Using Embodied Audio-Visual Interaction to Promote Social Encounters Around Large Media Façades

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ABSTRACT
In this paper we describe the design of a large-scale interactive light and music intervention on a corporate high rise building and its surrounding urban area. Designing for interaction with media façades has traditionally posed challenges regarding proxemics, scale of the augmented architecture and placement of interactive spaces. With the increasing availability and affordability of interactive technologies, factors such as playability and tangibility are assumed not only to be present but also to enable richer collective experiences. We propose a new approach for interaction with large media façades employing embodied audio-visual interaction at the floor level. That way, the floor level serves as proxy for interacting with the media façade whilst facilitating social encounters. We discuss aspects considered during different phases of the project development and derive principles for connecting zones of proxemics, promoting encounters by distributing the performance, designing for urban activation and isolating implementation concerns.

Author Keywords
Interaction design; media façade; urban computing; social technology; natural user interfaces; generative music.

ACM Classification Keywords
D H.5.2 [User Interfaces]: Interaction Styles; H.5.2 [User Interfaces]: User-centered Design; I.3.6 [Methodology and Techniques]: Interaction Techniques.

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INTRODUCTION
As responsive environments [13] become more and more commonplace, it is possible to observe a paradigm shift in the way that people perceive interaction with their surroundings. Technology can be found and carried anywhere and any space becomes, as a consequence, a potential portal for information access and exchange, changing the nature of social interactions. Public spaces, in particular, acquire a new layer to their traditional roles as transit hubs and congregational venues: through technology, they become more malleable and dynamic, with their principal purpose shifting depending on the context and the characteristics of the public visiting them.

Designing large urban interventions with digital technology – particularly involving media façades – has proven to pose recurring challenges [6]. Notably, when the intervention is driven by the goal of activating an existing public space with a temporary programme, issues associated with the integration of technology into the existing architecture and its surroundings, as well as the implication to the local social dynamics, must be looked at with greater attention. Previous research in the area [8] has demonstrated that proxemics [10], scale of the display in relation to the interactive spaces and the spatial layout of the site [11] are key in determining how members of the general public approach and engage with the intervention and interact among themselves.

In this paper we present the design concerns that guided us during the elaboration and implementation of *Solstice LAMP* (Figure 1), a large-scale interactive light and sound installation conceived for the 2013 edition of Vivid Sydney, an annual public winter festival in Sydney, Australia. After presenting an analysis of previous research on media façades and responsive environments, we explain the project background and how that influenced some of the decisions we took during the design process. In particular, we discuss the factors that led to our strategy of creating a proxy for the interaction with the media façade in the form of embodied interactive zones [7] at the floor level and how that helped to spark shared encounters [8, 9, 19]. We then

proceed to discuss our research and testing approach based in isolating concerns between floor and façade projections and how that benefited the overall implementation. Finally, we present findings from our observations of how the public approached and engaged with the work, and discuss the findings in light of our original design goals.

RELATED WORK

Dalsgaard and Halskov [6] compiled a list of challenges commonly encountered during design of urban media façades. Among those, they mentioned: the integration of technology into physical structures and their surroundings; catering for the wide (and occasionally unexpected) range of situations unfolding in the public space; designing content that is appropriate to the medium; and (particularly relevant to our own research) the fact that the introduction of new technologies often disrupts and transforms social relations and protocols in a manner specific to the location. Fischer and Hornecker [8], building on their extensive experience exhibiting interactive urban screens in a variety of public spaces, expanded such analysis into a framework for spatial design of urban interventions with particular focus on promoting shared encounters. Taking into account the social use of the space and the existing structures of the surrounding built environment, they proposed a classification of the spaces around the façade according to their social affordances. Such a framework can assist with the analysis of a site prior to the intervention and inform the design in regards to promoting social encounters facilitated by digital technology.

Schiek et al. [19] drew upon Goffman's work on social behaviour [9] to explore the concept of *digital encounters* as "ephemeral form of communication and interaction augmented by technology". In particular, they studied the effects of augmenting architecture by embedding temporary non-traditional user interfaces into the built environment and how that could facilitate shared interactions. Their *LEDs Urban Carpet* [3] consisted of a walkable grid equipped with pressure sensors and LEDs that, when walked over by pedestrians, would light up as a flock of seagulls. They documented a pattern of behaviour in which participants shifted their reactions from curiosity to awareness of the situation, an engagement with the new environment, feelings of immersion, and finally engaging socially with other participants via the augmented platform.

