City, Culture and Society 12 (2018) 44–53

Contents lists available at ScienceDirect

City, Culture and Society

journal homepage: www.elsevier.com/locate/ccs

Blending pop-up urbanism and participatory technologies: Challenges and opportunities for inclusive city making

Joel Fredericks*, Luke Hespanhol, Callum Parker, Dawei Zhou, Martin Tomitsch

Design Lab, Sydney School of Architecture, Design and Planning, The University of Sydney, Australia

ARTICLE INFO

Keywords:
Community engagement
Digital placemaking
Participatory technologies
Pop-ups
Pop-up urbanism
Engagement channels
Smart cities

ABSTRACT

This article investigates the use of participatory technologies for augmenting urban governance by giving citizens and local communities a voice in the city making process. We present a series of situated and temporary pop-up interventions deployed in public spaces that demonstrate the use of participatory technologies for engaging citizens in localised conversations. Through two field studies of digitally augmented pop-up interventions we discuss the value of various digital and analogue engagement channels and their effectiveness for allowing people to submit their views on various city making initiatives. We outline our design process and discuss the impacts of using multiple engagement channels to engage with a broader cross-section of society in the city making process. The article concludes on challenges and opportunities for digital placemaking strategies, and how such strategies can contribute to wider smart city initiatives.

1. Introduction

Smart city research increasingly acknowledges bottom-up initiatives as drivers for urban innovation (Caragliu, Del Bo, & Nijkamp, 2011; Han, Hawken, & Williams, 2015). At the same time, local governments are realising the limitations of top-down technology-centric solutions and starting to look at community-driven initiatives to inform solutions that improve the liveability of cities and their citizens, rather than being driven by key performance indicators focusing on efficiency and effectiveness. This branch of smart city research aligns well with the concept of placemaking – practiced in urban planning as a way of creating a sense of 'place', which is regarded in urban design as a "human need, essential for wellbeing and feelings of safety, security and orientation, and a remedy against feelings of alienation and estrangement" (Aravot, 2002). The use of digital technologies and media for shaping urban experiences that are citizen-centric, both in their conception and implementation, is also referred to as 'digital placemaking' (Tomitsch, 2016). In the context of this article, we more specifically use the term to refer to the use of digital technologies to inform city making by engaging citizens and local communities (Fredericks, Hespanhol, & Tomitsch, 2016).

However, such citizen-centred city development poses new challenges for governments as it requires a more collaborative approach than the currently practiced community engagement process, which commonly takes a 'one size fits all' approach to city making. Currently, community engagement is undertaken by local governments as a means of 'informing' and 'involving' citizens about infrastructure developments and policy changes within the built environment. However, traditional community engagement activities, such as town hall meetings, workshops and online surveys only reach certain demographics within local communities. As a consequence of this, opinions and input from the wider community, including time poor citizens, younger demographics and culturally and linguistically diverse people are not considered during the engagement process. Researchers and commentators have consequently argued that traditional community engagement activities are top-down, outdated, non-inclusive, fragment communities and rarely achieve genuine engagement outcomes (Fredericks, Tomitsch, Hespanhol, & McArthur, 2015; Hosio, Goncalves, Kostakos, & Riekki, 2014; Innes & Booher, 2004; Schroeter, 2012).

A growing body of research has investigated the use of participatory technologies to address these shortcomings of traditional community engagement with a particular emphasis on engaging citizens in localised conversations within certain urban environments around community topics (Gianluca et al., 2013; McCarthy et al., 2009; Taylor et al., 2012). Participatory technologies have been deployed in a variety of built environment settings as a means of engaging with citizens on local issues using specific platforms, such as urban screens (Fredericks et al., 2015; Schroeter & Foth, 2009), media façades (Behrens, Valkanova, gen. Schieck, & Brumby, 2014), projections (Valkanova, Walter, Vande Moere, & Müller, 2014), interactive posters

* Corresponding author.
E-mail addresses: joel.fredericks@sydney.edu.au (J. Fredericks), Luke.hespanhol@sydney.edu.au (L. Hespanhol), callum.parker@sydney.edu.au (C. Parker), dawei.zhou@sydney.edu.au (D. Zhou), martin.tomitsch@sydney.edu.au (M. Tomitsch).

http://dx.doi.org/10.1016/j.ccs.2017.06.005
Received 24 January 2017; Received in revised form 9 June 2017; Accepted 21 June 2017
Available online 08 July 2017
1877-9166/

(Vlachokyriakos et al., 2014), and distributed voting systems (Hespanhol et al., 2015; Koeman, Kalnikaité, & Rogers, 2015; Steinberger, Foth, & Alt, 2014). Such an approach has the potential to augment urban governance by giving citizens an opportunity to express their opinions 'on the go' (Hespanhol et al., 2015).

Previous projects have successfully managed to attract passers-by to interact with the technology platform, however, in most cases these interventions are limited to only one form of digital input for submitting responses and one form of digital output for visualising community feedback. For example, *Vote As You Go* (Hespanhol et al., 2015) allowed people to submit a response via a kiosk-like tablet device; aggregated results were then displayed on an urban screen. Passers-by therefore need to be familiar with the technology used in the intervention in order to participate in the engagement process, and willing to do so. While these technology-enhanced approaches to community engagement and city making successfully manage to involve demographics that are usually left out in traditional engagement activities (Fredericks & Foth, 2013; Fredericks, Caldwell, & Tomitsch, 2016), they too fail to implement a truly collaborative approach.

To address this gap, our research investigates the design of two pop-up urbanism (Fredericks et al., 2015; Lydon et al., 2014) interventions that use a combination of digital and analogue media for community engagement. Specifically, we were interested in understanding how engagement channels can be created to effectively attract people and promote interaction. These media offer multiple input and/or output channels for people to engage with, e.g. by visualising an aggregated view of participant responses. The interventions presented in this article integrate this hybrid approach with the use of pop-ups as temporary deployments in public space. The situatedness of the interventions and availability of multiple walk-up-and-use engagement channels contributed towards a more collaborative and varied engagement process. We employed a middle-out design (Fredericks, Caldwell et al., 2016) approach for the development and design of our two pop-up interventions by involving top-down decision makers and bottom-up community groups. This approach integrates the needs and interests from the top with those of the everyday people from the bottom, which are met somewhere in the middle. We present two field studies, *Digitally Augmented Pop-Up* and *Pop-Spot*, in which we embedded digital and analogue media into pop-up interventions, enabling passers-by to 'have their say' on localised matters and see accumulative results in real-time.

The article contributes to smart cities research and urban innovation in three ways. First, it provides a design exploration of using analogue media in addition to digital interfaces within the context of community engagement. To that end, the paper builds on and extends previous digital placemaking (Fredericks, Hespanhol et al., 2016; Tomitsch, 2016) research that investigates the application of participatory technologies for improving existing city infrastructure. Second, we present an analysis of the interactions and interaction patterns from two field studies involving digital and analogue media as engagement channels. Third, we discuss implications from our findings for the deployment of participatory technologies in public space, which contribute towards an emerging area of smart cities research. The remainder of this article is structured as follows. First, we review related work on participatory technologies for community engagement. We subsequently outline the context of the field studies, the design process that led to the interventions and the results from their evaluation in the field. We then discuss key aspects of using digital and analogue technologies for collaborative city making initiatives and present key takeaways for embedding them into smart cities initiatives and other types of urban interventions.

