
Interaction with Geo-Tagged Media in Urban Environments

David McGookin

Department of Media Technology
School of Science
Aalto University
FI-00067 Aalto, Finland

david.mcgookin@aalto.fi
www.davidmcgookin.net

Abstract

We present an overview of two studies intended to support digital engagement between users and their immediate physical environment: PULSE, an auditory display designed to ambiently present nearby twitter tweets, and DigiGraff, a location-first social network that uses pico-projectors to embed user sketches into the environment. We discuss, based on the study of both, wider implications relating to the emergence of concurrent places in digitally augmented spaces, the 'elasticity' of the relationship between media and its location, and implications for interaction on the modality of presentation.

Introduction

So far, smart city research has mostly focused on large-scale attributes of city monitoring and visualisation, such as traffic management, pollution and transportation. Whilst such 'utilitarian' uses are of key benefit, it is the citizens of cities, and the places that they create, that make each unique. So far, little research has been undertaken on how these more intangible qualities can be exposed to both citizens and visitors. In this paper we present an overview of the study of two systems (PULSE [2] and DigiGraff [3]) that seek to investigate this nascent issue. Both exploit the increasing amount of geo-social media (tweets, photographs etc. that are tagged with a geographic location when created) being generated, and

were designed to investigate how this media could be used to inform and engage users with their immediate environment. The results of both studies allow us to draw out broader themes relevant to designing and engaging users with digital media in the urban environment, supporting the emergence of research questions to push forward this nascent area.

PULSE

PULSE [2] was designed to allow users to gain a 'vibe' - an intrinsic understanding of the people, places and activities around their current location - derived from the Twitter social media service (www.twitter.com). PULSE ran as an 'app' on an iPhone, with a passive user interaction: interaction was driven solely by a user's physical movement through their environment. As users moved, PULSE downloaded Twitter messages ('tweets') generated by any user in the current location. Periodically, PULSE would select the closest tweet, synthesise it using a high quality Text-to-Speech engine and insert it in a virtual 3D auditory environment (using OpenAL running on the iPhone). Thus users heard tweets as whispered conversations in passing. Open ear buds were used to allow merging between the virtual and real auditory environment.

Evaluation of PULSE

PULSE was evaluated over in a 2-week field study in Edinburgh, UK with a group of 5 local residents. Participants were asked to use PULSE as and when they liked. Overall, participants integrated use into other activities, such as walking to the shops or going to work. The use of a largely passive auditory display meant that participants had to make a single, relatively large, decision to start using PULSE (by switching on the app), rather than multiple small decisions to take out the iPhone

and visually check it. This allowed PULSE to recede into the background, allowing a natural integration between the virtual and real auditory environments. Based on interviews three key findings between virtual media and the urban environment emerged.

The first was the way that PULSE contextualised the environment users were in, making them aware of other people, activities and social groups within physical spaces they were already familiar with. For example, one participant walked through a large public park on his way to work and found PULSE presented tweets generated by groups of people who had spent the previous day enjoying the summer in the park; finding it interesting how others chose to spend their time. Another, who walked through the city, discussed how PULSE made him aware of visitors' and tourists' current activities. Notably, as the Edinburgh festival was taking place during our study, PULSE allowed him to get an insight into how performers at the festival felt before their shows: *"This guy who said it was two and a half hours till his show started. That was quite interesting. Seeing it from the other side"*. In these cases PULSE helped to colour the environment that users regularly used, causing them to see it from a new perspective, and revealing hidden places in existing familiar spaces. Also highlighted was the discovery of places that participants would not have visited as they were largely used by other social groups. One participant who travelled to work on the bus described how PULSE made him aware of a working man's club on his bus route: *"I'd never have known there was a working man's club in and around that area. It was a nice insight into what other people do with their life"*.

PULSE not only shaped understanding of existing environments, but also supported the discovery of new



Figure 1: An overview of DigiGraff. Users sketch tags on a touch-screen before attaching them to a location in the world. Tags can then be viewed or modified by any other user. Tags are viewed either by projection (shown) or via the device touchscreen.

places and events in familiar environments. Due to the Edinburgh festival, this was largely through the discovery of shows through tweets posted by audience members, but it also extended to restaurant reviews.

Whilst the first two findings illustrate how the media helped to contextualise the environment, the third showed how the environment helped to contextualise the spoken messages participants heard. As might be expected, participants considered many of the Twitter messages mundane or boring. However, the re-embedding of these messages within the environment of their creation helped to increase their interestingness, or make them in a way more relevant. For example, where the environment, or a location in it, was explicitly named in the tweet, and known to participants, this helped to create a tight coupling between message and environment. However, this extended to other tweets that would be considered uninteresting in other contexts: *"The fact that it was geo-located made it more interesting, even if the content wasn't that interesting. I got one, some guy saying he was making lasagne for his kids. But given that I was just outside my flat, and that could have been somebody.."*.