Other studies confirm such notion that social interactions can be facilitated by installations promoting playfulness coupled with a smooth learning curve. Hornecker and Stifter [12] conducted a detailed analysis on the effects of interactive installations in a public (albeit indoor) space. Invited to evaluate the flow of visitors through a science exhibition that mixed traditional and interactive works, they combined quantitative data with qualitative feedback from field observations and semi-structured interviews to rank factors such as length and intensity of interaction with each work. Based on the collected metrics, the study revealed the great appeal of installations that encourage easily learnable interaction and enable conditions for group play.

Embodied technology has been described as technology that is invisible for the users and allows them to rely on the supporting infrastructure for the fulfilment of their tasks [20]. Lino et al. [13] explored the notion of responsive environments as the ability of embodied technology to redefine the social functions of a space by broadening and dynamically adapting the dialogue between people and their surroundings. In particular, they point out that interaction

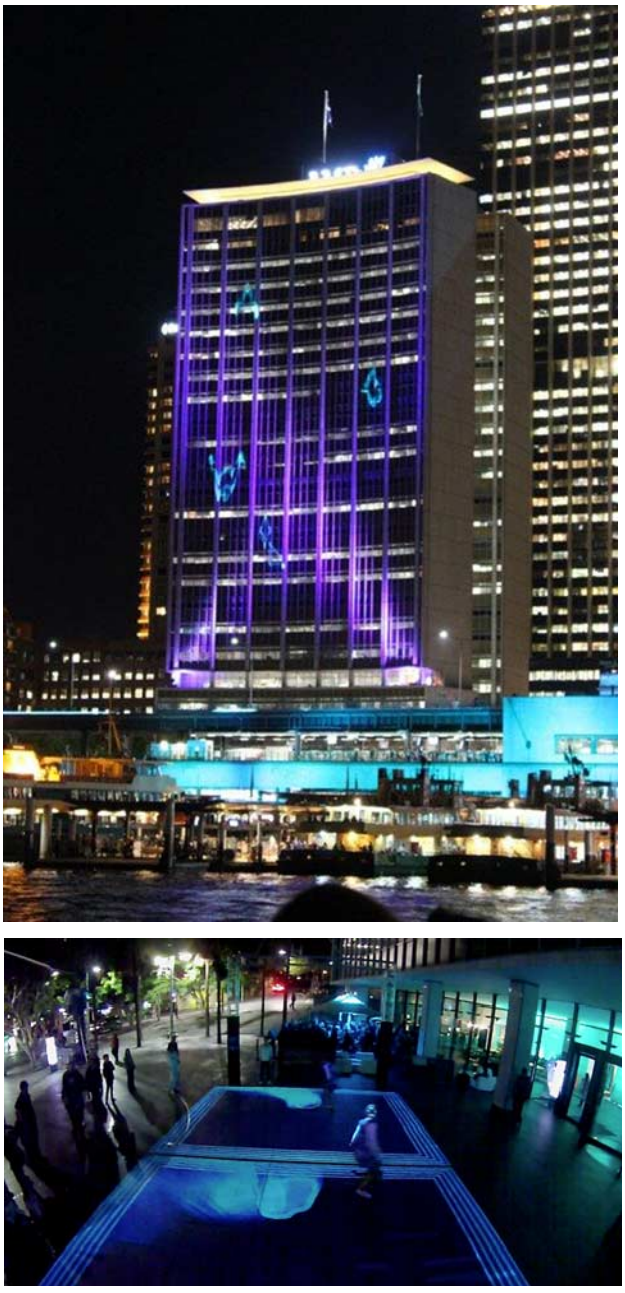

Figure 1. ***Top:*** **Laser animations on the building façade.** ***Bottom:*** **interactive spaces projected on the building forecourt floor. Photos courtesy of Nathaniel Fay.**

through embodied technology can create enough intimacy to allow users, even in public spaces, to spontaneously interact with the surrounding environment and have the experience that they are not manipulating a system, but reality itself. In this paper, we build on that concept and use the term *embodied interaction* to describe interactive experiences that make use of body reflectors [5] and physical affordances. Those are characterised for being non-cognitive, immediately learned and by feeling intuitive.

From an interaction design perspective, existing media façade installations mostly fall into three main categories: (1) targeting individual interaction, such as *Spread.gun* [8]; (2) targeting simultaneous full-body interaction by a small number of people, such as *Aarhus By Light* and *The Climate Wall* [6]; or (3) targeting simultaneous interaction by a potentially large group of people using handheld devices, such as *SMSlingshot* [8] or iRiS [21]. Installations addressing simultaneous full-body interaction with the façade by a large number of people – therefore promoting multiple digital encounters – are a rare occurrence (*Body Movies*, by Rafael Lozano-Hemmer [14], being a notable example). We perceive this as a challenge potentially overlooked by the current research in the field and argue that embodied interaction represents an effective option in addressing such a challenge.

