No Cure for Curiosity: Linking Physical and Digital Urban Layers

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ABSTRACT
Although mobile phones are often used in public urban places to interact with one's geographically dispersed social circle, they can also facilitate interactions with people in the same public urban space. The PlaceTagz study investigates how physical artefacts in public urban places can be utilised and combined with mobile phone technologies to facilitate interactions. Printed on stickers, PlaceTagz are QR codes linking to a digital message board enabling collocated users to interact with each other over time resulting in a place-based digital memory. This exploratory project set out to investigate if and how PlaceTagz are used by urban dwellers in a real world deployment. We present findings from analysing content received through PlaceTagz and interview data from application users. QR codes, which do not contain any contextual information, piqued the curiosity of users wondering about the embedded link's destination and provoked comments in regards to people, place and technology.

Author Keywords
Mobile Interaction, QR Codes, Mobile Phones, Public Places, Urban Informatics, Urban Experience

ACM Classification Keywords
H5.2 Information interfaces and presentation: User Interfaces.

INTRODUCTION AND MOTIVATION

In everyday life urban dwellers commonly engage with Information and Communication Technology (ICT) devices such as mobile phones while spending time in public urban places. These 'mundane' technologies are seamlessly integrated into the everyday life of people and can support a persistent sense of community [9]. The uptake of social media services such as Facebook and Twitter in combination with internet-enabled smart phones enables people to browse and explore the news updates of their social circles in addition to ordinary text messages or phone calls. Furthermore, global positioning systems (GPS) built into more and more smart phones enable new kinds of mobile services, which take the location of a user into account. These location-based services (LBS) provide additional digital information according to a user's whereabouts such as nearby restaurants, ATMs, or gas stations. A subsection of LBS are location-based social networks such as Foursquare, Yelp, and Gowalla, enabling urban dwellers to share their location and additional information about a place with their friend list on the respective service. On the other hand, the widespread adoption of such services and the widespread use of internet-enabled mobile devices open up new opportunities to investigate novel kinds of mobile mediated interactions and digital augmentations.

In the urban environment, people leave visible traces in the physical space such as garbage on the train or scribbles on public toilet stalls providing insights into previous activities or usages of the particular space. Instead of using mobile phones to connect to one's social circle while spending time in public urban places, such devices could also be utilised to connect more to the actual urban space and the people within. This study explores how this could be achieved through augmenting public urban places by providing an online space for leaving digital traces mediated through physical artefacts.

This paper describes our exploration into how physical artefacts attached to public urban places in combination with mobile phone technologies can enable mobile mediated social exchanges over time. Our approach, PlaceTagz, utilises QR codes printed on stickers linking to a digital message board enabling collocated users to interact with the space and each other over time resulting in a place-based digital memory. Like urban probes, which introduce physical artefacts into urban landscapes "to understand how our future fabric of digital and wireless computing will influence, disrupt, expand, and be integrated into the social patterns existent within our public urban landscapes" [22], PlaceTagz are attached to urban public places to investigate if such an approach can stimulate and create digital conversations and narratives about a particular place. This paper reports on our

experience of having PlaceTagz deployed in the field and used by real people.

PlaceTagz is situated within the research field of urban informatics, which is defined as the "study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures" [10]. This design intervention is part of a larger study investigating how ICT can be employed to create a more social and enjoyable experience while spending time in urban public places, and how this might influence the perceptions towards collocated strangers and place [28]. It employs QR codes to mediate the physical and digital layer of the urban environment enabling people to browse and leave digital augmentations in a particular place. This study was driven by the question whether urban dwellers are curious enough to scan QR codes when they find them in unusual locations without contextual information what the encoded information is about. Additionally we wanted to explore if, how, and why people interact with PlaceTagz.

The remainder of this section is structured as follows. We first review the relevant literature in regards to this project and then introduce PlaceTagz, our approach to link physical places to interactive digital resources followed by describing the data collection and the procedure employed for analysing the received comments. We then present our findings drawing from the content analysis and incorporating results from semi-structured interviews.

LITERTURE REVIEW

QR codes provide means to connect the physical with the virtual and provide a gateway between atoms and bits [13]. However, QR Codes are mainly used for advertisement encoding physical hyperlinks to access a mobile web site. They are usually placed next to an URL on a product or advertisement poster.