PULSE Discussion

Although participants were local and familiar with the areas where they used PULSE, their perceptions and understanding of these familiar places was changed and provoked, rather than them being "perceptually hidden" due to familiarity. Rost *et al.* [4] have found similar results with their Columbus system, that allowed users to rediscover Flickr images taken in their current environment. They found that 'unexpected' images were rated as more interesting and preferred. Again, illustrating how re-embedding social media can provide new perspectives on spaces that would be otherwise

considered as well understood and familiar. Our use of a passive auditory display allowed this to occur serendipitously, with participants 'stumbling' upon new insights during their regular activities (such as when commuting to work).

DigiGraff

Just because data is collected in a location does not necessarily make that data relevant to that location (or appropriate to visualise in that location). An issue with social media as used in PULSE concerns the intended and perceived relationship between geographic location (space) and media. The semantic relationship between textual updates on Twitter and their geographic location can vary. For example, the user may just happen to be in a location when posting a message rather than creating a message because of his or her location. Both can be useful, as a 'happens to be' relationship provides understanding of peoples' thoughts in an area (such as identified with PULSE). However, current social networks treat location as a secondary feature. When users create messages the current location of the device used is automatically appended. The relationship and relevance between the message and location is unclear, as users do not need to consciously consider the relevance of their media to the current environment. DigiGraff [3] was an attempt to study how users consider this relationship between media they create and the place where it is created, as well as how viewers of that media interpret this relationship.

DigiGraff (see Figure 1) was a location-first social network, strongly based on the affordances of graffiti. Users generated sketched 'tags' that were anonymous, publicly viewable (by other DigiGraff users), and could be freely altered or defaced. DigiGraff was location-first in

that all tags must be explicitly attached to a physical location in the environment when created. Users must be in an environment to create a tag, and the tag can only be viewed or modified when users are at the same location. Thus tags appear attached to the urban environment. Based on experience with PULSE, two different ways of viewing tags, each of which varied the visual integration between environment and media, were employed. In the first, a pico projector was used to project tags into the world (see Figure 1 (bottom)). The projector acted as a flashlight that progressively revealed the tag as it was passed over. The second version simply displayed the tag on the iPhone screen as an image.

DigiGraff Evaluation

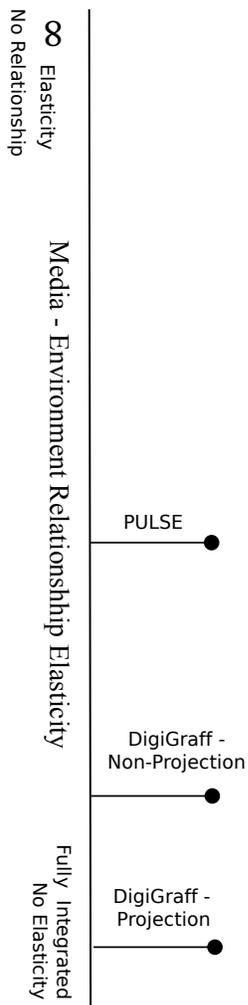
DigiGraff was evaluated by 13 participants in 3 groups over a 2-week field study. Participants within each group knew each other, but did not know participants in other groups. Hence there was a mix of people that knew and did not know each other. Each user spent one week with each version, with interviews at the end of each week.

Analysis revealed a number of diverse use cases that participants developed with DigiGraff. In all of these the interplay between digital media and the environment featured strongly: Hide & Seek games where participants would leave tags for their friends to find later, creating tags that indicated directions or that marked a meeting place for lunch that day, and asking questions of strangers by attaching tags to relevant places in the environment. In all it was the collocation of media and the environment that supported these uses, and in a way media by itself would not. However, most commonly, use related to creating tags that expressed participants' thoughts or feelings, sometimes for friends and sometimes for strangers (such as leaving an historical

record for future generations). In viewing tags the main objective was exploration and discovery of the environment, using DigiGraff as a way to find out about the physical place participants were in. In all cases participants moved dynamically and fluidly between use cases, often within the same interaction session with the app. The interaction between media and space leading to the emergence of concurrent hybrid places.

Although DigiGraff required users to place a tag somewhere in the environment, participants described that about 20% of tags they created did not relate to the environment they were created in. Of those that did, participants either related tags to the environment spatially or semantically. When viewing tags only those that were spatially related to their location had an obvious link for viewers. Semantically related tags, relying on a shared interest between the creator and viewer to understand the relevance of the tag to the environment, were more difficult to interpret. Participants noted that between 20-60% of the tags they viewed related to the environment. Therefore although participants were encouraged to consider the spatial relationship of media, it does not mean that all media will relate to the environment. As with PULSE, the relationship between tags and environment was two-way: tags helped contextualise the environment, and the environment helped tag interpretation. This extended to the expected density of tags in an area. Participants often described how they chose to use DigiGraff in busy areas, as they perceived these to have a greater number of tags to view.