PROJECT BACKGROUND

Solstice LAMP was commissioned by the University of Sydney, the government of New South Wales and the Amplify Festival. Amplify is Australia's largest open corporate business innovation platform and it is organised by AMP, one of the largest financial corporations in Australia and New Zealand. The Amplify Festival is a partner of Vivid Sydney, an annual public winter festival in Sydney, Australia. Vivid Sydney is held every evening, after dark, for a three-week period. A strong focus of the festival is to encourage the development of interactive light installations that allow the general public to experience their city in an unusual and playful way. In 2013 Vivid Sydney displayed more than 60 light installations and attracted almost a million visitors.

AMP occupies an imposing 125-metre skyscraper in Sydney's Central Business District. Our original design brief, as presented by the Amplify Festival, was to transform the tower into an interactive musical instrument, effectively enabling the audience to 'play the building'.

CONCEPT DESIGN AND RATIONALE

We set up a multi-disciplinary team consisting of interaction designers, composer-musicians and software developers to collaborate on the ideation and execution of a creative solution to the brief. The core concerns guiding the concept design were: (1) individual and crowd interactivity to animate the open and underutilised public space; (2) amplification of the interactions though the high visibility of the tall building façade; and (3) interactive musical generation unified with visual feedback.

Interaction Design

The interaction design was strongly determined by the contextual constraints around the installation – more specifically, *situation* and *location*. Situational aspects derived from the fact that the installation would feature in a prominent public festival spanning several nights and would therefore compete with the other attractions for the public's attention. In addition to that, previous editions of the event revealed that many evenings a very large audience should be anticipated. Due to the outdoor winter environment, we could not expect potential participants to linger for long before moving on to other sections of the festival. The interaction mechanism therefore needed to be not only easily learnable, but also *immediately perceived*. That factor, coupled with the increased demand for robustness in urban installations (and consequent concern with vandalism, theft and damage of equipment) [6], suggested that individuals should be able to walk into the space and immediately start interacting, thus participating in the collective creation just through their presence.

Our subsequent design consisted of surrounding individuals with projected halos as soon as they entered the space, which effectively cast shadows of blue light from above, following each visitor in their movement through the space (Figures 3 and 6). The halos were blobby shapes which became deformed in response to people's body movements. If two people got close enough to each other, their two halos would merge into a larger shape surrounding both of them; additional participants would grow the collective shape even further. Conversely, if people then walked apart their shapes would separate accordingly. Such a mechanism was satisfactory for providing immediate visual feedback to the participants, while also clearly conveying a sense of individuality and personal control over the interaction: effectively, each participant was able to carry their own visual personal interactive space around, as well as readily identify those of other participants in the surrounding space. Designing an embodied interaction space at floor level also helped to address the imbalance between its scale and that of the massive media façade [8]: although the viewing angle of people interacting in the forecourt would prevent them from watching the animations over the whole façade, they would be rewarded with a highly engaging 'localised' experience.

Interactive Musical Composition

Just as visual cues were direct manifestations of the interaction, audio feedback needed to be immediate and tangible enough to plausibly convey the experience of 'playing' the space as if it were a musical instrument. On the other hand, each participant was naturally free to move across the space as they wished, often in ways that could not be controlled or anticipated. The musical interaction

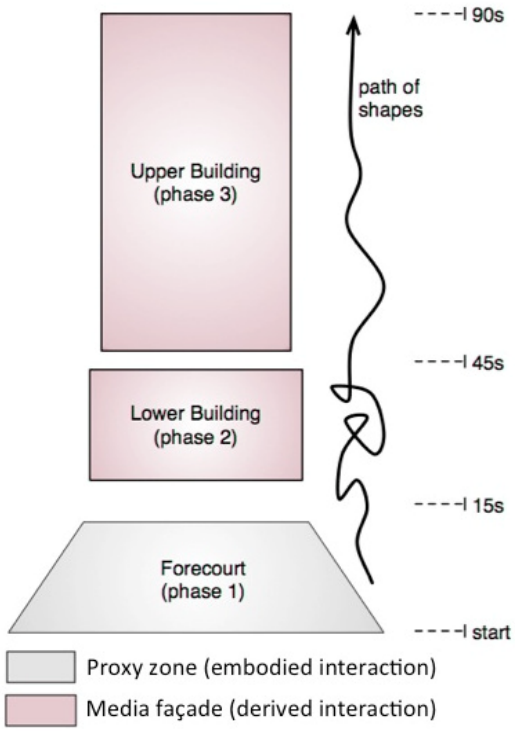

Figure 2. Movement of shapes upwards the building façade after being launched at the end of each interactive cycle.

design was thus guided by the need of balancing personal autonomy as an individual engaged with the installation, and the compositional structure imposed by the system.