Various research projects have utilised QR codes to explore their usage beyond the above-described scenario. For example, QR codes can be used in libraries for various purposes such as encoding mobile phone numbers to provide support, encode additional text for way finding and navigation within libraries, or encode URLs linking to additional content [30]. The City of Manor in Texas deployed fixed QR codes printed on street sign poles for citizen engagement and information pull of government decisions [15]. Urban planners integrate QR codes as part of *media-enhanced street furniture* [18] to link digital infotainment contents to physical locations. QR codes have been utilised to enable users of the location-based social network Foursquare to virtually check-in into a physical location [7]. The *Semapedia* [2] initiative and the *QRPedia* [3] project both utilise QR codes to connect physical objects to their digital entries in Wikipedia. Researchers have studied visual codes attached to advertisement posters in urban public places and the possibilities for context-aware service provisioning [27].

Some studies have been conducted where physical hyperlinks or location determination methods have been utilised to also being able to contribute to the digital content encoded. Three applications have been described utilising 2D barcodes linking digital resources to the urban space [14]. *TagBlogger* has been deployed during the Aarhus Festival in Denmark linking specific locations with event, concert, and location-based information enabling users to browse and comment on the content. *AudioMove* is a location-based audio theatre invoking sound files through scanning 2D barcodes across the city of Aarhus. The *Struer* application links local heritage information to 2D barcodes enabling browsing as well as contributing to the local history of the city of Struer in northern Denmark.

The *Tales of Things* [4] project investigates how physical hyperlinks can contribute to sharing experiences with things. Things, in this study, are everything from objects such as a soccer ball, painting, photograph to places and locations. User can create a *Tale of Things* for an object through a website specifying metadata such as title and description as well as integrating data form social media services such as Flickr and YouTube. The authors want to further investigate how the creation of a social history associated with an object can mediate perceptions towards the object.

The *GeoNotes* [23] project describes a digital alternative to analogue annotations in public spaces such as posters, graffiti, or post-it notes. While employing location determination through wireless Internet networks, a *GeoNotes* user can create a digital annotation with a custom label for exact location (e.g. blue door, grey park bench) specification. *GeoNotes* enables users to express views, opinions, and concerns in public space while also raising awareness of other people's opinions through their annotations and custom labels for location specification. Over a one-month trial, 78 users published 283 *GeoNotes*. The application trial found that users preferred to exchange notes about the social space and the activities within rather than the physical space and corresponding objects [24].

The *MobiTip* [26] mobile phone application allows users to share opinions about the physical environment employing Bluetooth technology for peer-to-peer opinion exchange.

While not employing QR codes, The *Dead Drop* [1] art project utilises USB sticks in the urban environment for anonymous peer-to-peer file sharing in urban public places. USB sticks are interwoven with the urban environment by for example using cement plastering the storage device directly into a brick wall leaving only the pluggable part of the USB stick accessible. The visible, pluggable part of the USB stick symbolises to urban dwellers that there is a digital layer on top of the physical layer leaving it up to urban dwellers curiosity to plug in a suitable device.

