Pinsight: A Novel Way of Creating and Sharing Digital Content through 'Things' in the Wild

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ABSTRACT

Existing platforms for sharing locative digital content rely on the use of mobile phones for accessing the content. This can be a major deterrent to wider public access and also hinders immediacy and 'in the moment' discoverability. Building on previous work in situated public installations, we developed *Pinsight*, a novel platform for enabling end-users, such as local communities, to create and share digital content in-situ with public audiences through physical interactive devices. *Pinsight* is based on a set of design principles that focus on supporting both the expressiveness of content creators and the appeal to public audiences. This paper describes the design of the platform and how it supports sharing knowledge in ways different to conventional media. Through preliminary evaluations and two in-the-wild studies, we explore how such a situated technology can be used by different user groups (content designers, history communities, local residents) for sharing content with public audiences (visitors, pedestrians, residents) in different contexts.

ACM Classification Keywords

H.5.2. Information Interfaces and Presentation (e.g. HCI): User Interfaces – Interaction Styles

Author Keywords

Situated display; authoring tool; locative media; tangible interfaces; public engagement.

INTRODUCTION

Placing digital information in the physical world allows users to experience it in the moment and its natural context. This is particularly powerful for telling stories, sharing ideas, and providing contextual knowledge relevant to places. Existing platforms are commonly based on websites [8] or mobile applications [29]. Most approaches in Locative Media [4], for example, allow users to link multimedia files to SMS codes,
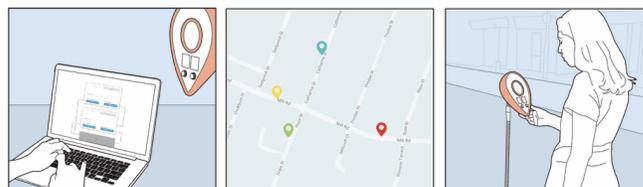
Figure 1. *Pinsight*: a user creates content with a web interface, content uploaded to a Pin device; multiple Pins distributed at public places; passers-by interacting with a Pin through two buttons.

QR codes or beacons placed in the environment. Another recent approach is mobile augmented reality [9], which overlays digital information on top of the surroundings to be seen on a screen. However, all of these approaches require passers-by to use an app on their mobile phone or a customised handheld device provided by the content provider to access the information. The additional steps of installing apps or scanning codes can limit accessibility and disrupt the 'in the moment' experience. Another approach is situated physical walk-up-and-use installations [16], which have been used to share community-relevant information or collect public opinions in ways that engage the broader public [34, 23]. However, these do not actively support end-users in creating content.

Recent research on public displays and installations shows that opening up content creation to citizens can have positive effects on community members' reception of the technology and their willingness to use it [33, 31, 37]. While some community-based public installations do allow members to contribute content via text messages [37], web applications [33], or taking photos [25], they are fixed-location kiosk systems that cannot be easily moved. Besides, while such installations focus on encouraging participation, little work has investigated how to enable end-users to create content in ways that are engaging for other members of the public.

We were interested in how, when given the opportunity, different user groups create content for passersby to approach and read - rather than it being developed a priori as part of a webpage. To this end, we developed a novel media platform – *Pinsight*, that can support both the creation and experience of location-relevant digital content via a set of physical devices (Fig. 1). The physical devices – *Pins*, were designed to be eye-catching and resemble the shape of digital location markers, to indicate the situatedness and draw in passers-by.

They were also designed to be situated yet mobile, robust and sturdy, so that they could be placed in streets, urban districts, parks, and other public places. To create content, a constrained and simple web-based authoring tool was developed. Such tool was intended to appeal to a range of users (e.g., local communities and content designers), to enable them to express their views, share local stories, and gather public feedback. The idea was to provide them with a structure that would help them to present content in a concise, intriguing and punchy way, rather than letting them write free-flowing prose. The hope was that this would then trigger passersby's curiosity in the content shown on the Pins and sustain their interest.