Having two versions of DigiGraff (projection and non-projection), with participants using a different version each week, also helped to illuminate where the deeper integration we assumed in PULSE was actually useful. As



expected when viewing tags, projection created a deeper sense that the drawn tag was part of the environment: *"It's kind of unexpected in a way that there is nothing there and you shine a light on it and suddenly there is"*. This physical act of movement in the environment, with the need to align the phone correctly - to see the tag projected - was also discussed as helping to consider the relationship between the tag and environment. With the non-projector version - viewing the tag via the iPhone screen - it was less clear how the tag should relate to the environment, as the tag could be: *"anywhere around you, it could be behind you, in front of you"*. It was the "obviousness" of the tag-environment relationship that determined if participants felt projection would be useful or not. For tags without a relationship, or with an unclear semantic link between the tag and environment, the projector was seen as less useful. In such cases presentation on the screen was seen as better. Overall, both presentation methods were seen as necessary. In creating tags the projector increased the intent of participants to relate a tag to the environment.

Future Research Challenges

Parallel Places

The design of PULSE assumed that Twitter messages would complement the existing space a user was in, lending a sense of placefulness [1]. However, what we found was that spaces in the city supported multiple *concurrent* places. To our users, in their everyday lives, many of these places were invisible or unseen. It was PULSE that allowed these to be revealed. We can consider these as parallel places, existing *concurrently* in the same physical space, but unobvious. DigiGraff furthered this, and we can consider the roles that users developed to generate subsets of tags, when combined with a physical space, generated a place. Some of these places may only

be suitable for friends, whilst others may be useful to strangers, tourists or visitors. It remains an open question how best to identify these places from media, and to do so in a way that enhances the serendipitous discovery afforded by PULSE, without restricting the free and rapid movement between roles and uses as we found with DigiGraff. However, there are significant opportunities in increasing the visibility of these parallel places. For example, increasing awareness of societal problems such as homelessness through a PULSE like system; allowing hidden places in familiar environments to be more visible.

These places were also user driven, supported by the flexible interaction with DigiGraff. This is in contrast to the enterprise level infrastructure being deployed in current smart cities. How can we make this infrastructure accessible to, and malleable by, end users to support their local needs?

Elasticity of the Media Environment Relationship

Both PULSE and DigiGraff were locative experiences designed to be used geographically *in-situ*. Each can be seen as supporting a different level of tightness (or elasticity) in the relationship between media and its location: from tightly coupled to non-coupled (see Figure 2). Both studies illustrated that users create media that varies along this continuum. Most notably with DigiGraff, participants created media both tightly linked to physical location and media that was loosely located to that location. In both cases, the looser (more elastic) the link with the geographic location reflects the relevance of the media over a greater geographical area. Having a standard fixed area where a tweet or tag was considered as relevant (and thus viewable) is not always appropriate. Users found it difficult to interpret a tight relationship (e.g. in DigiGraff projection) where no tight relationship

Figure 2: Each of the three systems affords supporting a different tightness or elasticity of relationship between media and its relevance to the environment.

was intended. Similarly, users may have missed relevant tags or tweets because the geographic relevance of the tag or tweet was greater than the area it was viewable within. Media cannot be considered a “point source”, and consideration of the elasticity of the media location relationship is important.

The Affordances of Interaction Technology

A final issue is the affordance of interaction technologies to support interaction with urban data. The use of audio in PULSE supported a passive interaction, allowing users to simply experience the relatively mundane snippets from twitter. If we had used an on-screen display and notification to present each tweet, it is likely users would have found PULSE to be irritating. The affordances of audio made it practical to present tweets *in-situ*. Yet the majority of urban installations tend to be largely visual in nature, either via ambient visualisations or interactive touch displays. As visual interaction can often isolate us from the environment, it seems important to consider how to provide interaction with urban data, without detracting or isolating users from the urban environment that data refers to. Are we restricting the data that can be presented through our visual dominance for presentation?

Related to the strength and extent of the link between media and location previously discussed, is the role the interaction technique and modality plays. This was most obvious between the projector and non-projector version. With projection assuming a tighter and closer relationship with the environment. The inherent “lossiness” in 3D audio technology, particularly with distance perception, affords a much more elastic relationship, and was considered as such by users. Consideration of the elasticity afforded by interaction techniques is important. For example, do large scale displays and ambient physical

visualisations - fixed as they are to a specific location - limit the media and elasticity of media-location relationship that can be presented? Would combining different modalities and interaction techniques afford the presentation of media at different scales, providing a more engaging urban interaction environment?

Conclusion

The study of future and smart cities has significant tangible benefits to both citizens and their representatives. However, as this paper has argued, there are significant potential intangible benefits. Through both PULSE and DigiGraff important themes for consideration when embodying spaces as digital places have emerged, indicating that that mapping between space and place is not straightforward. We believe these issues have wider relevance, and by considering them more deeply, user interaction in urban space can be significantly enhanced.

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