2. Participatory technologies and community engagement

Technologies play a key role in the communication of information to local communities. Traditional media channels, such as television, radio and newspapers are being used by local governments and elected representatives to inform and engage with citizens (Taylor et al., 2012). In addition to this the internet and social media are also being used as a tool to facilitate a dialogue, encourage participation (Fredericks & Foth, 2013), and create a platform to deliberate over community wide issues. However, traditional media and web-based technologies are limited to the audience who use them, and can often exclude people who are time poor or do not have access to technology, therefore creating a gap between those who access information and those who do not. The integration of digital technologies has become increasingly pervasive within urban environments, as they have evolved from being used in official locations and assimilated into the fabric of daily life (Tomitsch, 2014). In particular, urban planners, architects and interaction design researchers have investigated the use of participatory technologies in the city making process, highlighting that people are 'citizens' of technologies rather than just 'users' of mobile phone devices and smart technologies (Foth, Tomitsch, Satchell, & Haeusler, 2015).

A number of approaches have emerged that investigate new opportunities for community engagement enabled through digital technologies, including digital placemaking (Fredericks, Hespanhol et al., 2016; Tomitsch, 2016), urban interaction design (Brynskov et al., 2014), urban informatics (Foth, Choi, & Satchell, 2011), and urban HCI (Fischer & Hornecker, 2012). What these approaches have in common is the application of digital technologies for connecting communities with their city. Transdisciplinary research projects, including urban planners, architects and interaction designers, have previously investigated the use of urban screens, media façades, public displays, voting technology and pop-up interventions for community engagement. Schroeter and Foth (2009) developed *Discussions in Space,* which enabled passers-by to respond to community topics displayed on an existing urban screen using SMS and Twitter. Boring et al. (2011) investigated how media façades could be used by multiple people for collaborative interactions in public spaces. Public displays have also been used to engage with people in urban spaces, including through hand gestures (Hoggenmüller & Wiethoff, 2014) and interactive touchscreens (Memarovic, Elhart, & Langheinrich, 2011). Our research is particularly interested in how access and use of technology affect the experience of everyday people in public space.

Novel and creative situated engagement approaches have also been deployed in public space with the intention of attracting the attention of passers-by. In particular, situated voting technologies have been used as a means of collecting feedback from citizens around local contexts. For example, Hespanhol et al. (2015) deployed two *Vote As You Go* input interfaces in conjunction with an urban screen in a public square. The first consisted of a survey running on a tablet mounted on a stand, with a live camera feed streamed to the urban screen. The second incorporated an interactive body movement interface, which was broadcast live to the urban screen. The input interfaces were an effective strategy for attracting the attention of passers-by and converting them into active participants, whilst at the same time presenting the accumulative results on the urban screen. Similarly, Taylor et al. (2012) deployed *Viewpoint* as a situated voting device in public spaces frequented by members of the community and ensured widespread coverage. The voting device displayed an engagement question, which a person could answer by simply pushing a button as the input channel. Participants could also scroll through the output results by using a results dial, which displayed current results and the accumulative number of votes.

Other research has investigated the active involvement of community members through the deployment of situated and temporary pop-up interventions. Fredericks et al. (2015) investigated bespoke community engagement in public spaces through a series of digital pop-up interventions. Combining digital interfaces and a physical pop-up within a public space equipped with an existing urban screen, the study aimed to engage with passers-by from a diverse range of demographics. Using a customised web interface on a tablet device participants were able to answer engagement questions, which in turn would be displayed

in real-time on the urban screen. The study also investigated several variations of results displayed on the urban screen, as a means of attracting the attention of passers-by. This included static pictures with abstract overlays to live camera feeds facing directly to the pop-up. The study highlighted that interactive digital pop-ups deployed in public spaces can facilitate effective community engagement by attracting varied demographics and encouraging local discourse.

Caldwell and Foth (2017) deployed the *InstaBooth* as a community engagement platform in a variety of public spaces. Using a combination of digital and physical (hybrid) interactive technologies, passers-by were encouraged to participate and provide feedback on localised issues. This approach facilitated a dialogue around citizens' ideas and commentary and encouraged participation from a broader cross-section of the community. Each of these examples demonstrates how participatory technologies can be appropriate for community engagement to expand the reach and extent of participation for city making. Similarly, our two field studies discussed in this article further build on this research by examining various digital and analogue engagement channels for allowing people to submit their views on two city making initiatives.

3. Study 1: Digitally augmented pop-up

Our first case study, *Digitally Augmented Pop-Up* was a collaboration with an Australian electricity supplier, with the objective to obtain community feedback around their existing vegetation management program. As a legal requirement to prevent blackouts, bushfires and accidental electrocution, tree trimming and vegetation removal is performed around powerlines and power poles. However, current vegetation management techniques impact the visual amenity in some local areas, and are therefore seen as a divisive issue across many communities. Building on the concepts identified in our review of related work we developed a community engagement strategy targeting a variety of stakeholders, including local governments, businesses, community organisations and local residents. This strategy consisted of informal meetings, a focus group, the design of a pop-up featuring various engagement channels, and deploying variations of this pop-up across four sites to engage local communities in regards to tree trimming and powerlines.

3.1. Pop-up design

3.1.1. Engagement design

Using a middle-out design (Fredericks, Caldwell et al., 2016) approach we were able to draw on the collective knowledge of a variety of stakeholders (top-down and bottom-up) in the design, implementation and deployment stages of the pop-up. At the beginning of the study, we held informal meetings with representatives from a variety of city governments, elected representatives, and local community organisations. Throughout this process we introduced our pop-up engagement strategy, discussed potential engagement media, survey questions, pop-up setup, deployment locations, and identified specific issues people wanted to talk about.

Based on the feedback received from this process it was apparent that communities and stakeholders were unhappy with the engagement activities traditionally carried out around tree trimming in local areas. To identify alternative activities, we held a design focus group with four practitioners from backgrounds in creative design, public relations and communication and stakeholder engagement. We prepared a number of low-fidelity representations of initial ideas and invited the focus group participants to interact with those experience prototypes using bodystorming (Buchenau & Suri, 2000) (Fig. 1). The focus group session led us to the insight that the design of the pop-up and the engagement channels needed to incorporate the theme of the engagement process by using elements, such as trees, powerlines and safety. Additionally, based on the conversations during our informal meetings, we identified three key themes that people considered to be relevant around tree trimming and powerlines: *happiness, cost, and information*. We then discussed these themes with the electricity supplier, arriving at the following three questions for use in the study: *Q1: Are you happy with tree trimming in your local area?* (i.e. happiness); *Q2: Would you be willing to pay more for electricity if the trees were trimmed to look better not just for safety?* (i.e. cost); and *Q3: Should more information be provided about tree trimming?* (i.e. information).

3.1.2. Physical design

The design of *Digitally Augmented Pop-Up* was inspired by previous studies (Fredericks et al., 2015; Hespanhol et al., 2015) that deployed situated digital technologies for community engagement. Additionally, we drew on the following five design elements proposed by Fredericks et al. (2015) for pop-up community engagement: (1) Shelter; (2) Furniture; (3) Information Channels; (4) Data entry point; and, (5) Data visualisation. Taking into consideration that we were deploying our interventions in public spaces and therefore constrained to weather conditions we used a gazebo as the main structure for the pop-up Fig. 2A–D). The pop-up also included two fabricated trees made out of plywood, which served as props for the engagement channels (Fig. 2E–F). In addition to that we used 'call to action' signage explaining our study and showing how to use the channels.

