point were pedestrian traffic was known to converge due to the food and beverage facilities. It was anticipated that a context where crowds of pedestrians would

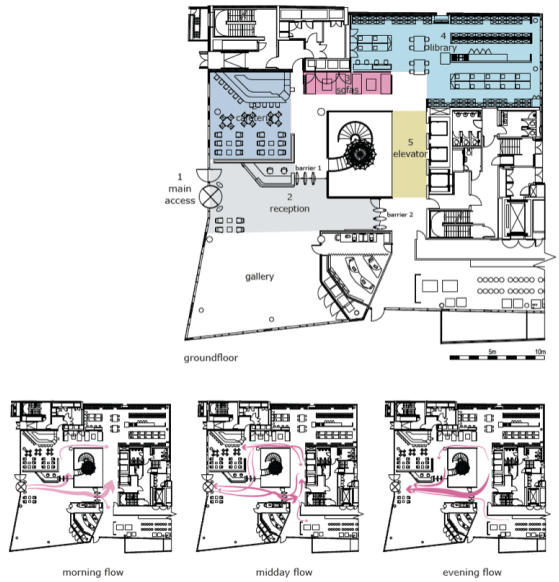

Figure 5: (left) overview of main facilities on the ground floor: The ASC is right in the centre of the atrium, 1 - main access, 2 - reception and seating area, temporary exhibition space (public access), 2 - cafeteria and seating area (behind barrier), 3 - sofas for relaxed seating, 4 - library with hot desks, 5 - elevator and staircase area, separated from the atrium through a semi-transparent glass wall; (right) visualization of the flow of people in the morning, during lunch time and in the evening.

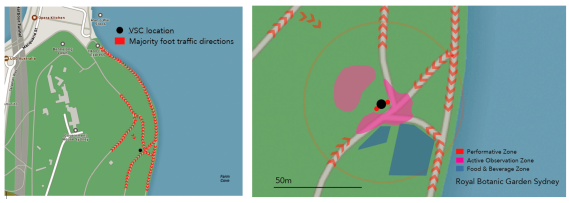

Figure 6: (left) overview of main site pedestrian traffic flow directions for the VSC, which was positioned in the Royal Botanical Gardens in Sydney, Australia. (right) site context showing 1 - traffic flows, 2 - active observation zone (in pink) 3 - performative zone (active engagement with MAI), 4 - Food and Beverage areas which caused large quantities of people to converge at the site of the VSC

be converging would be a favourable site for an iconic object such as the VSC.

3.2.2 Surface. The objective was to design a continuous and organic cocoon-like lightweight structure that would wind up through the atrium to connect all seven floors. The suspended structure of the ASC measures 20m in height and 1.4 to 3.5m in width. The 20m tubular PVC interior core is segmented by plywood disks at 1m

intervals. Each plywood disk has 10 protruding spokes creating 210 intersection points that are connected with steel cable creating a rhombic pattern and a complete structural system. The Pixel RGB LED system is comprised of four 400 node, 30 degree outward projecting continuous LED strands anchored to the core of the cocoon. Supplied by a 12 VDC power pack and Artnet control unit, the projected light passes through a special lenticular diffusion membrane before landing the partially translucent skin of the Cocoon itself. The translucency of the material created an effect whereby the suspended [redacted] generated a striking visual display of light informed by feelings. The lighting within the structure visually indicated the representation and physical location of the recorded sentiments there and therefore in the atrium space. The [redacted] structure was animated by the interactions themselves, when a user swipes her smart card and thus submits her sentiment, a white flash of light instantly illuminates the structure. This white flash of light is intended to mirror the participants presence and to make her feel like they have actually transformed their presence and sentiment into a pulse of light. The purpose of the visceral lighting response is to playfully reward participation with a moment of instant gratification, which in turn encourages further interactions with the artwork or with bystanders. Due to safe indoor conditions there were viewer constraints regarding environmental factors such as wind or rain. The nature of a monitored office space allowed us as well to neglect vandalism. The only concern we had to deal with was fire. The materials used must have low flammability and non-burning droplets properties.