The solution we developed to address these concerns was to conceive the sonic interaction as a mechanical wind-up music box: in this way, participation could embody an individual's natural movement, and melodic sound patterns would be controlled by the speed at which an individual moved. This approach ensured that each participant would both have a sense of autonomy and connect with the work by producing not only their own unique shape, but also an original melodic iteration.

Generative Media Façade

In order to extend the interactive experience to the entire skyscraper, it was important that the visual and auditory effects generated by people at floor level were reflected on the building façade. Given its scale – highly visible from a long distance across the city harbour – it was desirable that projections had a significant visual and sonic impact. However, applying to a large skyscraper the fast changing visual effects corresponding to those immediately generated by participants in the forecourt could be too erratic and obscure to be sustained for a prolonged period of time and potentially too disruptive to the city centre's skyline.

The solution we devised to address the challenge of developing content suitable to the medium [6] involved breaking the interaction down into two stages: (1) a direct audio-visual interaction taking place at floor level (Figures 1 and 2, bottom), and (2) slowly unfolding pre-rendered animations projected on the building façade (Figures 1 and 2, top). The latter were designed with enough variability so that they would seem to be determined by the events taking place in the forecourt, which therefore acted as a proxy for the interaction of people with the media façade (Figure 2). To achieve such effect, we decided that the light shapes originally assigned to people on the forecourt would eventually get detached from them and, for a short period, evolve independently – travelling from the floor up across the building façade and eventually disappearing from its top. The projections on the building façade would therefore echo the presence and actions of people in the interactive space below but would unfold at their own pace. Similarly, the façade animations were each assigned a unique soundtrack. The scheduling of the entire interaction and projection sequence was worked out to form a coherent musical progression.

We devised a schedule to control the process of *launching* the light shapes from the floor into the façade and then up (Figure 2). Every minute, a snapshot of interactive space would be taken marking the number of shapes then present, as well as their positions and sizes. A series of events would then get triggered: (1) the pre-rendered façade animation best matching such configuration would be selected from the pool (Figure 3, top left); (2) the floor interaction would temporarily be suspended at the "launching moment" (Figure 3, top right); (3) the floor shapes would gravitate towards the building with their original voices replaced by a continuous audio transition indicating such migration; (4) upon reaching the building, the shapes would transition seamlessly into their matched shapes on the lower façade (Figure 3, bottom left); and (5) after a few seconds the floor

Figure 3. Stages of the work exhibited at the festival.

interaction would resume, simultaneously with the animations on the upper façade (Figure 3, bottom right).

A cycle consisting of public interaction, snapshot of the audience, launch of their light shapes onto the building and play of façade animations was therefore continuously repeated, marking the rhythm of the installation and emphasising the music box metaphor. We also made the luminous shapes fill progressively with light, going from hollow outlines at the start of the cycle to increasingly solid shapes towards the launching moment. With that, we intended to give participants clear feedback about the duration of the cycles.

With simple rules, we therefore established a framework of evolving visual and auditory complexity whose outcomes were highly determined by the visitors playing live in the public space. The installation, organised in layers, would start from an audio-visual section for embodied interaction on the building forecourt that, in turn, would continuously feed a more structured section at the building façade.

IMPLEMENTATION

Both the conceptual solution and specific constraints of the site's physical architecture dictated decisions about the implementation of the work. Such decisions referred to (1) technology; (2) spatial design of the installation; and (3) strategies for user testing.

Technology

In order to track people's movements in the space and project luminous shapes around them, we coupled depth-view cameras to large-venue data projectors and hung them from a truss structure above the audience. Given the size of the expected audience and to avoid people having to spend too long waiting for their turn, we decided to double the interactive area by having two camera/projector modules – and hence two zones – available side by side. The two camera/projector modules were connected to a controlling computer running the tracking software, while a second computer controlled the audio and the façade animations. Due to the large vertical extension of the façade, traditional data projectors would need to be extremely bright – and therefore expensive. Instead, we investigated laser projectors as a more cost-effective solution.

Spatial Design

The chosen site for the installation posed some peculiar challenges. Although a reasonably large space, the forecourt in front of the AMP Building was occupied by a variety of street furniture and shops (Figure 4). Our concept demanded that we positioned the interactive zones as close as possible to the building, in order to maximise the illusion of the shapes moving from the floor towards the façade. Given the constraints of the built environment, the most suitable space was the area near the façade itself.

