SENSORY URBANISM AND PLACEMAKING

Exploring Virtual Reality and the Creation of Place

ANASTASIA GLOBA¹, RUI WANG² and BEAU B. BEZA³
¹University of Sydney
²³Deakin University
¹globalnaya@gmail.com
²³{rui.wang|beau.beza}@deakin.edu.au

Abstract. Sensory Urbanism is an experimental prototyping project exploring the potential of immersive Virtual Reality (VR) environments to support the incorporation of sensory and intangible aspects of place. The study investigates how sensory exploration of urban places can be integrated into decision making regarding the future of cities. In the past, numerous studies reported various sophisticated ‘livability’ measures, deeming to determine what makes a city a great place to live in. While a part of these measures can be quantified and be represented as text, graphs or images, most of the qualitative aspects of place are inherently abstract and sensory. These aspects have to be experienced to be understood and therefore they are extremely difficult to communicate using conventional representation means. The proposition explored in this study is that the increasing ubiquity of VR and Augmented Reality (AR) technologies can provide new opportunities to engage with the multi-sensory and temporal aspects of urban place. A mixed media approach was adopted, tapping into a temporal dimension as well as visual, aural and kinesthetic range of human senses. The paper reports on the development of the VR sensory urbanism prototype and the initial pilot study that demonstrated the proof-of-concept.

Keywords. Sensory Urbanism; Immersive Environments; Virtual Reality; Design Evaluation; Placemaking.

1. Introduction: The Problem, The Opportunity and The Proposed Solution

A large number of existing studies (Gil-Garcia et al., 2015; Driskell, 2017) investigated what makes a city a great place to live in. Sophisticated metrics were developed involving a wide range of data sets that underpin our understanding of urban liveability such as: patterns of use, infrastructure, stability, culture, environment, health, engagement, education, opportunities, etc. The problem is that while some of these measures can be supplemented with text and images to describe qualitative aspects of place; many of the intangible and sensory characteristics are difficult to communicate. Which, in terms of the latter, are
similar issues faced by a community, when asked to advise on proposed public works.

Hence, the **proposition** explored in this study is that the increasing ubiquity of VR and Augmented Reality (AR) technologies can provide new **opportunities** to engage with the multi-sensory and temporal aspects of urban place. Hence, a mixed media approach was adopted for use in this research, tapping into a visual, aural and kinesthetic range of human senses. The media used in this experimental prototyping study included 360 degree videos taken on site at different times of day; which provided a dynamic ambient background for the 3D modelling of the urban scene and proposed design interventions. Time and location tagged photographs, walk through videos and bitmap textures were recorded on site and transferred onto the spatial digital environment. These visual and kinesthetic representations were complimented with the audio recordings taken on site. The audio tracks were placed in the virtual environment as spatially distinct and time dependent sound emitters. The combination of audio emitters generated a dynamic soundscape experience and changed as the observer moved through the scene. The temporal character of urban place was foregrounded by enabling the end user to switch between various daily and seasonal cycles of site activity and environmental conditions.

**Development and initial testing of Sensory Urbanism - an immersive VR prototype application** was established, with a setup VR headset, external projector and surround sound systems, allowing individual and small groups to evaluate urban scenes. Projecting the VR scene(s) was conducted to provide other respondent(s) / spectators with the ability to also view respective settings; which would be a similar scenario when engaging with a community on proposed public works. The haptic interface (Oculus touch) enabled the user to hold a virtual smartphone with functions of teleporting around the site, ‘dialing up’ the time of day, accessing videos capturing typical movement paths, viewing supplementary drawings and photographs. For this pilot project, architecture, industrial design, landscape architecture and urban planning students from Deakin University and Pontificia Universidad Javeriana, Colombia developed temporary events that could occur within the public space of Eastern Beach Reserve in Geelong, Australia; including a hand held interface that enabled the user to switch between and experience the three proposed design interventions.