The VSC measured 10 metres in overall height, it was situated at the intersection of several busy pedestrian pathways in a public botanical garden during the [redacted] 2016 light festival in Sydney Australia. New structure was developed, rather than suspending it, it had to be outdoors and ground based next to a windy waterfront in the Royal Botanic Gardens. As the VSC had to deal with all the environmental factors that an Australian winter brings (wind storms, floods, sun) a new surface that would both provide for aesthetically favourable diffusion of light while enduring the elements had to be developed. The external skin consisted of diamond shaped nylon fabric tiles (facets), which were individually positioned/ anchored to a type of diagonal grid provided for by the internal structural spokes of the [redacted] (an element which was unchanged from the original ASC). The positioning of the diamond shaped tiles within the existing grid preserved the unique curved or undulating form factor of the [redacted] shape while still providing for excellent diffusion of the light emanating from the core of the structure in the same way as with the first ASC version.

3.2.3 Mediator. At the ASC, employees sentiments were collected and materialised as light and fibre, provoking mediated social interactions through an exploration of architectural form, translucent materials and responsive lighting. Via simple *sentiment interfaces* in the form of dashboards attached to the atriums balustrade, participants were invited to meditate on and express their mood. An algorithm fed their feelings into the system before projecting them digitally into the light field that formed the spine of the cocoon. The [redacted] thus represented the feelings of everyone in the office building on any given day.

Figure 7: Iterative design process of a series of tangible interfaces: 1 - Swipe-I-Like, 2 - Smart Citizen Sentiment Dashboard, Version 01, 3 - Smart Citizen Sentiment Dashboard, Version 2, 4 - Sentiment Dashboard for the ASC installation and 5 - the Heart Rate Dashboard for the VSC; whilst 1-4 are base on RFID-card reader technology 5 has an integrated pulse sensor instead.

For the VSC the interface was modified and streamlined to capture physiological data, which could be related to a participants level of excitement by measuring their heartbeat. The lighting visualisation algorithm would translate heart rate to a colour and vertical position on the vertical core of the cocoon. Passers by were encouraged to *translate* their heartbeat to the cocoon by touching a diamond shaped Mediator which would pulse in a glowing light in accordance with the heartbeat of the participant, seconds later the same animation would appear within the cocoon and the next participant would be invited to register their heartbeat. After 10-15 seconds of active participation several animated *heartbeat patterns* would be visible all over the [redacted] structure for other passers by to take note of and refer to, after 20 seconds the MAI glowing light pulse, a live heartbeat visualisation, would turn off to indicate the interaction session had ended. The interface was a much more streamlined version of the first ASC MAI. This MAI contained an infra-red based pulse sensor that would in real time visualise whatever heart beat it was capturing (Figure 5 - right). The form factor was intentionally diamond shaped to relate visually to the individual diamond shaped fabric tiles which made up the VSCs surface. As with the ASC, to encourage interaction via the MAI, the lighting patterns would be noticeably animated along the vertical core of light within the [redacted] structure.

The in-situ interaction component of the cocoon is building upon previous research by [redacted], who deployed early *sentiment recorders* or physical situated *like buttons* (22). Known also as *sentiment dashboards* (8) these consoles could be deployed in public space to entice interaction by large scale visualisation of the interactions on a buildings facade. The intent was to not only find a way to entice users to engage with the dashboards but to meaningfully collect, visualise, and analyse the data to inform future work. With the first deployment, the ASC, the goal was to implement previous observations and research relative to the sentiment dashboards was achieved. Through the simplified dashboard over 1800 interactions were captured and visualised. One significant insight we applied to the next iteration was based upon the level of awareness users had when interacting with the dashboard. For the next iteration, the VSC, we aimed to eliminate the performative self awareness that we observed users had in previous implementations of sentiment collection dashboards.

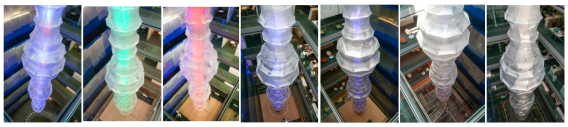

Figure 8: The translucent skin of the ASC created appealing light situations: (1) at night the whole structure glew from the inside, some visualizations reminded onlookers of jellyfish (2) (3); during the day the upper parts of the Cocoon reflected the daylight, whilst only in the lower parts of the structure the light from the core shin through the skin (4), (5); particularly on sunny mornings the position of the sun threw direct sun light onto the Cocoon and the skin reflected the light silvery.