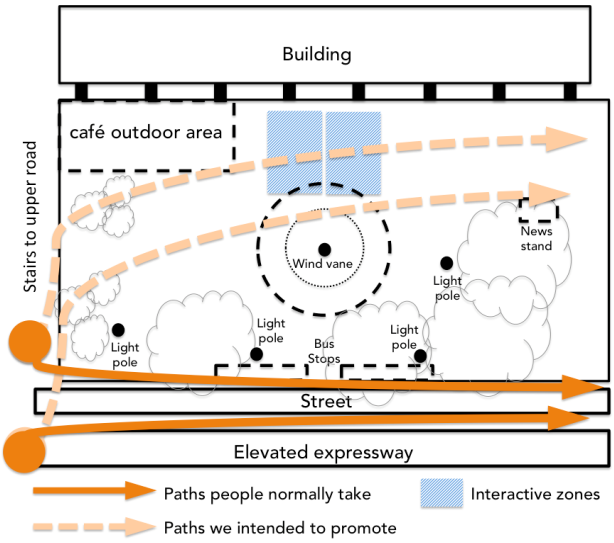

Figure 4. Installation site plan. Arrows show the intended diversion in the audience flow.

While close to the building, the interactive zones were also relatively far from the main flow of people, which at that location tends to get concentrated along the street fringe. Figure 4 illustrates the typical flow of the general public in that space, contrasted with the scenario we proposed to achieve through our design – in the terms of the framework proposed by Fischer and Hornecker [8], a very large activation space we needed to work with. For that reason, we aimed to make the "invitation to play" [18] more pronounced so that people could perceive the space as interactive from a distance and feel tempted to explore it further. We addressed this concern by framing the interactive zones with thick projected boundaries, clearly delimiting where the space would "come alive" with the participants presence (Figure 3, top). To enhance their attractiveness from a distance, we also made them fade in and out every second, like beacons.

User Testing

As Wiethoff and Gehring [21] point out, given the wide exposure of media façades, testing them before their official launch is difficult since any testing procedure is already visible to a large audience. Likewise, the logistics involved in setting up the structure for the actual installation on site – implying rigging activities, equipment rental (and therefore extra costs) as well as more rigorous approval cycles imposed by the façade owners – make integrated tests with all components in place virtually unfeasible prior the installation date only days before going live.

In order to overcome such limitation, we adopted a solution similar to the one presented by Wiethoff and Gehring by creating a small-scale prototype of the laser projections on the building façade. To that end, we developed graphic animations projected on a whiteboard with a regular data

projector, their size corresponding to a scaled down version of the actual building façade. Figure 5 illustrates the scaled-down prototype, showing shapes transitioning from the proxy zone (represented within the electronic display) to the building lower façade (white rectangle in the whiteboard projection). In addition to test and tune the scale of the interactive spaces in relation to the local architecture, the other core concern of the prototyping sessions was to ensure synchronicity between the shapes leaving the proxy zone at the floor level (to be rendered, in the final system, as data animations projected on the building forecourt) and those entering the building lower façade (to be rendered, eventually, with laser projectors). In that regard, we found that our proxy-based approach to the interaction design also proved itself highly beneficial, since it provided a well-defined interface between the two animation stages (floor and façade), allowing us to achieve a clear isolation of concerns: the façade animations were not created directly by the participants, but instead triggered in response to their relative positions while interacting with the work at the floor level, as captured at the "launch moment" – and those could be easily simulated. Separation of concerns, in turn, not only enabled parallel development of both modules (speeding up the overall implementation time) but also created conditions for the tests of the direct interaction with the floor projections to occur separately to those of the façade animations and to the generative music composition without compromising the accuracy of the final integration between the various parts. The prototype displayed at Figure 5, for example, did not require actual participants creating the shapes on the floor (and the inherent complex setup of overhead infrared cameras and projectors); rather, we developed a mechanism whereby we could record such interactions once, at a previous session, and then replay them later multiple times, effectively simulating audience participation for the purposes of integration tests. Likewise, the interactive music composition, being determined by the shapes sizes and positions, could also be seamlessly added or removed. Such a solution was instrumental for the feasibility of testing our interaction in the lab environment.

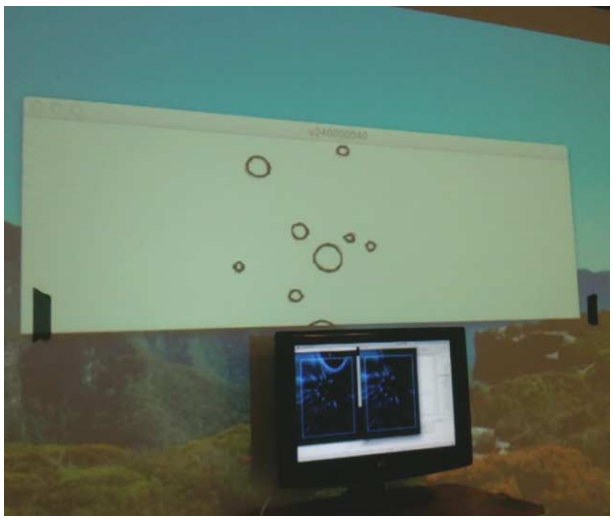

Figure 5. Small-scale prototype for integrated tests.