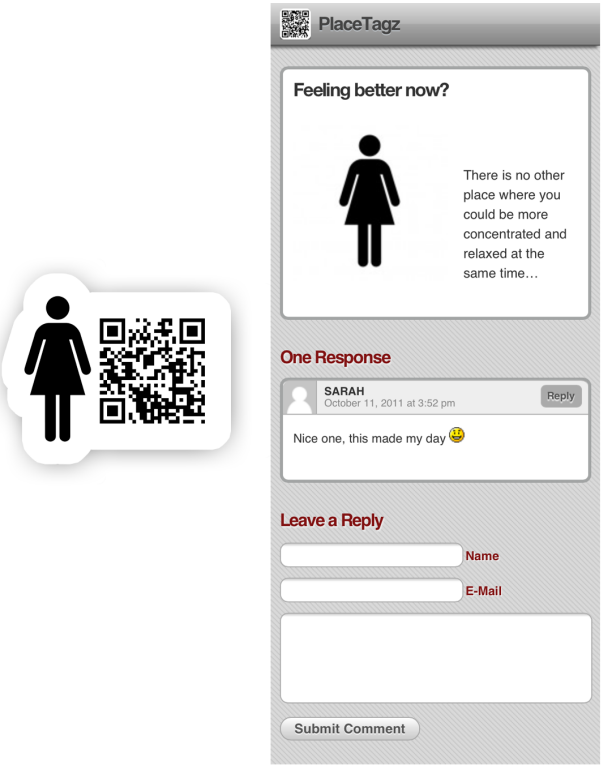

Figure 1: PlaceTagz sticker and respective mobile website

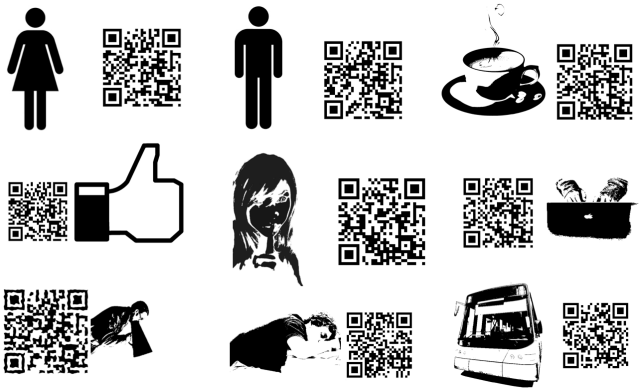

Figure 2: PlaceTagz designs

PlaceTagz is situated at the intersection of *Tales of Things*, *GeoNotes* and the *Dead Drop* project. In contrast to these projects, PlaceTagz utilises visible, physical artefacts in the form of QR codes without contextual information to symbolise that digital information is available at a particular urban space piquing urban dwellers' curiosity to scan, read, and contribute to PlaceTagz in an open and anonymous way without the need for user profiles.

PLACETAGZ

The PlaceTagz system consists of two components, the sticker with the QR code and the website containing the digital content. Each single PlaceTag has exactly one digital representation on the PlaceTagz website.

Wordpress, an open source weblog software, has been repurposed and modified according to the needs of PlaceTagz. Each sticker represents one unique post in the weblog. The commenting functionality of the weblog system has been utilised to enable urban dwellers to leave a comment on the respective PlaceTag. Most of the additional weblog features such as hyperlinks navigating to other entries in the system or the search functionality have been removed to present a clean and minimalistic user interface. Figure 1 shows a PlaceTag and the mobile website behind the URL encoded in the QR code.

While each sticker only consists of an image next to the QR code, the mobile website contains a headline as well as additional text and the image shown on the sticker. The headline and the text contain location or activity-based information, questions, or statements encouraging interactions. Received comments are visualised underneath the content followed by a form for submitting new comments. The name and email text field are optional allowing users to comment anonymously on a scanned PlaceTag. Submitted comments are not moderated and are visualised underneath existing comments instantaneously.

Figure 2 shows a variety of different designs for PlaceTagz. In the studied iteration of PlaceTagz, only the researchers were able to generate new stickers and their respective digital representations. (We are considering a DIY interface to allow users to create their own stickers in the future.)

The process of creating a new PlaceTag involves adding a new weblog post to the system and therefore creating a unique URL. The URL can then be used to create a QR code with a QR code generator. For printing the stickers we use transparent easy to peel address labels, which can be removed without leaving any traces on the object where they have been placed.

All submitted comments are centrally stored on the weblog system and accessible on the website or administration panel. The lightweight software architecture behind PlaceTagz enables us to easily create, manage, and analyse comments submitted via PlaceTagz.

DEPLOYMENT

PlaceTagz have been deployed at two locations in Brisbane, Australia: (1) at two University campus locations and (2) at The Edge, the digital culture centre of the State Library of Queensland which promotes knowledge exchange at the intersection of digital arts, technology, science and enterprise. Altogether we placed 150 PlaceTagz at those locations. Figure 3 shows four examples where PlaceTagz have been attached to various objects in the urban public space. Selected urban public places all fulfil one or more of the following criteria: (1) Usually people are occupying the space by themselves, (2) the place is mostly used for a short period of time, and (3) people are usually resting or waiting for a specific event to occur. Figure 3 shows PlaceTagz at the counter of a coffee shop, in a public toilet, in the waiting area in front of an auditorium, and a park bench. At the university location, the majority of stickers have been placed in public toilets

(101). A few stickers have also been placed in elevators (2), benches (8), water fountains (5), a shared office space (8), and at a bus stop (3). In total 127 PlaceTagz have been deployed in the university setting.

The Edge in Brisbane provides facilities such as workstations, window bays with couches and tables, and workshop rooms allowing visitors to work and collaborate on their projects in a creative environment. At The Edge, stickers have been placed onto the coffee machine at the coffee shop (1), toilet cubicles (8), window bays (11), the outside glass door (2), and at a water fountains (1). Altogether 23 PlaceTagz have been deployed at The Edge.