3.1.3. Engagement channels

After undertaking a collaborative and iterative design process, we developed four mechanisms (henceforth referred to as engagement channels) for people to communicate with staff, submit their responses and visualising the engagement topic and results. It should be noted that non-digital interactions are referred to as analogue, (i.e. talking to staff and paper submissions). Our four channels consisted of: (1) interactions with official representative and research staff; (2) a selfie voting app, where participants could answer the three engagement questions by taking a selfie; (3) the same questions printed on paper; and, (4) a tree game using augmented reality (AR).

Channel 1 - Staff Interactions: Official representatives from the electricity supplier and researchers from our university continuously staffed the four interventions. Staff provided information to participants around the context of the study, as well as technical support regarding the engagement channels.

Channel 2 - Selfie Voting App: The concept of using self-portraits (selfies) for community engagement was inspired by the social phenomenon of selfies becoming part of everyday life. Based on the observation that selfies are used across the social and cultural divide to express people's thoughts, emotions, opinions and activities (Seiter, 2015), we hoped that selfies would offer an engagement channel that would especially attract those demographics that would normally not participate in traditional community engagement activities. We developed our selfie voting app to be used as a fun and creative input channel for participants to answer the three engagement questions. Using a tablet device (iPad Air 9.7 inch) participants could respond to the engagement questions by taking a selfie in front of one of the fabricated trees. The tree featured 'Yes' and 'No' signs, allowing participants to answer the questions by positioning themselves accordingly in front of the tree (Fig. 2F). The app was custom-developed and ran in the tablet's web browser. Photos were saved into a Dropbox folder, and an overview of all photos previously taken was displayed on the app's home screen.

Channel 3 - Paper Voting: To provide an analogue media channel, the same three engagement questions were printed on a coloured sheet of paper, cut in the shape of a leaf. This allowed participants who did not want to take a selfie to submit their responses by answering all three questions on paper leafs. These responses were then pinned to the second fabricated tree (Fig. 2E). Over the course of the day the tree would slowly grow a story by visualising participants' responses.

Channel 4 - AR Tree Game: This channel was included to create visual awareness of the consequences of a tree growing in close proximity

Fig. 1. Experience prototypes and bodystorming activity for the design focus group.

Fig. 2. Top row: The four sites used as deployment locations for the Digitally Augmented Pop-Up study. Bottom row: The engagement channels used in this study: (E) Paper voting tree; (F) Selfie voting with tree; (G) Google Cardboard video see-through augmented.

to powerlines. It was structured as a multiplayer activity, where one person would look through a head mounted display (HMD) to see a video feed of the real world. To enable walk-up-and-use interaction, the HMD was fixed onto a tripod (Fig. 2G). The second person would then move the AR markers, which were in the form of two 590 × 840 mm cubes. When the markers were in view, the first person would see 3D models of a tree and powerlines appearing to 'grow' out of the cubes. If the tree marker was moved too close to the powerlines marker, the 3D model of the tree would catch on fire (Fig. 2H). The person looking through the HMD therefore had to guide the person moving the marker until they were far enough apart, which caused the 3D tree to return to being a healthy tree. The AR tree game consisted of a pair of modified Google Cardboard HMD goggles with an HTC One Android smartphone, running a custom-built AR app made in Unity 3D. We cut a small hole into the Cardboard goggles where the smartphone's camera lens is located so the camera feed was unobstructed, and mounted it on a tripod with an adjustable strap. We created the AR markers as large cubes easily moved around, built from Corflute, a lightweight building material. They featured a black on white picture of a tree and powerline. The colours and design were chosen to best stand out in outdoor conditions.

3.2. Methodology

To explore perceived differences across a variety of demographics we deployed our pop-up in four sites over four separate days: a local park in a social housing area (Site 1); a local farmers market in a middle-class suburb (Site 2); a local park in an affluent suburb (Site 3); and a local plaza in a culturally and linguistically diverse suburb (Site 4). The first three sites featured other activities happening at the same time as our interventions, as part of local community events (e.g. community picnic's, market stalls, information booths). These sites and their alignment with other events were strategically chosen as we anticipated that they would attract a broad cross-section of the local demographic. The fourth intervention was located as a standalone pop-up in a public space. Although, there was no other event taking place at the same time, the square was located in the busy centre of a suburb and surrounded by shops and restaurants, ensuring a steady flow of people through the space. Due to space restrictions we were not able to install the AR tree game in the second site. Other than that, all engagement channels were used in all sites.

During each intervention we took observations and notes about the types of behaviours of people moving around the space. This included, (a) the total number of passers-by walking by each site; and (b) the number of those who actually proceeded to engage into interaction with the pop-up (henceforth referred to as 'participants' of the study). For the latter, we also marked down the channels they interacted with, thus eventually obtaining the total number of interactions for each engagement channel. In addition to this we conducted 17 semi-structured interviews with willing participants across the four sites to obtain

Table 1
Counts of passers-by and participants across all four deployments of Digitally Augmented Pop-up.

Site	Engagement Channels			
	Staff	Selfie	Paper	AR
1 (2.5h)	15	4	7	7
2 (5.0h)	60	17	28	–
3 (3.5h)	50	8	24	20
4 (4.5h)	21	10	9	8
TOTAL	**146**	**39**	**68**	**35**

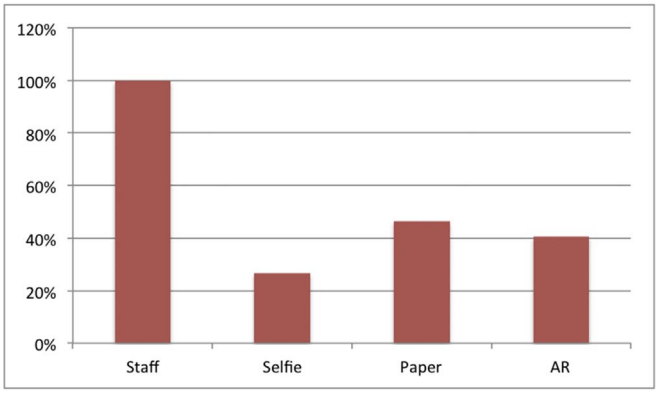

Fig. 3. Percentage of participants for each channel across all sites of Digitally Augmented Pop-Up.

feedback about their experience with the engagement channels and what they would like to happen with their responses.

3.3. Quantitative results

Table 1 shows the results observed for each site, and Fig. 3 shows the rate of utilisation of each channel across all four deployments of the pop-up. We counted a total of 284 passers-by, of which 146 engaged into participation, resulting in a conversion rate of nearly 51%. Such a high participation rate can be explained by the fact that all participants (100%) engaged into conversation with the staff members onsite, in addition to at least one more channel. Therefore, participants may have been nudged into further engagement. 47% of participants filled in the paper survey, 41% used the augmented reality application, and 27% engaged with the selfie voting interface.