4 INTERACTIONS

The ASC installation was running 24/7 throughout 13 weeks (from Monday 25th of May 2015 to Friday 28th September 2015). During this time the database logged about 1880 single interactions, which were recorded through six sentiment dashboards placed on different floor in the building. Many employees at [redacted], on their way to their desk, during lunch time or in the late afternoon on their way back home, either engaged directly with their RFID cards (direct interaction) or simply enjoyed the colourful and dynamic visualisation on the [redacted] (ambient interaction). According to the collected data most interactions took place after planned events in the building: the official opening of the [redacted] (June 2nd 2015), after the Show and Tell event (June 16th 2015), during the opening of another exhibition in the [redacted] reception space (June 22nd 2015) and whilst the [redacted] summer party was in full swing (July 14th 2015).

4.1 The Surface

The VSC was successful as well, in terms of interactions and the social media buzz we tracked online, the estimated passive observations were approximately 500 000 views. The installation was running for 21 days (date to date) from 8 pm until 12am all week long. In between there were severe weather conditions which destroyed many light installations, with the exception of 4 days when the installation was closed due to weather.

The focus at the ASC was on the construction of a lightweight translucent structure that diffuses and emits light from the core in a new way through innovative materials applied through a robot on site. At the same time the sun through the roof of the atrium had a beautiful effect on the translucent skin during the daylight. Hence a very important aspect of light based media architecture was fulfilled, that is an appealing day and night perception. This aim was also important for us in the next iteration. When designing the surface for the VSC, even though there were no visitors allowed to the festival during daytime, daylight was considered as a significant factor. In contrast to the ASC the VSC was structurally more thought through and the outer skin was therefore more defined through the diamond shaped nylon sailcloth elements which could diffuse both daylight and LED light an an efficient and aesthetically pleasant way.

4.2 The Mediator and Interactions

Each version of the [redacted] had unique interaction patterns, this was an intentional variation in the design and function of the dashboards. In the [redacted] (ASC), the interactions were more complicated and difficult to understand, a term is use to describe this is *feature burden* many participants did not understand the operation procedure when they approached the interaction device for the first time. For instance, we experienced people who swiped their RFID card before actually turning the dial or pushing a category button. At the same time, many people understood that their actions would trigger a lighting display but could not explain what it meant. One of our design priorities was to focus on simplicity as regards to interaction modes and the visual representation of those interactions. observation of real-life encounters highlighted the need to further clarify the interplay between dashboard and lighting design.

In the second version of the [redacted] structure (VSC) we simplified the features down to a capture device that would animate the lighting patterns according to *how* the dashboard was touched. The intent was to make the participants less aware of the actual interaction mechanics, as well as having fewer features it required less attention and understanding for users to operate, they simply had to touch it and watch for the effects on both the MAI and the [redacted] itself. However, the value of the collected information in the ASC was more useful and insightful compared to the VSC where the heart rate was just a trigger for a specific visualization, and where the reward for the interaction itself was weighted more heavily. We conducted a preliminary data analysis of the 1880 valid ID card interactions captured by the dashboards and logged on our database. The aims were two-fold: (1) Understanding how participants use the dashboard and (2) identifying sentiment patterns of group and individual behaviour. For each unique ID card that has been used, we looked at the logged data sets and extracted the specifics of the submitted sentiments (which floor, which category, and which preference to this category).

From our observations and in accordance to the collected sentiment data three different major participation patterns were observed when individuals or groups approached the sentiment dashboards: (1) Serious behaviour: This was the least frequently identified participation pattern. The participant (card ID) has submitted exactly one sentiment for each of the explored categories. And each submission recorded a different preference value (i.e. in between 0-1024). This pattern would reflect how we expected the interaction mechanism to work - i.e. a person would explore the categories by pushing one of the three buttons and would submit one sentiment for a specific preference. (2) Clumsy behaviour: This was the most frequently extracted participation pattern. The participant (card ID) has submitted the same sentiment (preference) for each of the three categories. Or the same value of the sentiment was submitted as by the previous user. The occurrence of this pattern can be explained with our frequent observation of participants holding their card over the RFID reader only without having pushed any of the category buttons. This behaviour might be due to a usability flaw of our installation - the participating person did not realise the effect of her participation in the visualisation, hence tried several times. (3) Playful behaviour: The participant (card ID) has submitted several