Figure 3: PlaceTagz deployed in various locations

By placing the stickers in the urban environment, user comments can be received throughout the life span of the stickers. However the life span depends on various external factors such as cleaners or urban dwellers removing the stickers and cannot be easily influenced. In this paper we consider comments which have been submitted between December 2010 and February 2012.

METHOD

The content analysis method has been selected and applied to analyse the submitted comments of PlaceTagz attached to urban public places. The content analysis method provides a toolkit to code, examine, and interpret various kinds of qualitative research data [6]. As each sticker collects text comments left by urban dwellers, content analysis seems to be the starting point of investigation into how PlaceTagz have been used and perceived by urban dwellers.

Two major attributes have been addressed through the coding of PlaceTagz comments: the content of the comment and the general notion or experience reported in each comment. Each comment has been analysed in regards to whether or not it belongs into one or more of the following ten categories: reply to previous post, reply to PlaceTagz content, use of emoticons and abbreviations such as "LOL", humour, asking a question, referencing the PlaceTagz system, information sharing in regards to the sticker location, referencing other people in space, off topic comments or comments which are not related to previous comments or the sticker content, and information sharing regarding activities in the sticker's location.

No.	Category	κ	#	%
1	Positive Experience	0.85	69	57
2	Neutral or descriptive experience	0.87	39	32
3	Negative Experience	0.80	13	11
4	Reply to previous post	1.00	8	3
5	Reply to PlaceTagz content	0.83	85	33
6	Emoticons/ abbreviations	1.00	28	11
7	Humour	0.52	19	7
8	Asking a question	1.00	8	3
9	Referencing PlaceTagz System	1.00	12	5
10	Information sharing re sticker location	0.85	33	13
11	Referencing people in space	0.76	15	6
12	Off-topic and unrelated	0.72	10	4
13	Information sharing re activity in sticker location	0.76	40	16

Table 1: Categories for content analysis

Additionally PlaceTagz comments were coded according to the general tone of the reported experience. The following three categories have been established: positive, neutral or descriptive, and negative experiences. Text comments within the positive experience category have a positive notion in general or contain words, abbreviations, or emoticons which indicate a positive experience. Text comments within the neutral or descriptive experience category either describe the activity of the user while interacting with PlaceTagz or are commenting directly on the question asked within the PlaceTag not using any words indicating emotions. Text comments within the negative experience category have a negative notion in general or containing words, emotions, or abbreviations indicating a negative experience. However, these negative experiences are not necessarily directly related to interacting with PlaceTagz but rather sharing a negative experience within the physical space with other users. Following this method of coding each comment was assigned exactly one of the general notion or experience categories as well as all

Location	PlaceTagz Content	Reply No.	User Comment	Coding Result
Public Toilet	Feeling better now? There is no other place where you could be more concentrated and relaxed at the same time…	1	Highly recommended device, overall a good experience. The sensor for the lights is on the fritz though, but the darkness merely added to the relaxing environment.	1, 5, 10
		2	Yeah the lights in here are farked! Love pooping in the dark!	1, 4, 7, 10, 13
		3	At least it's clean, some of the toilets here are filthy, seriously if you screw around in a toilet you shouldn't be at university. What does the writing on the door mean? Also how good is laying a cable/backing one out before an exam…good strategy I think.	2, 4, 7, 8, 10, 11, 13
Public Toilet	Feeling better now? There is no other place where you could be more concentrated and relaxed at the same time…	1	Awesome idea :-D	1, 6, 9
Public Toilet	Feeling better now? There is no other place where you could be more concentrated and relaxed at the same time…	1	I do feel much better. Also, it's Friday, which helps. Where does my message go by the way?	1, 5, 8, 9
		2	It's time we ladies stopped putting up with scratchy toilet paper!	3, 10, 11, 13
Coffee Machine	Have you rinsed the milk frother? Coffee police is watching you!	1	I'm bored. Make a Coffee!	2, 13
		2	Milk is sour again!! :-(	3, 6, 10
		3	I'm down to my last capsule! Where is the dealer Ronster?	2, 8, 11
		4	Ahh coffee the great social lubricant.	1, 13
Window Bay	What are you working on @ The Edge	1	Meeting of UQVieSA	2, 5, 13

Table 2: Example comments and their coding with the coding numbers from Table 1

applicable content categories describing the comment. The content analysis required 1573 decisions to be made by the coding team for the 121 PlaceTagz comments.