The Sensory Urbanism pilot study and prototype demonstrated proof-of-concept. Feedback from participants and observers, was that there is much potential in the development of an immersive multimedia and multisensory approach to urban design exploration and evaluation. This approach aimed to allow qualitative aspects of place to be utilised engaging with communities, business and industry during the early stages of urban design. Full case studies in a range of urban and cultural contexts, however, need to be undertaken. It is planned to develop the interface and authoring systems, including the embedding of task based activities, voice activated survey and data tracking of user behaviour, to generate statistically valid evaluation studies on the effectiveness of the approach.
2. Background / Related Work

2.1. EXISTING METHODS EVALUATING URBAN SPACES

Commonly the qualitative and quantitative aspects of urban spaces are identified through community engagement practices. ‘Engagement’ with a community in relation to the design of a public space is usually enshrined in planning legislation in settings like the USA, UK and Australia (Beza and Hernández-Garcia, 2018). How communities are engaged with depends on the preferred approach that is used by the design consultant, council team and/or researcher (e.g. Moughtin, 2003) charged with identifying the place elements valued by the community and that they wish expressed in the new design concept. In themselves the approaches can be as straightforward as talking to people and asking them to describe and/or rate the qualitative and quantitative aspects of place, through to having them draw (e.g. on butcher paper) their preferred/ideal place (e.g. Sanoff, 2000). The designer then takes this data and translates it into a concept, which is then presented and discussed with the community. Their respective opinions are then taken into account when producing the final design concept. The latter dimension of this approach (i.e. review of the concept) is normally a static exercise; with people asked to review paper and/or projected drawings/imagery of the intended design outcome and to imagine how the space may act and feel.

2.2. AFFORDANCES / IMMERSIVE ENVIRONMENTS IN ARCHITECTURE

When people interact with the environment, the environment provides stimuli that influences behaviour or one’s action(s). These elements of the environment are what Gibson (1986) refers to as affordance: a concept that uses visual stimuli in the environment as a mechanism to explain the relationship between people and space. Another dimension to his concept is Technology Affordances; which refers to a means for analysing technologies in relation to the ‘possibilities’ they offer people and their potential action(s) relative to the technology (Gaver, 1991). In the context of this interaction design analysis considerations, four complementary types of affordances have been identified: cognitive, physical, sensory and functional (Hartson, 2003). Sensory affordance, in particular, supports cognitive and physical affordances in design by enabling the user to sense his/her environment; it plays an essential role for the user enabling one to gain an understanding the elements displayed in environments and to then act upon them.

Emerging technologies that support sensory affordance including video game technology, virtual environment and 360 videos; which have also been adopted for urban design and placemaking exercises, provide a wide range of affordances to enable better sensory experiences. For example, Alvarez and Duarte (2017) explored how video games can inform spatial design and practice through storytelling and multiple viewpoints; Puyana-Romero et al. (2018) carried out case studies on the use of interactive soundscapes and 360-video based virtual environment as a collective participatory tool with three different hardware settings (immersive VR, mobile VR and screen based applications), however they found no statistical difference in the settings used by respondents. Ghani et al. (2017) conducted preliminary investigations on using VR technologies that enable
users to experience virtual urban environments, and identified a number of factors which determine user experiences with a place, including contextual setting, interactivity, navigation, level of details, viewpoints and auditory elements.

3. Methodology and Prototype Development

3.1. PROJECT SET-UP: HYPOTHESIS / SOLUTION / VALIDATION

This Sensory Urbanism VR prototype and the pilot study reported in this paper are the first stage offshoot project of a larger research agenda investigating the affordances of immersive AR and VR environments as a means to explore and evaluate the conceptual design ‘phase’ in architecture and city planning. The aim of this pilot study is to ascertain the extent to which the development of an immersive mixed media prototype application can be realised. To achieve this aim, we adopted a prototyping approach that is grounded on the conceptual positioning: within the context of rapidly emerging opportunities afforded by new digital technologies, they could allow for the development of highly innovative outcomes (Bury, 2016). Eastern Beach Reserve in Geelong, Australia (a public beach area on the foreshore of the city) was used as a case study (urban context) for this initial proof-of-the-concept research stage. Three urban design interventions - temporary structures and events, proposed to take place on the Eastern Beach, were designed and integrated into the VR scene by a group of international and domestic undergraduate and postgraduate students. This paper reports the development of the software prototype that adopted agile project development methods and progressed through incremental, iterative work sequences and participant-observer evaluation.