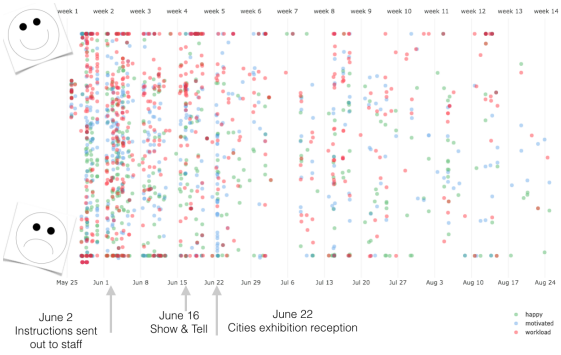

Figure 9: The above chart clearly shows that there were more interactions on the dashboards throughout the first 5 weeks. The plotting of the interactions also visualize peak events such as the Show and Tell event.

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 visualisation work. After eliminating the repetitive submissions, we extracted the distribution of submissions across the three categories. The category *workload* was the most popular (35 percent) of all submissions, followed by *motivation* (33 percent) and *happiness* (32 percent). While we cannot account for representative polling results, the findings indicate the installation fulfilled its intentions as a public feedback platform, where people engage meaningfully with their sentiments. Besides the data captured through the TUI device we observed interactions around the Cocoon 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 behaviours. In particular, we frequently saw people taking pictures of the installation with their mobile phones or taking pictures of each other in front of the [redacted]. In addition we observed [redacted] employees introducing the [redacted] to their clients when they are visiting the building. These informal observations would suggest that people liked the Cocoon and the visualisation it used. With the [redacted], the rate of direct interactions with the [redacted] dropped considerably after five weeks. A reason for this could be that many users now seemed to understand how the cocoon worked and might have become tired of it. The data sets suggest that this started after week five of the deployment. Besides the data captured through the Sentiment dashboard, we observed interactions taking place around the cocoon. Although these observations were not rigorously conducted, we did notice a few recurring behaviours. We frequently saw people taking pictures of the installation with their mobile phone. Occasionally, employees introduced the cocoon to visiting clients when they met at the reception.

4.3 Observations

Although the direct interactions with the ASC through the interfaces dropped significantly through the weeks, we observed that yet occupants got quite accustomed to the large light structure in the centre of their building. During the installation phase, people were suspicious at the beginning stages. Seeing a construction site in the middle of their work place, they became curious about the small structure that continuously grew towards the skylight day by day. We remember closely the Monday morning after we completely dismantled the [redacted] during the weekend. It was a typical rainy day in September and people immediately noticed that their Cocoon was gone and a vast void was left behind in the atrium. Employees got used to their sentiment architecture.

With the [redacted] there were thousands of interactions and we observed just under one hundred of them first hand. In a large majority of interactions users would not understand what effect they were having other than altering the lighting pattern of the [redacted] which brought them great joy in most cases and displays frustration in some. Two key observations from both versions of the [redacted] are that users see the interaction framework as a game framework. With the [redacted]n we observed that users would turn the dial to simply place light pulses on the vertical line of the cocoon in a position they found visually appealing. In the second version of the Cocoon users would tap the hand sensor on the dashboard harder and harder assuming the impact would change the visualisation, when some users learned the dashboards were reading their hear rate, they would run in place in an attempt to alter the patterns of the animated light emanating from the core of the [redacted].

5 DISCUSSION AND CONCLUSION

The main contribution of this paper is demonstrated through an extended exploration of the MAI framework and its validation through a design case study in various contexts. The framework combines results from research in the field of HCI, particularly public displays, and interaction design with the focus tangible and embodied interfaces and media facades coupled with architectural research on the role of the built environment in enabling shared encounters.

The framework has been applied and tested by us iteratively in various projects and adjunct research. In this paper, we validate MAI usability exemplary with our latest project the [redacted]. The aim of this framework is to provide a practical guide for the design and implementation of media architecture.

To date, the [redacted] has been manifested in two significant versions, each of which has successfully responded to variations in spatial and social context, performance requirements and available resources. In each version the original design intent has adapted to the changing circumstances through building on our previous experience combined with a balanced application of known research in the field, iterative designing along with a prototyping process tested and modified in relation to the MAI framework.