Two researchers coded the PlaceTagz comments independently and compared the results afterwards. In the case of a disagreement, both researchers discussed the content and recoded it towards the agreed categories. In general, agreement between both coders was high with κ ranging from 0.72 to 1 testifying meaningful categories [11]. One exception was the humour category with a κ value of 0.52. This midrange value can be explained due to the subjective nature of humour and how the location of the PlaceTag, activity, or collocated people while submitting the comment generated inside jokes not directly visible to the researchers. Overall, 74 disagreements between both coders have been discussed and recategorised according to the results. Table 1 lists the κ values of the content analysis as well as how often a comment has been categorised into the respective category. Table 2 shows examples of comments and how they have been categorised.

In addition to the content analysis, semi-structured interviews have been conducted in order to get richer insights into the motivation of using PlaceTagz and the user experience. To recruit study participants a simple web form has been displayed to users after they left a comment on a PlaceTag. The web form, which has been set up in November 2011, asked users to leave an email address to participate in an interview. However, due to the real world deployment of PlaceTagz and since many of the PlaceTagz were deployed in public toilets, the response rate was low. We assume that many people who left a comment would not feel comfortable talking about their interaction with PlaceTagz while using a public toilet. Nonetheless three participants were interviewed who left comments at

PlaceTagz deployed at The Edge. Participant 1 (P1) is a 21-year-old male university student. During the interview, P1 revealed that he also scanned a toilet sticker at the university campus. Participant 2 (P2) is a 36-year-old male communication advisor who also left a comment at The Edge. Participant 3 (P3) is a 43-year-old male project officer who left four comments and scanned various PlaceTagz around The Edge. Each interview took between 15 minutes to 20 minutes and each participant received an AU$10 coffee shop voucher.

FINDINGS

The 121 PlaceTagz comments have been assigned 258 categories in addition to the three general categories in regards to the overall experience or notion.

As shown in Table 1, more than half of the submitted comments (57%) had a positive notion and communicated a positive experience towards the overall PlaceTagz system. As an example, the simple and short comments such as "*made my day :-)*", "*lol*", "*very inspired*", or "*Bahaha*" clearly show that content discovered behind the scanned QR was perceived as fun and entertaining.

Nearly one third of the received comments had a neutral notion in their response and mostly directly replied to the PlaceTagz content (54%) or either described the activity (33%) or place (15%) within the PlaceTagz context.

The comments classified in the negative notion or experience category (11%) mostly commented on the place (46%) or the activities (46%) within the place.

The following subsections investigate the results of the content analysis incorporating data from the semi-structured interviews under the people, place, and technology paradigm of Urban Informatics [10]. Additionally we discuss the findings in light of having PlaceTagz deployed and studied in actual urban public places rather than in a lab environment.

People

A small percentage of PlaceTagz comments referenced people who were either collocated at the same time, have been at the place prior to the commentator, or addressed their comment towards future occupants of the space. With PlaceTagz we wanted to investigate if such an approach can create digital narratives or conversations over time. Only 3% of the received comments have been categorised as replies to previous PlaceTagz comments. The first example in Table 2 shows such a dialogue between people who have used the same space over time. While these dialogues are only a minority of the received comments, we argue that it is possible to create digital narratives or conversations over time. However, the content on the website and the previous comments are the crucial factors influencing the creation of conversations. While the first example shown in Table 2 exemplifies a digital conversation, PlaceTagz deployed at The Edge asking: "*What are you working on@The Edge? – Work, play, or just enjoying the view... what's on your agenda?*" simply stimulated exact responses to the stated question leaving not much impetus for additional conversations. P2, who left a comment on the above mentioned PlaceTag however describes his interaction as contributing to a conversation. While we did not categorise these comments as conversations in terms of replying to other people's comments, the study participants perceived them as such or rated the comments as valuable. P1 explained that he liked to be able to see what other people have done in the same space in the past resulting in a positive experience through using PlaceTagz "*because you always want to hear what other people have to say about it*".

Sharing lightweight text comments in urban public places can raise the awareness towards people who used the same space in the past. Research in urban sociology showed that people and their activities are seen as most rewarding while spending time in urban public places [12, 31]. PlaceTagz enable urban dwellers to access, read, and contribute to a digital layer of social information relating to a space.