In terms of the undertaken research, the study is split into of three overlapping areas. The first area refers to the development of the VR prototype, that was conceived as an interactive and highly customisable urban space exploration platform and was developed using Unity3D gaming engine, with the VR application and interfaces implemented for Oculus Rift and Oculus Touch. The second area, encompassed the collection of the mixed-media geo-located data, collected on site at different times of day, including: 360 videos, sounds, photos and walk though recordings; 3D modelling of the scene; and design of the proposed temporary structures and public events (Fig 1). This was followed-up by the integration of the recorded data and designs into the VR scene in Unity. The third and final stage involved the actual testing of the prototype: group evaluation of the proposed urban events (temporary architectural installations) in VR, collecting the feedback from the users, and accessing the the capacity of the Sensory Urbanism prototype (immersive mixed-media approach) to support the incorporation of sensory characteristics of place into architectural design decision making and city planning.

3.2. PROTOTYPE DEVELOPMENT

The development of the prototype adopted a mixed media approach, involving simultaneous representation of a wide range of media forms including recorded 360 videos, 3D models, bitmap textures, spatial sounds, photos and time lapse
videos. A game engine platform, Unity3D, was used to integrate these varied media inputs and allow a set of proposed user functions.

Figure 1. Prototype Input-Output.

Figure 2. Spatial Grid and Data mapping / Virtual Interface (Map).

To bring all these elements together two components were integrated in the
virtual environment platform, as illustrated in Fig. 1: a collection of media representations of the existing site, as well as potential design events for the site. Such a mixed media approach was adopted to provide an immersive, interactive environment to the users, so that they could experience the place; which included both the existing site of the Eastern Geelong beach and the proposed design interventions, in a sensory and intangible way.

The media resources included in the sensory urbanism platform were created to be highly customisable. Users would only need to copy the new sound files and/or images to the designated folders in the application, for them to be automatically loaded when the application starts. For 360 videos and time-lapse videos, users needed to upload them to an online video platform such as Youtube, and then provide the links of the online videos in a text file located in the application folder. A naming system of the sound, image and video files was used as a means to determine where each media file would be placed spatially within virtual environment. For instance, a sound file named “da_D_3_8.mp3” will be placed
for the time of dawn (‘da’), in the setting of grid D3 (see Fig. 2.), at a volume level of 8 (with 0-to-10 volume scale). As such, this sound file will only be played when the virtual environment is dialed to the time of dawn, and when the user is within a certain distance to the sound source; and the closer the user is to the sound, the louder it gets. By mapping the real-world experiences onto the virtual environment, this replicates the “intangible” aspects of the sound of dawn, in this setting, and conveys this sensory aspects of place for people; which they can share when trying to communicate their design ideas. A similar data mapping approach was used for all the images and video files.

The user interface (UI) for the virtual environment was designed using a smartphone metaphor. The main menu of six main functions were placed as six buttons on the virtual mobile phone (see top-left in Fig. 3); where the user holds the smartphone with their left virtual hand, and the buttons are clickable with the right index finger. Once clicked, the buttons would bring up their corresponding sub-menus, which include: (a) a ‘Map’ menu - teleporting the user to different grids; (b) a “Time of Day” menu - switching between different times of the day; (c) a ‘Video-Scape’ menu - showing a collection of time-lapse videos that were taken on the site, at the current time of the day; (d) a ‘Photo-Scape’ menu - showing a collection of photos that were taken on the site, at the current time of the day; (e) a ‘Soundscape’ menu - visualising the locations of the sound resources on site, with a master volume slider; (f) an ‘Event’ menu - allowing the user to turn on and off the three proposed interventions individually.

4. Case Study / Testing the VR Place Making Prototype

The pilot study was organised as a two week architectural and urban design studio that took place at Deakin University (Australia) and involved a group of Colombian and Australian undergraduate and postgraduate students (Fig. 4). Workshop participants were asked to model the site (Eastern Beach Reserve in Geelong) in 3D and texture this 3D urban model using the photographs taken on site, such as: palm tree bark texture, asphalt, street signs, the sand on the beach, facades of the buildings etc. Working on site, students made a large number of sound, photo, and video recordings tagging each data entry with the location and
time, so that afterwards all the data that they have collected could be accurately mapped into the VR environment. Students were also split into three groups, each developing an ‘event’ (see Fig. 5.) that was to occur on the site & to be experienced and evaluated in VR by inviting guests and other Faculty students.