It should be noted that, since we did not run the AR interface in Site 2, we calculated the percentage of utilisation for the AR interface based on the numbers observed in Sites 1, 3 and 4. For the other channels, all

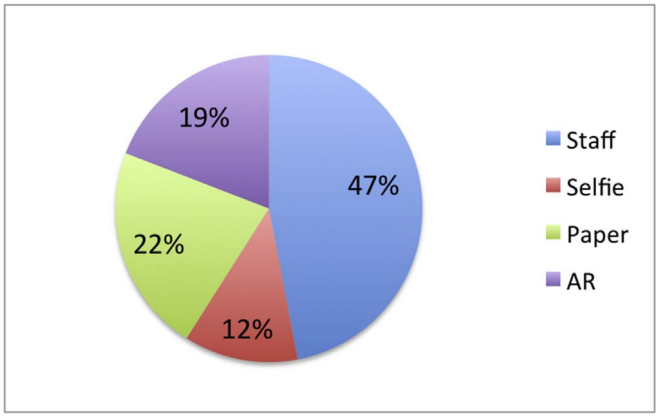

Fig. 4. Percentage of interactions per channel on sites 1,3 and 4 of Digitally Augmented Pop-Up.

Table 2
Votes, pictures and participants for the selfie channel in Digitally Augmented Pop-Up.

Site	Votes	Pictures	Participants
1	5	5	5
2	36	33	36
3	21	21	21
4	24	24	24
TOTAL	**86**	**83**	**86**

four sites were taken into account. Interestingly, if we exclude Site 2, then only one of the remaining 86 participants interacted with all 4 channels. We also counted the number of people who answered the three questions presented both in the paper survey and via the selfie application. 100% of the 77 people who answered the survey on paper completed the three questions (total of 231 questions answered out of 231 asked). That was expected, since the forms handed to participants included all the three questions at once. Given the nature of the selfie interface, however, questions were then asked one at a time, giving users the chance of dropping out between questions. Yet, the observed participation rate was almost as high as the one observed for the paper survey: out of the 30 participants engaging with that channel, 27 answered all questions, with the others answering only one or two (total of 86 questions answered out of 90 asked), resulting in a participation rate of 96%. This suggests that selfie surveys can be considered just as effective as paper surveys for simple questions, such as yes/no questions, that can be answered in visual form.

Table 2 displays the number of participants on each selfie picture, showing that in only one occasion a photo included more than a single participant. A possible reason could be the fact that a person had to hold the tablet in order to take the photo, thus standing close to the camera and limiting the available space in the frame for fitting additional people.

4. Study 2: Pop-Spot

Pop-Spot was developed as a further adaptation of the pop-up interventions deployed during the *Digitally Augmented Pop-Up* study. For this study we collaborated with other researchers from our university who were investigating the use of digital and analogue input and output media in public spaces. Our transdisciplinary research team therefore included an urban planner, architect, electrical engineer, interaction designer and computer scientist. As the study took place at our university campus, we focussed the engagement context around transport infrastructure to and from campus. This ensured that the engagement topic was relevant to the local community. It was further loosely linked to an initiative at our university concerned with active transport on campus. Although there were no requirements from external stakeholders as was the case for *Digitally Augmented Pop-Up*, having some alignment with ongoing initiatives allowed us to engage relevant stakeholders with knowledge in transport around campus in the design process. We consequently developed our engagement strategy to encourage people to stop and vote, provide feedback, and express their opinions about transport infrastructure on and around the campus.

4.1. Pop-up design

4.1.1. Engagement design

Similar to the previous study we used a middle-out (Fredericks, Hespanhol et al., 2016) design approach to engage with a variety of stakeholders in the design, implementation and deployment stages of the pop-up. We had discussions with representatives from the campus infrastructure department and researchers from other university faculties to discuss our pop-up concept, engagement objectives and the associated engagement channels. Over a period of 12 months the research

Fig. 5. Pop-up design and engagement channels used in the Pop-Spot study. (A, B) Pop-up in different perspectives; (C) Mechanical drawing robot; (D) Tablet voting interface for the robot; (E) Selfie voting app; (F) Touch screen displaying transit times.

team held several workshops to develop, design and test the engagement activities and refine the *Pop-Spot* design. In addition to this, we presented our prototype designs at a focus group with six industry professionals working across public relations, urban planning and community engagement. This step allowed us to fine-tune our engagement channels and to ensure that they were easy to understand and accessible to a wide range of participants.

Based on our informal discussions we identified three themes, which contributed towards the development of our engagement strategy: *Happiness; information*; and *opinion*. In turn, the following three questions were used with three of the engagement channels. *Q1: Do you like the transport options to uni?* (i.e. happiness); *Q2: How did you get to uni?* (i.e. information); *Q3: If I was in charge of transport …* (i.e. opinion).

4.1.2. Physical design

Drawing on previous work by Caldwell and Foth (2017) we designed our pop-up as a booth structure consisting of five modular components and three A-frame roof sections (Fig. 5A–B). The design allowed the modules to be arranged in various configurations, making it possible to adapt the physical layout of the pop-up to the characteristics of the urban space. The feedback received during our design focus group and a review of pop-up urbanism (Fredericks et al., 2015; Lydon et al., 2014) interventions determined the visual appearance of the booth – which in its final iteration was painted in a bright colour to create curiosity and make it stand out in a public space. In order to engage with people who are culturally and linguistically diverse we also displayed our 'call to action' signage in languages most commonly spoken in the local campus community: English, Chinese and Korean.

4.1.3. Engagement channels

Through our design process we developed seven thematically themed input and output engagement channels. These channels were selected and designed based on previous studies, e.g. (Fredericks et al., 2015), our own findings from the *Digitally Augmented Pop-Up* study, and the insights collected during our engagement design process. The channels were: (1) a tablet voting app; (2) a dedicated Twitter handle; (3) a mechanical drawing robot; (4) a selfie voting app; (5) a 40-inch interactive touchscreen; (6) chalk stencil visualisations; and (7) a static chalkboard. Channels 3 and 6 were for output only, channels 1, 2 and 4 were for input only, channels 5 and 7 allowed for input and output.

We kept the selfie voting app from *Digitally Augmented Pop-Up*, but iterated its design based on our findings from its previous deployment. Instead of paper, we used a static chalkboard as analogue-only input/output channel, to match the overall theme of *Pop-Spot*. It further complemented the use of chalk in two of the other channels (3 and 7), while also allowing for more free-form input. The AR game was very specific to the theme of *Digitally Augmented Pop-Up*, which is why it was not included in *Pop-Spot*.

Channel 1 - Tablet Voting App: We used a custom-developed tablet voting app to gauge people's overall sentiment about public transport options by answering with 'yes' or 'no' to the question *'Do you like the transport options to uni?'* (Fig. 5D). The app asked participants to enter their first name and a response to the engagement question, which were then sent to the mechanical drawing robot and drawn as an emoticon. This channel was based on previous work by Hespanhol et al. (2015) allowing for simple walk-up-and-use interaction.

Channel 2 - Twitter Handle: Alternatively, participants could submit their answers to the question about whether they liked transport options to uni by posting 'yes' or 'no' tweets to the Twitter handle '@usydpopspot'. A similar form of channel was used in previous studies, e.g. by Schroeter and Foth (2009). We included it in our intervention to enable passers-by to submit their responses using their personal device and without having to publicly engage with any other in-situ channel.

Channel 3 - Mechanical Drawing Robot: The mechanical drawing robot (Fig. 5C) took the form of an analogue display, consisting of a large transparent screen driven by a mechanical writing mechanism. It resembled a large public display, however, the content was mechanically drawn onto the screen using erasable window markers. The mechanical drawing robot drew the responses to the question: *'Do you like the transport options to uni?'* as a happy emoticon if the answer was 'yes' or sad emoticon if 'no'. To make the responses more personal, the system drew the eyes of the emoticon as the first letter of the user's Twitter handle or the name they entered into the tablet app.