This research project was also interested in the question whether people are curious enough to scan QR codes when they are attached in urban public places without contextual information hinting at their purpose. Curiosity was one of the main factors why the three interviewed participants scanned the QR codes. P2 explained that he was curious about the QR codes. "*They are usually embedded in print ads or something else whereas this was kind of intriguing. Having it kind of by itself. Like it didn't give its context really out*". P1 and P3 also stated that they were curious "*to see were it led*" (P3). Additionally, Figure 5 shows a large PlaceTag, which has been physically augmented by an unknown person with a sticker stating, "*This inspires curiosity*".

Place

The location-awareness of the PlaceTagz through the icon next to the QR code and the displayed content on the website stimulated comments taking the location of the sticker into account. P3 states that the interaction with PlaceTagz "*felt like it was location specific because of the image. Like in the men's toilet there was a little men's toilet symbol so I thought this isn't the same barcode just splattered around everywhere*".

Out of the 121 analysed comments, 13% of the PlaceTagz comments generally referenced the place and commented on its characteristics and 16% of the PlaceTagz comments referenced the activity within the place. One PlaceTag attached at The Edge asked on the respective website "*I like The Edge because…*" which generally provoked positive place related answers such as "*It has a nice view :)*", "*great seats, great games, great vibe*", and "*it's a place where chance meetings can lead to new ideas*". On the other hand, place related comments on stickers placed at toilets mostly contained negative notions towards the place in regards of hygiene conditions. It appears that the geographic context

in combination with the digital information of the PlaceTag essentially influences what sort of comments are received. P3 states that the digital content would influence what kind of comment he might leave: *"If they all had something like 'What would you like the person following you to know about exactly this location' then I might go: 'I like them to know this or did you notice that' and then it would encourage me to be specific about this location and my comments and to not comment about life in general"*. The initial content on the digital representation of each PlaceTag was established at first to provide a conversation starter. P2 explains that he was waiting at an event to start at The Edge so he was "*carrying on the conversation what was someone doing at this place*". P1, who left a comment at the coffee machine at The Edge states: "*I thought it is an easy way to provide feedback. I didn't have to talk to anyone. I didn't have to do anything too labour intensive. It gave me something to do while I waited*." Stickers, which were placed at locations where people usually have to wait, receive more comments than PlaceTagz deployed in locations where people pass through (for example water fountains).

While waiting in a public urban space, the physical hyperlinks in form of QR codes symbolise the availability of digital information. "Adding a digital layer to the existing physical and social layers could facilitate new forms of interaction that reshape urban life" [20]. Usually, the digital layers of the urban environment are not physically visible to urban dwellers. People might have checked in at a specific place on Foursquare or Facebook resulting in shared recommendations, photos, or other digital information. These digital augmentations however are not physically represented at the urban space. The employed QR codes utilised for PlaceTagz act as physical markers in the urban space for an openly accessible digital layer containing digital augmentations and interactions.

Technology

All study participants had prior experience with scanning QR codes and explained that most of them are used for advertisement. P1 states, "*if it is very obvious I ignore it because I think it might be advertisement. Whereas the quirky little ones in the corner, I want to see what's it about*". The unusual location where PlaceTagz have been deployed motivated users to scan them, or as P2 explains: "*I haven't really seen them like as guerrilla stickers*". P3 states that he usually scans QR codes wherever he finds them but PlaceTagz were the first QR codes which let him interact and accept social interactions.

A small percentage of comments have been categorised as referencing the PlaceTagz system. Due to the novel and unknown concept we received comments asking, "*Where does my comment go by the way?*" or in a more humours way if PlaceTagz is some sort of "*Intimate Details Viral Marketing?*" Others commented that "*QR codes in random places is cool*" or that it is an "*awesome idea :-D*". One user stated his expectations towards the PlaceTagz system and was disappointed to find an empty PlaceTag without comments. This particular user left three comments on three different PlaceTagz, all deployed at The Edge stating: "*What's going on here? There should be thousands of posts here! :p*", "*I'm a lonely place tag in a sea of toilets*", and "*Tumbleweeds*". These comments are a good example of the co-experience [5] created through PlaceTagz. A user who scans a PlaceTag without previously submitted comments will have a significantly different experience then a user who scans a QR code containing various comments. This experience is further influenced by the content of the previous comments and has an impact on future comments in terms of sharing, empathising, rejecting, or ignoring the previously shared experience.