When developing for media façades, however, it is crucial to gather user feedback regarding the interactive experience iteratively during the design process [21]. Once again, this was facilitated by our modular multi-zone interactive media façade design. By isolating the concerns through a well-defined interface, we could also structure test sessions for the full body interactions at the floor level with complete independence from the actual media façade. For that purpose, we carried out multiple day sessions in theatre rooms, where we could more easily rig cameras and projectors up to the desired height above the stage area and readily fine tune the system based on the direct feedback of participants. This process also allowed us to evaluate how social encounters occurred and unfolded as a consequence of group interaction within the space, besides providing recording of interaction data for integration tests such as the one depicted on Figure 5.

EVALUATION AND ANALYSIS

The festival context where the installation was deployed into implied unrestricted access to the interactive zones at all times. Likewise, one of our core research drivers for this study was to gain insights about the impact of our proposed proxy spatial configuration into the local crowd dynamics. Of particular interest was observing how such layout could help us address some of the challenging aspects of creating public interactive media façades as pointed out by Dalsgaard and Halskov [6], more specifically: the integration into physical structures and surroundings (Challenge 2), diversity of situations (Challenge 6), transforming social relations (Challenge 7) and emerging and unforeseen uses of places and systems (Challenge 8).

Those contextual constraints and research foci discouraged us from running traditional user sessions and interviews during the period the work was on, in the interest of maximising ecological validity. To evaluate the effectiveness of the design solution, we therefore decided to adopt a highly qualitative approach, gathering field observations at different hours and days of the week during the duration of the festival. Observations were taken from different spots in and around the space during 2 hours each night for 12 of the 18 nights of the event. The fluid nature of the space and continuously large crowds made it impossible to accurately count the number of individual participants observed, though we estimate a minimum of 250 participants during the 2 hours each night we conduct the study in the field. Additionally to visual observations, we also recorded 16 short videos of the projected image created by our software; our intention was that the movement of the shapes in the videos could give us a "birds-eye view" of how participants occupied and moved across the space, and further inform us about the crowd dynamics. Anecdotal feedback (mostly in the form of

spontaneous remarks from participants and other observers) was also taken into account.

In particular, we attempted to identify, through repeated observation, emerging patterns of people's behaviour while they approached the interactive space and played within the space, as well as how they interacted with each other while in the space. For each of those situations, we sought to notice demographic factors such as age group (particularly adults versus children), whether participants arrived to the space alone or as members of a larger group, and how occupied was the space at the particular time of their interactive experience. We then analysed the results in light of our design concern of using the interactive floor zones to connect the façade to the periphery of the space while promoting social encounters throughout the space.

Behaviour approaching the interactive space

Perhaps as a consequence of the very large activation space [8], some visitors expressed that the connection between the two sections – forecourt and façade – did not appear to be sufficiently clear from a distance. Also, when few participants were in the space (e.g. beginning of the week or rainy nights) people walking closer to the street often failed to realise that an interactive component was available; second, people could be observed at the periphery of the space taking photos and making videos of the building without necessarily getting any closer. Once attracted to the space, however, they were quick to start playing. Those who chose not to participate consistently respected the projected lines on the floor delimiting the space. The gap space [8] separating the two zones, on the other hand, did not seem to deter participants crossing from one side to the other: the two zones were naturally approached as a continuous interactive area.

Figure 6. Common gestures by participants.

Behaviour within the interactive space

Soon after starting to interact with their digitally projected outlines, people were able to make the connection between the visual elements on the floor and those on the façade. People pointed to the building as the shapes transitioned up, sometimes commenting that they were following their "personal" bubble amongst the others. In contrast, the connection between the individual visual shapes on the floor and the corresponding musical sounds produced was not so clear when a high number of people were interacting with the work, as was the case most of the nights (8 out of the 12 observed): with multiple sounds already playing, it was difficult for new participants entering the space to distinguish the new melodies produced by their presence. The musical interaction was much clearer, however, when the space was less crowded.

When observing adults playing in the environment, we could notice two distinct types of interaction, depending on how many other people were around. When the space was already full of other people by the time they start interacting, adults tended to demonstrate restrain and self-consciousness, performing less expansive body movements and only tentatively exploring the interface (Figure 6c). On the other hand, when adults found themselves alone in the space or when they engaged with the work as part of a large group of friends – in other words, when their familiar circle was larger in proportion to the rest of the audience – they felt more liberated to try expansive movements like dancing (Figure 6d), jumping (Figure 6e) or even running around. The installation also struck a strong engagement with children, who would generally start playing as if they were in a playground space (Figure 6a). Families and groups of friends would quite naturally engage in collaborative play. Observed examples included parents exploring the interface and then explaining it to their infants (Figure 6b), and groups of young adults improvising some quick choreographed dance.