Compared with traditional content systems, such as websites or blogs, *Pinsight* was designed to be physically and digitally constrained; to scaffold user choices about what to write and how to sequence content so that it would be intriguing for others to consume. Our rationale was to enable users to dovetail between their nascent idea and how to make them interactive so that it would be appealing and sustain passersby's interest in a public setting. We assumed that having the physical device at hand while authoring using a structured template would enable them to switch between first person (themselves) and third-person perspectives (i.e. the public who would read it).

This paper describes our design process and report on two in-the-wild studies demonstrating how *Pinsight* was used by two different communities: (1) local history community members sharing knowledge about historical buildings on urban streets; and (2) local residents sharing topics about the neighbourhood at a street party. We discuss how the various constraints we put into place were essential for helping community members get started and transform their ideas into engaging public experiences. Furthermore, we show how the social and spatial contexts affected both content creation and consumption in different settings.

RELATED WORK
There have been a number of approaches and platforms that allow users to share digital content in-situ. We describe these regarding two broad categories: locative media and situated installations.

Locative Media
Locative Media [4, 35] connects content to places, where the content is often related to social, historical, and cultural features of the place. Early Locative Media used location-tracking on mobile devices. Now, location-based social media platforms allow users to contribute content registered to GPS locations, which get viewed by others as nearby information or locations on a map interface. For example, Foursquare[1], a location-based social network allows users to 'check-in' to places and leave reviews or personal content.

Other approaches that enable users to 'tag' digital content in the physical world include the use of SMS / QR codes, beacons, mobile augmented reality (AR), and tangible user interfaces (TUIs). For example, *Yellow Arrow*[2] allows users

[1]https://foursquare.com/
[2]https://brianhouse.net/works/yellow_arrow/

to place stickers featuring a unique code on objects in the street; passers-by could then send text messages which later were received by the owner of the sticker. Balestrini *et al.* [3] engaged a community to preserve its heritage by placing QR codes linked to videos created by community members in-situ. *Tales of Things* [8] is a website that allows visitors to upload text and photos about stories or memories related to vintage objects, which are attached to those objects via QR codes. *ButterflyNet* [38] enables users to link handwritten notes to multimedia files in an augmented reality notebook, which can be viewed as an overlay through the screen of a mobile phone. TUIs have been developed that allow people to create and share stories by recording and attaching audio to physical objects, such as a memory box [12] or toys [17].

The above approaches all require the use of mobile devices for viewing the content, such as by scanning tags or opening applications to access content. This either makes the content hard to be noticed, or creates barriers that limit access for a broad public audience.

Situated Installations
In contrast to location-tracking technologies, situated installations are tethered and fixed in a given physical location, intended to attract public audiences when walking past them. They have been used for entertainment purposes [26, 14], citizen participation [23, 34], and for gathering feedback on events [15, 13, 16] and locally-relevant issues [32]. Many are designed to allow the public to add their feedback or comments. For example, *Wray Photo Display* [33] was developed to enable residents to contribute photos of their community events as a way of sharing and preserving their memories. In *Beyond YouTube* [7], video stories co-created with housebound people were publicly displayed at a local community event. *Moment Machine* [25] allowed passers-by to take situated snapshots through a camera placed in a public community setting.

A few installations have been designed to encourage the general public to contribute their content. SMSlingshot [10], for example, was a public installation that allowed visitors to 'shoot' text messages onto a large public display using a device that resembles the shape of a catapult. The Madeira Story Generator [30] encouraged passers-by to post text messages to a large physical public display in an airport. However, they found that passers-by did not feel comfortable creating content on the spot. In contrast, invited writers were more self-motivated and excited by the possibility of publishing content in such a way.