Additionally, Table 1 shows that 33% of all received PlaceTagz comments have been categorised as a reply to the content presented to the user after scanning the QR code. During the data collection time frame, we noticed this trend towards answering stated questions or referencing the PlaceTagz content. The initial driving force behind this project, however, was to find out how physical artefacts linked to digital message boards can generate interactions and narratives about a particular space. To find out what sort of comments we would receive, we deployed 13 stickers out of the 150 deployed PlaceTagz which did not contain any textual information on the respective digital resource. These PlaceTagz without any textual content only received one comment total. It appears that the openness of an empty canvas alienates prospective users not knowing what to do with the digital system and what is appropriate to submit.

PlaceTagz in the Field

Mobile applications and services are ideally evaluated in an environment which is as realistic as possible to the final application context [16]. This implies that field experiments or real world deployments are the preferred method instead of lab studies. However, lab experiments are the commonly used method in mobile human-computer interaction research, because they are easier and more manageable than field experiments [19]. "An essential aspect of mobile and ubiquitous computing research is evaluation within the expected usage context, including environment. When that environment is an urban center, it can be dynamic, expansive, and unpredictable" [17].

PlaceTagz have been deployed and studied in its designated application context: public urban places. Through having PlaceTagz deployed in the field and made available to urban dwellers, we found that the life cycle of PlaceTagz can vary dramatically. For example, two stickers have been deployed in two outdoor elevators at the university campus in the morning. Both PlaceTagz had been already removed in the afternoon either through university staff and students or the cleaning employees. While most of the deployed PlaceTagz are still at their designated place at the time of writing this paper, others were removed within days, weeks, or month. Additionally, the physical characteristics

of PlaceTagz can change when deployed in urban environments. Some PlaceTagz, which have been placed outdoors, got washed out and made unusable from natural forces such as rain and sunshine.

Figure 4: Physical comments on a PlaceTag

Figure 5: PlaceTagz comments in the physical space

On two occasions we could observe that PlaceTagz have been physically augmented in urban public spaces. Figure 4 shows a PlaceTag deployed in a public toilet with a personal comment using a waterproof marker: "*Toilet door Man Do you take strange box as your lawfully wedded bride?*" Figure 5 shows a large PlaceTag, which has been physically augmented by an unknown person with another sticker stating, "*This inspires… Curiosity*".

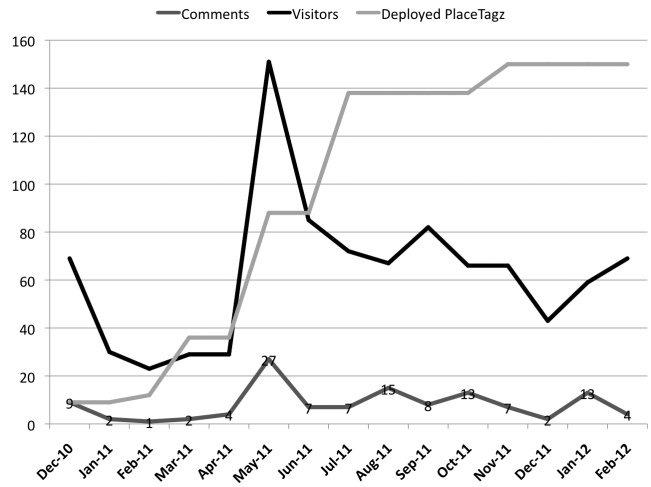

Figure 6: PlaceTagz usage statistics

These kinds of physical augmentations (in the case of Figure 4 some might call it vandalism), the fact that some PlaceTagz were removed or made inaccessible through the act of nature beyond our control, and that some PlaceTagz still receive comments after being deployed over one year ago show that sticker based QR codes are a suitable low-cost technology for design interventions deployed in urban environments.

On the other hand, QR codes are not commonly used in Australia. According to the Telstra Smartphone Index, a market research study conducted by Nielsen for the Australian telecommunications provider, only 17% of the respondents ever scanned a QR code with their phone in 2011 [29]. A comScore study for the US revealed that one out of five smart phone users scanned a QR code in December 2011 [8]. The majority of the scans took place at participants' homes while scanning QR codes on products to receive additional information. The participants interviewed for this study also mentioned that their prior experiences with QR codes was usually in an advertisement context.