Social encounters

Striking differences between the behaviour of adults and children within the installation could also be observed in regards to the level of social interaction between participants. Children would engage in natural play with other children in the space, even if not previously friends with them, using the luminous shapes almost as "toys" and inviting others to play together. Clearly, the play was mediated by the embodied technology: while no physical barrier was used to delimit the space, children respected its borders regardless. Social interaction between adults was

much more restrained. Most adults frequented the space as part of small groups and tended to cluster together with their acquaintances. In many occasions, particularly in peak hours when the space got crowded, it was not uncommon to observe participants apologising to strangers for "invading their bubble" when they accidently got too close together causing their shapes to merge. To a certain extent, the projected shapes worked as if *delimiting personal or group space* and mixing it with the space of others was perceived as some sort of social transgression – akin to bumping into someone on the street. Nonetheless, it served the purpose of sparking conversation and social interaction between people who would otherwise hardly had approached each other.

Encouraging social encounters through embodied interaction and playfulness with light and music was, as described, one of our core concerns from the outset. Levels of social interaction [15] varied greatly with contextual conditions, particularly distance from the media façade and number of participants in the environment. A shared awareness of the façade animations united people observing from the periphery of the space, while visitors to the forecourt all shared the unfolding of floor animations. They also watched the other participants in the space, who were effectively turned into public performers. Occasionally, this social dialogue would evolve into collective action, with groups joining forces in spontaneous creative collaboration. As in similar media façade settings [4], however, most interactions in the space were part of larger social relations, with people seldom reaching out to others outside of their pre-existing social groups. Children were the notable exception, breaking the pattern in two ways: they not only easily integrated with each others regardless of previously existing social relations, but often in the process initiated conversation and collaboration between their respective parents around the digital installation.

Perception of proxy zone and façade

The low learning threshold designed for the interaction mechanisms can be regarded as highly successful. Once engaging with the installation, people tended to stay in the space for many minutes, immersed in playful social experiences. The festival environment, with more than 60 installations available to the public, can in a way be compared to open-air museums: early success experience is crucial, as the first few seconds determine whether a user continues or turns to competing objects of attention [12]. Our design was also conducive to creative appropriation and play, entertaining for groups and encouraged bodily movements. From a usability perspective, the audio and visual effects adopted for indicating to participants the transition between the animations from the floor to the façade were clearly effective. Most people understood the recurring launching mechanism and, once shapes detached from them, would wait for the interaction to resume, sometimes suspending any other movements. On the other hand, the visual progression from empty to filled shapes

Figure 7. *Left:* Proxy interaction zone at floor level and building lower façade. *Right:* building upper façade.

appeared to be less effective as a cueing mechanism, with some participants not perceiving when exactly the shapes would launch from them towards the building.

Perception of proxy zone and periphery of the space

The lack of perception about the forecourt interactive section by some people walking along the periphery of the space was expected due to the obvious diversion of the projections on the façade, a much more prominent focal point [11] from that perspective (Figure 7, right). However, the effect of visual cues at the floor level was greatly diminished by intense glare from other light sources in the environment – e.g. the building foyer (Figure 7, left), which were only turned on half way through the festival. For the purposes of better guiding people's attention from *peripheral* to *local awareness* and then to *direct interaction* [2], we should perhaps have made the floor section of the installation more attractive. Given the scale of the building and openness of the forecourt, that could have been achieved by displaying clearer visual cues above the ground (e.g. extra lights installed on the truss structure).

DISCUSSION

While acknowledging the challenges of evaluating human behaviour in a large-scale event attended by large crowds, we argue that our approach offers insightful contributions for the design of interfaces for social interaction around large media façades.

Connecting zones of proxemics

The large-scale of a media façade makes it inevitably perceived by people in a much larger area beyond its immediate vicinity. Each person naturally experiences it differently depending, among other things, on their distance to both the façade and the interaction zones. From our observations, the experience seems to be enriched by designing the installation so that the distribution of different interaction modalities matches the spatial distribution of people across the site. In our installation (and as suggested

by Fischer and Hornecker [8]), a strong audio-visual connection between the contents of the floor and façade projections proved to be highly effective in overcoming the gap space between the two, contributing to the overall coherency of the experience. In our case, however, the achieved coherency was also largely due to the fact that the proximity of the interaction zones to the building discouraged much else happening between the two: by far, the people we observed positioned themselves either within the interactive zones or immediately behind, away from the façade, in order to get a nicer angle of view for both. That spontaneous dynamic, in turn, seems to have further reinforced the visual continuity between the floor and the lower building façade.