We included this channel as a form of output to provide an aggregated view of participants' responses, which was shown to be an important aspect in situated community engagement (Fredericks, Caldwell et al., 2016, Fredericks, Hespanhol et al., 2016, Fredericks, Tomitsch, & Stewart, 2017). Initially we planned this channel to take the form of a digital TV screen, but in the final intervention decided for the mechanical drawing robot for two reasons. First, we noticed during informal experiments with digital display technologies in our lab that the drawing robot was more effective in attracting attention of passers-by, thus addressing the issue of display blindness (Memarovic, Clinch, & Alt, 2015). The drawing robot therefore became a prime engagement channel in our pop-up, attracting the attention of passers-by and drawing them into interaction with other channels in the pop-up. Second, using a chalk drawing robot served the practical purpose of being more visible during bright daylight compared to standard TV screens.

Channel 4 - Selfie Voting App: In this study we used the selfie voting app to display only one engagement question: *'How did you get to uni? Tell us by taking a selfie'*. The app ran on a tablet device (iPad Air 9.7 inch) mounted to one of the booth modules (Fig. 5E). We provided prop cards featuring iconographic representations of transport modes: a bus

for public transport, a person for walking, a bicycle, and a car. Participants could use these props to answer the engagement question by taking a selfie while holding up one or multiple cards. Photos were automatically displayed in the lower portion of the interactive touchscreen, which was attached to another booth module right next to the selfie module. We included the selfie voting app as it was deemed successful in our *Digitally Augmented Pop-Up* study and to further develop the concept of using selfies for answering community engagement questions.

Channel 5 - Interactive Touchscreen: The interactive touchscreen took the form of a 40-inch TV screen mounted in portrait orientation (Fig. 5F). It was divided into two areas. The top area displayed a series of 12 buttons representing nearby suburbs that could be tapped on to show departure times for public transport connections from campus to the selected suburb. This part was implemented using Google's Directions and Places APIs. We used buttons for selecting suburbs instead of a free-text input field to allow for easy and quick walk-up-and-use interaction. Along with departure times, the display showed three of the most highly rated locations of interest for the selected suburb. People were also provided with the option to filter these results by restaurants, bars, shopping, and cinema, based on their interests. The lower area of the touchscreen was used to display selfies taken with the selfie voting app. The photos were displayed in the form of a ribbon, allowing passers-by to scroll through all the selfies that had been taken over the course of the study. This engagement channel functioned as an input and output mechanism that provided relevant contextual transport information, points of interest and displayed the selfie app pictures. However, it should be noted that the input functions of the touchscreen were not recorded and did not serve as a community engagement mechanism to obtain feedback. During the *Pop-Spot* deployment the touchscreen was positioned away from the sun and partially covered by the booth's roof to ensure that it was visible in bright daylight.

Channel 6 - Chalk Stencil Visualisations: To provide an analogue output channel using chalk stencils we displayed the accumulative results of the selfies on the ground beside the booth (Fig. 5H). Each result was listed under the respective mode of transport – public transport, walking, cycling, car. This was visualised in a similar fashion to Koeman et al. (2015).

Channel 7 - Static Chalkboard: We installed the static chalkboard (Fig. 5G) as an analogue input channel on the opposite side of the booth, along the engagement question *'If I was in charge of transport … '*. The purpose of this channel was to tie in all the other digital and analogue channels, giving participants the option to contribute more feedback through freehand drawing and writing, in a similar fashion to Chang (2013).

4.2. Methodology

We deployed *Pop-Spot* in one site over six days spread out over two separate weeks (Wednesday to Friday on week 1 and Wednesday to Friday on week 2). We strategically placed our intervention in a busy pedestrian thoroughfare, which is frequented primarily by staff and students walking to and from the nearby train station. The location is also a place where student organisations set up stalls and people gather to socialise and eat lunch. Similar to the previous study we also counted (a) the total number of passers-by at the site, through direct observation for 2 h each day over the six days of the study (1 h in the morning, 1 h in the afternoon on each day), and (b) interactions that unfolded with any engagement channel, through the analysis of the data logs from each day's run (10am to 3pm, or 5 h, each day).

We intentionally refrained from being onsite counting the general number of passers-by for more than 2 h a day (in a daily run lasting 5 h) in order to avoid the bias observed in the *Digitally Augmented Pop-Up* with the presence of local staff members. However, recording the number of passers-by for a section of each day revealed fluctuations during the deployment of *Pop-Spot* as shown in Fig. 6. Possible reasons

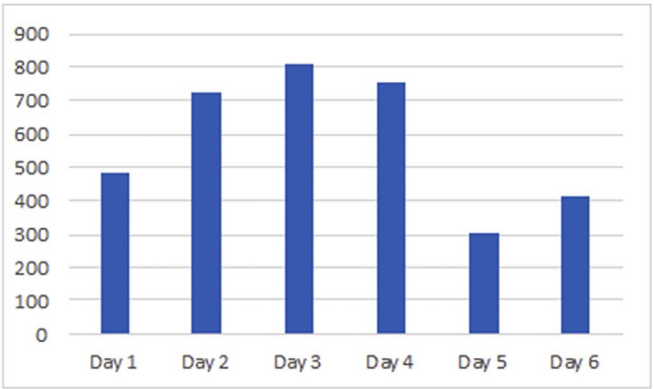

Fig. 6. Total number of passers-by (2hr period).

for these fluctuations could be attributed to increased social activity within and surrounding the public space, therefore increasing the number of passers-by on the respective days. We further specifically focused our attention to the input channels in which participants could express their opinions on the engagement questions asked – therefore excluding the interactive touchscreen, as well as the drawing robot and the stencils, which were used for visualisation purposes only. A total of 20 semi-structured interviews were conducted with willing participants over the six days. We specifically asked participants about the engagement channels, and how the overall intervention can be improved.

4.3. Quantitative results

Table 3 displays the results broken down per input engagement channel (excluding the interactive touchscreen, as explained above), while Fig. 6 shows the total number of passers-by (2 h period), and Fig. 7 shows interactions for each of the six days running the *Pop-Spot* (5 h period), therefore showing the evolution of the total number of observations and participations throughout the entire study. We counted a total of 3260 passers-by during the 12 h we observed them (2 h per day for 6 days), while 401 interactions were recorded over 30 h (5 h per day for 6 days). It is important to point out, however, that this should not be interpreted as a conversion rate, since not only they refer to different time intervals, but also individuals often engaged with many channels sequentially. Additionally, given the multiple entry points available in this setup, it was not possible to keep an accurate record of individual participants during their interaction. Fig. 8 shows the rate of utilisation of each channel per day (in percentages of the overall participation), while Fig. 9 shows the breakdown across all six days of the study. As illustrated by Fig. 8, the tablet channel was the most popular by a large margin, representing 45% of the interactions, followed by 29% involving the selfies channel. 15% of the interactions occurred via Twitter, while the chalkboard contributed with 11%.

Table 3
Input engagement channels of Pop-Spot.