The low rates of people using QR codes and the fact that many people associate them with advertisement resulted in an extend period of time needed to collect data through PlaceTagz. Figure 6 shows a diagram illustrating the amount of comments received, unique visitors who scanned PlaceTagz, and the amount of PlaceTagz deployed. As mentioned earlier, there is a discrepancy between the amount of PlaceTagz deployed and the amount of PlaceTagz still in place. Therefore, while the graph showing deployed PlaceTagz increases over time, there is no increase in received comments. The peak in May 2011 can be explained through a major event held at The Edge. Figure 6 also shows a discrepancy between people who scanned a PlaceTag and the actual amount of comments received. Research on online communities found that a large amount of members do not actively participate in discussions, the so-called lurkers [21]. One reason why lurkers do not post is because simply reading is enough for

them and they do not feel the need to post [25]. While online communities are mostly thematically focused around a specific topic of interest, the heterogeneity of people in places where PlaceTagz have been deployed might have contributed to the discrepancy between people who scanned a QR code and read the content and people who actually submitted a comment and contributed to the digital layer.

Through having a design intervention deployed in the field and exposed to a variety of urban dwellers, the people, place, and technology factors of the studied artefact are as mentioned by Kellar et al. [17] dynamic, expansive, and unpredictable. On the other hand, a methodological approach based on a simulated environment would not have generated the findings and experiences as presented in this paper.

The data from the interview participants and the collected comments presented in this paper shows that highly unique QR codes (in the case of PlaceTagz each QR code was redirecting to an individual website) in combination with interactive and location aware content are perceived as novel, interesting, and intriguing and can stimulate digital augmentations of urban spaces.

LIMITATIONS AND FUTURE WORK

Due to the real world deployment, this study has some limitations. As discussed earlier and visualised in Figure 6, there is a discrepancy between how many people scanned a PlaceTag and the amount of comments received. To gain a more general picture about PlaceTagz, it would be beneficial to investigate why urban dwellers did not leave a comment after they scanned the QR code. Additionally we would be interested if and how this user group perceived PlaceTagz. Researchers studying users lurking in online communities have access to their virtual presence. In the case of PlaceTagz, lurkers are only physically present at a specific time and place. Furthermore, the majority of PlaceTagz have been deployed in public toilets, making it impractical to get access to this user group. The second limitation of this study is that we could only find three interview participants. These three participants provided valuable insight into their motivation and experience interacting with PlaceTagz. However, more data especially from people interacting with PlaceTagz in the university location would generate more diverse insights into the variety of motivations and experiences PlaceTagz might create. On the other hand, the three interview participants were users who interacted with our system in its real world context without having any enforced incentives.

This exploratory study paved the ground for future work in the area of physical artefacts deployed in urban public spaces linking to location-aware interactive digital content. In the future, we want to redesign the workflow of creating PlaceTagz stickers, enabling urban dwellers to create and deploy them in their desired locations. In this study, the locations of PlaceTagz and the content creation were based on the authors' ideas. The empowerment of urban dwellers to create and deploy their own DIY PlaceTagz might create a variety of new, interactive digital content ideas and installations beyond the authors' ideas and the usage context described in this paper.

CONCLUSION

This paper presented our study on PlaceTagz, QR codes printed on stickers linking to digital message boards enabling collocated users to interact with the place and each other over time resulting in a place-based digital memory. PlaceTagz have been deployed in various urban public places and collected comments and interactions from urban dwellers. This paper presented the findings of a content analysis of the received interactions and interview data of people who interacted with PlaceTagz. We also discussed the implications and shared our experiences of deploying a QR code based design intervention in the field.

We found that PlaceTagz and the employed QR codes, which do not contain any contextual information about their purpose, piqued users' curiosity about the linked web location. PlaceTagz deployed in locations where people wait for an event received the most interactions. The location awareness of PlaceTagz and the interactive content was perceived as novel, interesting, and intriguing by urban dwellers. While only the minority of the collected comments were directed at previous interactions, the collected data showed that people shared information about people, place, and technology and that the initial content plays a major role in what sort of comments might be received. All these factors can positively influence the experience of people while interacting with PlaceTagz in space or as the poet Dorothy Parker stated: "*The cure for boredom is curiosity. There is no cure for curiosity*".

Overall, this paper provided insight into how people can be inspired to engage with their physical surroundings using mobile phones. This engagement adds a digital layer to the existing environment, resulting in people interacting with their surroundings and possibly developing a new perspective of their city and other urban dwellers.

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