To achieve a seamless connection between the interaction zones and its immediate surroundings we employed embodied interactive mechanisms [13], while also creating an intuitive interface capable of handling multiple participants simultaneously. In fact, the literature on intuitive interaction suggests that body reflectors [5] and physical affordances are known for enabling highly intuitive interfaces [1]. Likewise, studies have shown that people tend to respond favourably to interfaces that display their silhouettes or video images [17]. The whimsical visual representation of their silhouettes contributes to the perceived playfulness of the installation, enabling a "porous" interface that people could freely step in and out of without risk of social embarrassment [2]. As observed, such ease of interaction strongly attracted families with children and made individuals who were not part of larger social groups comfortable enough for trying the interaction on their own. The interaction zones and their immediate vicinity formed a social interactive space [8] made of participants both directly interacting with the visual projections and those indirectly participating by observing, talking to or recording the participation of the former.

Beyond that, there was the periphery of the space where people were rewarded with a better angle of view of the entire façade. Standing at that area, people could have passive observation of the whole experience, although with only marginal appreciation of the interactive floor zones. As they approached the façade, however, their focus would switch to the embodied interactive experience and to the people in the immediate vicinity – while still being able to perceive and enjoy their contribution to the content evolving on the generative façade. The perceived disadvantage of participants standing so close to a monumental façade was therefore offset by the highly interactive localised experience. This way, we matched different zones of proxemics [10] with different modalities of participation.

Promoting encounters by distributing the performance

Our study suggests a novel strategy for connecting the façade with the proxy interactive zone at floor level, by regularly taking a snapshot of their state and using it to drive the animations in the façade. That way, participants can experience a much more personal and tangible interaction (directly mapping movements of their own bodies) while still appreciating their combined (and largely public) impact amplified in the larger façade. Another consequence of driving the visual effects on the façade from the aggregated interaction taking place at the floor level is to "dilute" the performative aspects of the interaction, distributing the responsibility for the highly visible outcomes in the façade through the whole group of participants. We would argue that this distributed performance, combined with the system's ability to support multiple simultaneous participants, has the potential to promote higher levels of public participation, both in number of participants and in the depth of their involvement with the augmented environment. As in other implementations [3, 14, 21], participants in Solstice LAMP engaged in social interaction via triangulation [16], i.e. mediated by the digital interface. The distributed floor interface, however, prompted them to also engage in direct social interaction through the exchange of verbal remarks and by negotiating the physical space in response to the movements of others in their immediate surroundings.

Designing for urban activation

Despite the usual social inhibitions observed among non-acquainted adults congregating in public, it seems clear that making an interactive zone available at the floor level built upon embodied interaction promoted the social reactivation of that particular urban space in a way that would unlikely have happened otherwise. By enabling a direct, intimate and playful interactive experience [13] at the building forecourt as a proxy for the interaction with the building, we managed to overcome the imbalanced relation between the scales of the very large media façade and that of the interactive space, a design challenge often encountered in similar interventions, as highlighted by Fischer and Hornecker [8]. Given the large audience attracted to the installation and the high level of participation observed, we understand such strategy as have being successful.

Breaking down and isolating implementation concerns

The proxy-based approach to interactions with media façades proposed by our study is inherently complex and demands a structured design and implementation process to ensure its feasibility. That can be achieved through the clear separation of the various concerns posed by the design solution: (a) development of digital content suitable to the medium; (b) seamless integration of technology into the local urban architecture; (c) design of interaction strategies that encouraged social encounters through simultaneous interaction by large groups of people; (d) spatial design and thoughtful placement of the interactive spaces relatively to the media façade; and (e) effective modularisation of the system, thus enabling parallel development, easy integration and consequently robust prototyping.

CONCLUSION

In this paper we presented a novel approach for interaction with large media façades, where embodied audio-visual interaction at floor level is employed as a proxy to the façade while promoting shared encounters. Firstly, we described the context for our installation and how it determined our design solution and subsequent implementation, explaining how we used embodied interaction at the area facing a very large media façade as a proxy for public interaction. We presented the strategies we adopted for user testing, describing how the proxy-based design helped us to overcome many of the potential pitfalls highlighted by related research in the field [6, 8, 21]. We then analysed the behavioural patterns observed during the festival and discussed the results of our field observations. We presented insights we believe can benefit future similar design endeavours, particularly when it comes to encouraging social encounters around a large media façade. Albeit social etiquette was still upheld, our urban intervention successfully sparked casual human-to-human interactions: social encounters were promoted and led to small-talk between strangers united by sharing the playful experience. The urban space was noticeably reactivated, with people spontaneously behaving in ways they would not otherwise, partially due to the "license" to play granted by the festival environment, but also due to the social encouragement of witnessing other people engaged in the embodied interaction at the floor level.

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