Days		Tablet	Twitter	Selfies	Chalkboard
W1	Day 1	28	7	25	9
	Day 2	35	6	28	4
	Day 3	39	0	23	4
W2	Day 4	31	23	16	10
	Day 5	25	14	12	7
	Day 6	23	9	12	11
	TOTAL	**181**	**59**	**116**	**45**

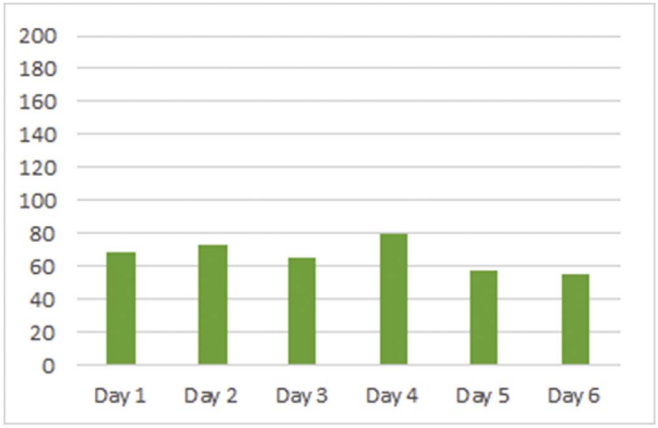

Fig. 7. Total number of interactions for each of the six days running the Pop-Spot (5hr period).

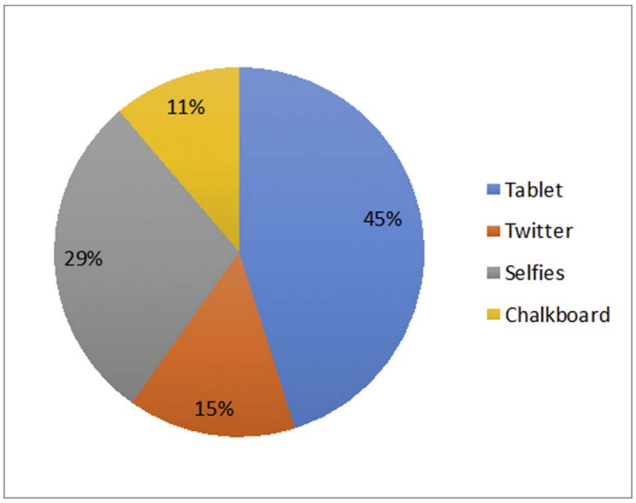

Fig. 8. Percentage of interactions per channel across all days of running Pop-Spot.

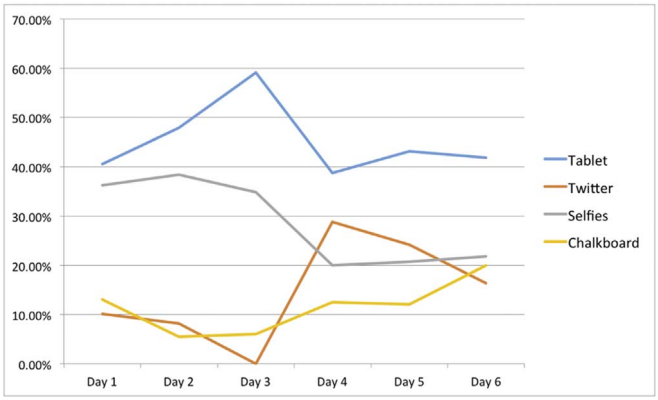

Fig. 9. Percentage of interactions per channel and per day of running Pop-Spot.

5. The value of participatory technologies for community engagement

The observations from our field studies point to a series of interesting findings regarding the combined utilisation of various digital and analogue engagement channels, which we discuss below in greater detail. We also transcribed all participant interviews and completed an open coding analysis of the interview data to identify common themes across the deployments.

5.1. Hybrid engagement channels for inclusive city making

In the *Digitally Augmented Pop-Up*, the presence of local staff members clearly biased the engagement process by functioning as first point of contact for participants, therefore engaging every single participant (Fig. 3) and accounting for 47% of the total interactions (Fig. 4). However, the qualitative findings from our interviews hinted at the value added by the pop-up itself as a 'beacon' attracting passers-by and prompting them into starting a conversation with staff members and among themselves. One participant, for example, expressed that *"the trees and the boxes for that tree game made me come over"*, while another one simply remarked about the pop-up setting: *"It's a good conversation starter."* However, the constant presence of event staff also seemed to have discouraged people from freely experimenting with the two digital interfaces we tried in that study: the selfie voting app and the AR game, with the only analogue interface available – the paper survey – becoming the most popular choice of engagement (Fig. 4).

In *Pop-Spot*, where we did not have an overt presence of staff members initiating the interaction, the survey prompted via the tablet (as input for the mechanical drawing robot) stood out as the favoured channel, with participation much more evenly distributed among the two other digital interfaces for answering the engagement questions – the Twitter handle and the selfie voting app – as illustrated in Fig. 8. However, just like in *Digitally Augmented Pop-Up*, also in *Pop-Spot* the analogue interfaces were instrumental in grabbing attention of passers-by and initiating their engagement. As one interviewed participant declared, *"when I first saw the mechanism for the drawing of the face I thought that was super cool, I really want to see more of that as well."* Participants also pointed to the pleasing aesthetics and novelty of the drawing robot (*"even though I didn't actually vote I think watching the robots was really good!"*) and the stencilled visualisations (*"my favourite aspect was the spray painted icons, it is creative and also visually engaging"*) as motivators for approaching the pop-up. The analogue nature of the architectural pop-up itself also emerged as an attracting factor to some participants: *"I really liked how rustic it was, and it feels really homey."*

Admittedly, novel technologies and unusual analogue interfaces, especially when deployed in public spaces, play a significant role in sparking interest among passers-by, as in fact pointed out by an interviewed participant: *"It was exciting because there were so many different forms of technology being used in the one location"*. Or, as another interviewee expressed: *"It was engaging because I wasn't quite sure what was going to happen next."* We understand, therefore, that blending digital and analogue interfaces only works insofar they are temporary and still novel enough to the community where the study is deployed (hence our concern for designing it as a pop-up structure) – were they to be installed permanently, their effect would most likely wear off over time.

Still, its effectiveness for the purposes of community engagement corroborates the findings from similar studies, especially when used for visualisation of the data just gathered, such as in Koeman et al. (2015) and Valkanova, Jorda, Tomitsch, and Vande Moere (2013). As the latter pointed out, *"public visualisation can be considered as a potential mediator for social communication and constructive feedback among urban stakeholders (i.e. the citizens, the media, the government) on other relevant civic issues, such as, pollution, criminality and beyond"* (Valkanova et al., 2013, p. 3468). Yet, the analogue chalkboard interface was arguably much less well received by participants: *"Things like the blackboard I guess they're sort of a bit boring because everyone's seen blackboards before, and you can't really read off them from a distance if someone writes tiny and stuff like that"*. Another participant was more direct: *"I liked the chalkboard the least because I don't like writing on them"*. Despite of that, as illustrated in Fig. 8, the use of chalkboard in *Pop-Spot* actually increased steadily over the course of the six days of the study. It could be assumed that this trend hints towards a growing adoption of the chalkboard once recurrent visitors became more familiar with its purpose within the context of the pop-up activity. However, it should be noted that we did not measure if previous participants had revisited the *Pop-Spot*.

5.2. Maximum throughput capacity

The total number of passers-by and interactions illustrated in Figs. 6 and 7 are not really comparable, given that they correspond to different intervals of time; however, the trends they suggest definitely are. A surprising fact highlighted by them is that, although the absolute number of passers-by around *Pop-Spot* varied greatly across the six days, the absolute number of actual participants remained fairly constant. This points to a 'maximum throughput capacity' for the *Pop-Spot* setup, i.e. a situation where the number of simultaneous participants within and around the structure would actually inhibit other passers-by to join in. This, naturally, is dictated by the occasional unavailability of the input channels, namely the tablet, the selfies, the chalkboard and the Twitter feed. The latter is dependent solely on internet connectivity, which was continuously available during the study – hence, Twitter consisted as an accessible entry point throughout the study and, therefore, did not bare any impact on a 'maximum throughput capacity' of the setup.