In particular, the [redacted] delivered novel insights regarding the longitudinal impact of Media Architectural implementation on the socio-spatial Context. Initially the novelty of the MAI led to large popularity amongst building occupants, after five weeks of implementation the input data was abating and levelled off to a constant low. However, [redacted] employees expressed disappointment when the illuminated 3D Surface was gone. It seems that the presence of the large atrium, filling structure, with

its lighting was more dominant and hence more significant than the fact that there were interfaces in places that would allow employees to voice their opinion about well-being in the workplace. This raises the question whether the buildings occupants understood the installation as a nice playful ambient installation rather than a medium for negotiating boundaries of social and spatial issues. We argue that this MAI with its components proved satisfying on different levels: the media architectural structure itself (the illuminating Surface) raised awareness and was well perceived, the light visualization, although mostly perceived from an ambient perception, many people were curious to get to know the concept behind the colours in motion.

The Mediator was successful in terms of enabling the discussion around the release very personal and intimate data - such as human emotions - in an highly competitive work environment where one may expect that complaints about personal happiness, motivation and workload would be kept secret. Finally, the fact that we were able to bring such an installation in the centre of the workplace of one of the biggest employers in London to observe how this implementation affects the flow and potentially the performance of people, the types of encounters at communal areas such as the cafeteria, the entrance hall or the waiting area in front of the elevators - or within. Although personal data was the input in both iterations of the case study, when comparing this data there were some noteworthy differences. Specifically, the ASC was more of an opinion poll where people *intentionally* and actively reported various aspects that the tangible interface interrogated through the use of another medium (the RFID card) whereas the VSC manifested physiological data visualisation of people who implicitly and directly interacted with the tangible interface through touch.

Regarding the social significance of the data embedded within the architectural context: the ASC with a very deliberate data visualisation and collection of sentiments proved to be interesting to the office management in what it could deliver, many office workers many office users did not fully understand. VSC visualisation, on the other hand, seems more chaotic and the (individual) input was generated *unintentionally* through physiological data. Which one is more socially relevant? And according to which criteria this could be defined? One could say each instance adapted to its context very well: the ASC, and according to the initial aim, helped reflect on feelings manifested in that space, whereas the VSC, and as people were able to perceive it from the distance and move slowly towards it and stand very close to the illuminating structure, it felt big, fun, engaging, and helped relieve tensions of the crowd.

Finally, coming back to our initial argument, media facades and architecture need to go beyond the mere background for spamming the city with commercial or spectacle content, in order to stand out, sustain and add value to our cities. In fact, we strongly believe that media architecture need to become the canvases for citizens to reflect the experience of the city back to itself, and to negotiate what their city life may look like. The MAI framework has established a structure (Mediator, Surface, Context) that is described by its components (interaction, interface, content, carrier, spatial, temporal, social), the related requirements (level of participation, interaction modalities, transmitter, values, form factors, interaction zones, scenarios, human behaviours) and attributes. As the scope of urban interaction design and research changes to respond to the city scale and context, previous Media Architecture research such as the City Bug Report (24) that used a large scale design case as a facet of the city, has raised questions about prototyping and what to prototype *the technology, usage, adoption, quality, aesthetics or the usability?*. According to the authors argue there is a need to expand the initial call to target the planning system (25) and to start prototyping *policy, challenges and implications with the aim of providing insights, not only around the media facade, but also for the strategic level within the city.*

We believe that targeting city managers and municipal department heads needs to be augmented with a detailed understanding and active explorations of the sensory and embodied dimensions of urban space and urban interactions, for it to take into account the city scale and to be able to respond to all its complexity and varied interactions. Our explorative research intends to support this endeavour ad offer material for stakeholders, curators, artists, designers and architects to be more aware of their design decisions and their implications through the application of the MAI framework. The application of this framework can raise practitioners awareness to the components needed, requirements to look at, and attributes that could be applied to define their initial design intent, complete their design concepts or to double-check design proposals.

A nicely designed media facade will become a useless investment and a clutter without a strong narrative for the interaction and its content that needs to be adapted to a given socio-spatial context. Developers, architects and interaction designers may realise that designing for media architecture means to find design solutions to each component, the Mediator-Surface-Context framework, in order to create sustainable architecture.

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ACKNOWLEDGMENTS

The authors would like to thank XXX for nothing. Thank you, thank you, thank you!

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