The events were placed as separate interactive entities in the mock-up of the existing urban set-up (base VR scene). Each event included: a 3D model of temporary architectural structures placed on the beach, music and sound effects associated with each particular event, as well as animated objects such as kites, fire pits, wind turbines, and particle effects such as fireworks (Fig. 4). The user could turn the events on and off, or switch between them. By using the time menu, they could experience each event at different times of day (Fig 6.). At the end of the two week session invited guests, the undergraduate/postgraduate students and academics involved in this project evaluated the positive and negative aspects of the prototype along with the work involved in creating it. Although aspects of the prototype are in need of redevelopment (e.g. some cells in the map menu functioned incorrectly, greater time allocation for tasks) the prototype was considered by those involved in the evaluation to have potential in representing the intangible and sensory characteristics of a setting.

![Figure 5. Design Interventions / Proposed Events.](image)

![Figure 6. Placemaking VR exploration of proposed events at different times of day.](image)
5. Discussion

The proposition explored in this study was that the use of mixed-media urban data mapped within interactive immersive environments could allow for the incorporation of sensory and intangible aspects of place, that are otherwise very hard to communicate. The resulting Sensory Urbanism prototype incorporated and blended together a wide collection of media and data inputs. Thus, allowing users to engage with the multitude of visual, aural and kinesthetic range of human senses, as well as enabling the exploration of temporal aspects of existing and proposed urban spaces.

Development of the Sensory Urbanism prototype and initial proof-of-concept pilot study suggest that this approach can be successfully used as a mechanism to convey the intangible aspects of place, that can be found in an urban setting. Interestingly, the sensory element of sound appeared to be a key urban element that conveyed a sense of place, or not, in the immersive environment (i.e. virtual world). Sight is still considered an important element in this exercise but respondents were able to ‘look beyond’ the visual anomalies and imperfections of the prototype. Importantly, it was noted by respondents (and the researchers) that the imperfections conveyed a message that the work is incomplete (i.e. in draft form). This later dimension (i.e. work in draft form) can be an effective tool when working with communities as in their review of highly rendered architectural design imagery, it can present with a look of completeness. Hence, work in ‘draft form’ they may consider has the ability to still be amended based on their review.

6. Future Work

Up to the date of writing this paper, the city council of Greater Geelong (where the Eastern Beach Reserve is located) has initialled conversations with us, after seeing the VR placemaking prototype we created. The city council has seen great potential of adopting this approach in the actual practice, and has proposed that we work on a real case in the City of Greater Geelong for placemaking with virtual environments, with future development on the current prototype in two possible directions: firstly, on the surface of it, in depth development is needed towards a more flexible, customisable platform. In its current form, 3D models are not exchangeable or editable; interfaces which allow the users to upload their own 3D models should be developed, so that along with the existing interfaces for sounds, images and videos, the users will be able to create their own immersive virtual spaces. Secondly, on the background of the application, functions for user activity tracking can be developed. For instance, the application can track the locations of the user in the virtual space, and the interactions that the user has engaged or the actions the user has taken within the virtual environment. It might even record the qualitative experiences of the user by taking their voice comments can be documented. Such information can help us to better understand the affordances that the virtual environment provides, to grasp the insights of user experiences and to aid with decision making in the urban space.

Other than the potential work with the local city council, we propose that a number of VR sensory urbanism workshops be arranged, with the same platform
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and different urban contexts. One of the most immediate workshop can take place at CAADRIA 2019; we are in the process of preparing a proposal on a workshop using our VR placemaking platform with the urban context of Wellington. Through this workshop and a few following workshops, case studies can be organised to evaluate the use of VR technology in Placemaking and Sensory Urbanism for different urban contexts.

7. Conclusion

Despite these Sensory Urbanism considerations helping the research team to suggest positive leanings in the development of the prototype - it is the affordance of the Mixed Reality technologies, in this case - Virtual Reality, that further supports the validity and potential of this research in relation to the larger research agenda. It reinforces a proposition that the affordances of immersive AR and VR environments could allow for better sensual engagement between the observer and the constructed space, facilitating more comprehensive exploration and evaluation of conceptual designs in architecture and city planning.

References