Consequently, we can conclude that *Pop-Spot's* throughput was determined by the availability of the chalkboard and the two tablet channels – the polling app running on one tablet, and the selfie voting app running on another. In that sense, it was understood that the chalkboard channel, for being limited in size, would inevitably fill up after a certain period of time. Likewise, the tablets required a certain period of usage by an individual until they would be able to cast their vote. Any passer-by approaching the setup during that period would feel discouraged to have to wait for participating and, most likely, would just keep walking. This insight points to the need of evolving the current design solution towards a much simpler and nimble usability pattern for both tablets.

5.3. Conflicting privacy concerns

The analysis above also suggests that Twitter is likely underutilised as an engagement channel: despite being a continuously available engagement channel, it is also, as our study shows, often ignored. In fact, as illustrated by Fig. 8, among the *Pop-Spot* input channels Twitter has only produced slightly more interactions than the chalkboard. Even more interesting is the fact that, on one hand, answering the survey via Twitter was inversely proportional to engaging with the survey via the tablet or the selfies. On the other hand, the use of the selfies was directly proportional to the tablet usage. It appears, therefore, that there are two types of behaviour at play: individuals either feel comfortable with using the tangible digital interfaces on site, or they resort to participating remotely by voting via Twitter – but not both. Some of the interviews we conducted on site during the *Pop-Spot* field studies point to privacy concerns as a potential reason for such a usage pattern. As one of the participants pointed out, after using the selfie interface: *"I shielded half my face and I noticed other people did that too."* Such a concern was also echoed by other participants, with one arguing that "*as long as people can't contact me easily I'm fine*", while another explaining: *"I'm more worried about my name than other data, because my name is like a handle, you can search me on google and find out who I am using my name, but using my photo it's more difficult to."*

That seems to suggest two key types of participant profiles: passers-by who are comfortable interacting directly with the pop-up interfaces deployed in the public space, however wary about their personal details not being misused beyond the scope of the community engagement activity; and, individuals who are not comfortable with exposing themselves through direct interaction in a public space, but are not too concerned about having their personal identity associated with the views expressed on the theme via online channels associated with the activity (e.g. via Twitter).

5.4. Limitations

Field studies conducted in public space are notoriously difficult to run (Alt et al., 2011; Hespanhol et al., 2015), and each of the studies presented in this article have very clear limitations. The *Digitally Augmented Pop-Up*, for example, suffers from data inconsistency as we were not able to run the AR game in the second iteration of that study, due to the lack of adequate physical space to accommodate it. Likewise, the nature of the *Pop-Spot*, with its multiple interfaces and entry points, made it impractical for us to count the number of individual participants as we had done for *Digitally Augmented Pop-Up* – i.e. counting those interacting with the system while ignoring their interactions with multiple successive interfaces.

The studies also revealed clear points for improvement regarding the usability of the pop-up platform. For example, we learned from our interviews that some participants, unfamiliar with such a novel context, felt quite confused about both its purpose and how to navigate it effectively. As one participant argued, *"there could be more instructions about the different things because the chalkboard speaks for itself but the other ones until you actually got up and click, then maybe it's less obvious"*. In this article, we attempted to factor those caveats out as much as possible by only comparing scenarios when appropriate, however our analysis must be considered in light of those limitations.

6. Conclusion

In this article, we presented two field studies – *Digitally Augmented Pop-Up* and *Pop-Spot* – investigating the design of temporary, situated urban interventions for the purposes of community engagement. The insights from our studies contribute to smart cities and urban innovation research in three ways. Firstly, they advance the field by proposing a novel approach for community engagement through middle-out design (Fredericks, Hespanhol et al., 2016) incorporating digital and analogue media. Secondly, it introduces the concept of 'engagement channels', expressed through novel interfaces combining emerging digital practices – such as selfies – with traditional data gathering strategies – like paper surveys and chalkboards. Thirdly, the results from the studies offer preliminary insights regarding heuristics for blending digital and analogue media in community engagement urban interventions. The article thus aims to advance this relatively new area of smart cities research, which transgresses beyond 'smart' technologies and considers hybrid forms of media for designing urban interfaces that match the context of the urban environment and the needs and behaviour of people, instead of limiting solutions to taking the form of digital-only interfaces.

Digital placemaking initiatives provide new opportunities for inclusive city making within local communities. Tomitsch (2016) outlines the following three approaches to digital placemaking, which can be applied to the evolving smart cities movement: (1) Community Placemaking; (2) Spectacle Placemaking; and (3) Infrastructure Placemaking. In particular, community placemaking (Fredericks, Hespanhol et al., 2016) can be facilitated through digital and non-digital platforms and employs a collaborative approach where all stakeholders are involved in the decision making process – an approach also postulated by the urban interaction design movement (Brynskov et al., 2014).

The role of digital technologies in community placemaking is to enable passers-by to engage in conversations around topics of city making. However, the reliance on digital channels as sole mechanisms to engage with citizens can limit the overall engagement process if people are unfamiliar with the technology used. Using a combination of digital and non-digital platforms as undertaken in *Digitally Augmented Pop-up* and *Pop-Spot* provides further opportunities to improve collaboration in the city making process. Community placemaking provides an alternative approach to traditional placemaking initiatives for engaging passers-by into a digitally augmented experience, by drawing on local knowledge through the application of digital and analogue media

for improving existing city infrastructure. This hybrid approach opens up new ways of engaging with citizens through situated temporary experiences, such as pop-up interventions that temporarily change the appearance of public spaces.

In addition to this, incorporating a middle-out design approach in the design, implementation and deployment stages of pop-up interventions can further enrich the engagement process. This approach allows for an integration of the objectives from top-down decision makers (local government), with those of the everyday people (community groups) from the bottom-up, to meet somewhere in the middle (Fredericks, Caldwell et al., 2016). With research on digital placemaking and smart cities evolving, there is an opportunity to explore synergies between both disciplines to connect urban dwellers in public spaces.

Acknowledgements

The research presented in this paper was supported by Ausgrid, Aurecon and the Sydney School of Architecture, Design and Planning. We would also like to acknowledge the significant contributions of Charlie Li during the design and deployment of Pop-Spot.

References

Alt, F., Kubitza, T., Bial, D., Zaidan, F., Ortel, M., Zurmaar, B., et al. (2011). Digifieds: Insights into deploying digital public notice areas in the wild. *Proceedings of the 10th international conference on mobile and ubiquitous multimedia* (pp. 165–174). ACM.

Aravot, I. (2002). Back to phenomenological placemaking. *Journal of Urban Design*, *7*(2), 201–212. http://dx.doi.org/10.1080/1357480022000012230.

Behrens, M., Valkanova, N., Gen Schieck, A. F., & Brumby, D. P. (2014). Smart citizen sentiment dashboard: A case study into media architectural interfaces. *Proceedings of the 3rd ACM international symposium on pervasive displays* (pp. 19–24). New York, NY, USA: ACM.

Boring, S., Gehring, S., Wiethoff, A., Blöckner, A. M., Schöning, J., & Butz, A. (2011). Multi-user interaction on media facades through live video on mobile devices. *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 2721–2724). ACM.

Brynskov, M., Carlos Carvajal Bermudez, J., Fernandez, M., Korsgaard, H., Mulder, I., Piskorek, K., et al. (2014). *Urban interaction Design: Towards city making*. Amsterdam: Book Sprints.

Buchenau, M., & Suri, J. (2000). Experience prototyping. *Proceedings of the 2000 ACM conference on designing interactive systems* (pp. 424–433). ACM.

Caldwell, G. A., & Foth, M. (2017). DIY/DIWO media architecture: The InstaBooth. In A. Wiethoff, & H. Hussmann (Eds.), *Using information and media as construction material*. DeGruyter.

Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, *18*(2), 65–82. http://dx.doi.org/10.1080/10630732.2011.601117.

Chang, C. (2013). *Before I die*. New York: St. Martin's Press.

Fischer, P. T., & Hornecker, E. (2012). Urban HCI: Spatial aspects in the design of shared encounters for media facades. *Proceedings of human factors in computing systems* (pp. 307–316). ACM.

Foth, M., Choi, J. H., & Satchell, C. (2011). Urban informatics. *Proceedings of the ACM 2011 conference on computer supported cooperative work*. New York: ACM.

Foth, M., Tomitsch, M., Satchell, C., & Haeusler, M. H. (2015). From users to Citizens: Some thoughts on designing for polity and civics. *In proc. Of OzCHI'15. Melbourne*. New York, NY, USA: ACM.

Fredericks, J., Caldwell, G. A., & Tomitsch, M. (2016a). Middle-out Design: Collaborative community engagement in urban HCI. *Proceedings of the annual conference of the Australian computer-human interaction special interest group*. ACM.

Fredericks, J., & Foth, M. (2013). Augmenting public participation: Enhancing planning outcomes through the use of social media and web 2.0. *Australian Planner*, *50*(3), 244–256. http://dx.doi.org/10.1080/07293682.2012.748083.

Fredericks, J., Hespanhol, L., & Tomitsch, M. (2016b). Not just pretty Lights: Using digital technologies to inform city making. *Proceedings of the 2016 media architecture biennale*. Sydney: ACM.

Fredericks, J., Tomitsch, M., Hespanhol, L., & McArthur, I. (2015). Digital pop-up: Investigating bespoke community engagement in public spaces. *Proceedings of the annual meeting of the Australian special interest group for computer human interaction*. Melbourne: ACM.

Fredericks, J., Tomitsch, M., & Stewart, L. (2017). Design patterns for integrating digitally augmented pop-ups with community engagement. *International Journal of E-Planning Research*, *6*(3).

Gianluca, S., Milano, M., Saldivar, J., Nasir, T., Zancanaro, M., & Convertino, G. (2013). Agora2.0: Enhancing civic participation through a public display. *Proceedings of the 2013 conference on communities and technologies*. ACM.

Han, H., Hawken, S., & Williams, A. (2015). SMART CCTV and the management of urban space. In D. Harrison (Ed.), *Handbook of research on digital media and creative technologies*. Hershey: Information Science Reference.

Hespanhol, L., Tomitsch, M., McArthur, I., Fredericks, J., Schroeter, R., & Foth, M. (2015). Vote as you go: Blending interfaces for community engagement into the urban space. *Proceedings of the 7th international conference on communities and technologies* (pp. 29–37). ACM.

Hoggenmüller, M., & Wiethoff, A. (2014). LightSet: Enabling urban prototyping of interactive media façades. *Proceedings of 2014 ACM conference on designing interactive systems* (pp. 925–934). ACM Press.

Hosio, S., Goncalves, J., Kostakos, V., & Riekki, J. (2014). Exploring civic engagement on public displays. In S. Saeed (Ed.), *User-centric technology design for nonprofit and civic engagements* (pp. 91–111). Cham: Springer International Publishing.

Innes, J., & Booher, D. (2004). Reframing public participation: Strategies for the 21st century. *Planning Theory & Practice*, *5*(4), 419–436.

Koeman, L., Kalnikaité, V., & Rogers, Y. (2015). 'Everyone is talking about it!': A distributed approach to urban voting technology and visualisations. *Proceedings of the 33rd annual ACM conference on human factors in computing systems* (pp. 3127–3136). ACM. http://dx.doi.org/10.1145/2702123.2702263.

Lydon, M., Hartley, L., Mengel, A., Wallace, K., Budahazy, M., Monisse, N., ... Kearney, S. (2014). *Tactical Urbanism 4. Street Plans Collaborative, Vols. 1–4*.

McCarthy, J., Farnham, S., Patel, Y., Ahuja, S., Norman, D., Hazlewood, W. R., et al. (2009). Supporting community in third places with situated software. *Proceedings of the 2009 conference on communities and technologies*. ACM.

Memarovic, N., Clinch, S., & Alt, F. (2015). Understanding display blindness in future display deployments. *Proceedings of the 4th international symposium on pervasive displays* (pp. 7–14). ACM Press.

Memarovic, N., Elhart, I., & Langheinrich, M. (2011). FunSquare: First experiences with autopoiesic content. *Proceedings of the 10th international conference on mobile and ubiquitous multimedia* (pp. 175–184). ACM.

Schroeter, R. (2012). Engaging new digital locals with interactive urban screens to collaboratively improve the city. *Proceedings of the ACM 2012 conference on computer supported cooperative work*. ACM.

Schroeter, R., & Foth, M. (2009). Discussions in space. *Proceedings of the 21st annual conference of the Australian computer-human interaction special interest group*. Melbourne: ACM.

Seiter, C. (2015). *The psychology of selfies: Why we love taking and viewing photos of faces*. (Retrieved 19 February 2016), from https://blog.bufferapp.com/psychology-of-selfies.

Steinberger, F., Foth, M., & Alt, F. (2014). Vote with your Feet: Local community polling on urban screens. *Proceedings of the international symposium on pervasive displays* (pp. 44:44–44:49). New York, NY, USA: ACM. http://dx.doi.org/10.1145/2611009.2611015.

Taylor, N., Marshall, J., Blum-Ross, A., Mills, J., Rogers, J., Egglestone, P., et al. (2012). Viewpoint: Empowering communities with situated voting devices. *In proceedings of the 2012 ACM annual conference on human factors in computing systems* (pp. 1361–1370). ACM. http://dx.doi.org/10.1145/2207676.2208594.

Tomitsch, M. (2014). Towards the real-time city: An investigation of public displays for behaviour change and sustainable living. *Presented at the 7th making cities liveable conference*. Kingscliff.

Tomitsch, M. (2016). Communities, spectacles and Infrastructures: Three approaches to digital placemaking. In S. Pop, T. Toft, N. Calvillo, & M. Wright (Eds.), *What urban media art can do*. Stuttgart: av edition.

Valkanova, N., Jorda, S., Tomitsch, M., & Vande Moere, A. (2013). Reveal-it!: The impact of a social visualization projection on public awareness and discourse. *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 3461–3470). ACM.

Valkanova, N., Walter, R., Vande Moere, A., & Müller, J. (2014). MyPosition: Sparking civic discourse by a public interactive poll visualization. *Proceedings of the 17th ACM conference on computer supported cooperative work & social computing* (pp. 1323–1332). New York, NY, USA: ACM. http://dx.doi.org/10.1145/2531602.2531639.

Vlachokyriakos, V., Comber, R., Ladha, K., Taylor, N., Dunphy, P., McCorry, P., et al. (2014). PosterVote: Expanding the action repertoire for local political activism. In Proceedings of the 2014 ACM conference on designing interactive systems.