Some recent work has begun to explore how citizens create content when given new technologies. *Open Window [37]* allowed citizens to control the content of a public display through interfaces placed on windows of local households. While this approach facilitated a sense of community, it was difficult to sustain engagement over time and to know who should be responsible for sharing the content. In contrast, *PosterVote* [36], was designed as a DIY paper electronics kit specifically for local action groups, to enable them to build a low-cost voting system for public deployment. It was found

to be a promising approach for opening up the ownership of situated public installations.

Enabling local people to create content, however, is challenging – not least working out how to allow local communities to create content that they feel a sense of ownership, that is relatively easy to develop and which can be enjoyed when shared with other members of the public. *Pinsight* was designed with these challenges in mind, enabling local people to create content in a constrained and accessible way, being guided by where and how it would be accessed in a given locale. In particular, we were interested in how limiting the authoring tool for creating content would affect how people went from their ideas to the published public content.

DESIGN PRINCIPLES AND RATIONALE

Our design goals were twofold: (1) to entice and support creators in sharing context-relevant content through interactive devices placed in-situ, and (2) to attract members of the public. To achieve them, we used the following set of design principles and constraints: conveying situatedness through a digital-physical metaphor; attracting passers-by through simple interactions and a physical form factor; balancing flexibility and complexity through constrained, text-based input; and enabling two-way communication. We describe each in more detail next.

Conveying Situatedness with a Digital-Physical Metaphor

Metaphor. It is well known that the use of physical metaphors can have a motivating effect on public audiences [27] and provide a *"cognitive lens"* [21] that helps users to intuitively comprehend the purpose and usage of a system [11, 21]. Here, we were interested in what happens when you reverse this conceptual approach: going from the digital to the physical. Do the same benefits occur and make users readily understand what the device is intended for? To explore this, we applied a well-known digital metaphor – that of the ubiquitous location pin used in digital maps – to the physical world. The aim was to convey the devices' relevance to their locative contexts by applying a familiar and relevant metaphor to their form factor. It was hoped this process of turning the digital 'inside out' would encourage content creators to come up with context-related content, as well as indicate the place-relevance of the content to the public.

Mobility. Context can strongly influence how passers-by interact with public installations [2]. Rather than create public installations that need to be tethered and have a power supply, we wanted to create a device that could be placed in different contexts - both indoors and outdoors - for example, secured to benches, fences, or floor stands.

Attracting and Holding the Attention of Passers-by

Physical Affordances. Drawing attention to a public device can be challenging [28]. Many people either do not notice them or choose to walk past because they are in a hurry or not wanting to approach a strange device located in their pathway. To overcome this threshold, researchers have created a variety of physical interfaces that entice and make people feel comfortable when approaching them [13, 19, 16, 15]. To

Figure 2. Design of the *Pin* devices: form, interface and hardware.

draw passers-by to the physical pins, we designed them to be brightly coloured and to have a high-fidelity look (see Figure 2). We also chose only to let passers-by interact with the digital content via two physical buttons to make it intuitive to use and require little effort on their behalf [13].

Interacting by Making Simple Choices. People can easily give up using a public display if the interface is confusing or their actions do not result in expected feedback from the system [18]. The need for navigation support when developing public displays is even more important to get right [16, 20]. Based on this, we constrained navigation to make a two-option choice at each stage of the interaction.

Balancing Flexibility and Complexity

Constraining Input. Applying constraints is an established strategy in HCI design [39], for GUIs, smart devices [24], and home IoT systems [6]. Our goal was to support the creation of interactive content while providing the flexibility for content creators to use it for multiple purposes, including expressing ideas, telling stories, asking questions, etc. One constraint was to enforce a character limit (cf. to Twitter) to make content creators think about how to make content precise and salient. Likewise, we provided them with answer fields with the purpose of encouraging interactive content with a conversational style. The hope was to provide enough scope for creators to produce different material but to make it easy to do so using constrained content templates.

Text Modality. We started with providing only a textual modality to minimise the complexity of content creation. Images and videos may be added in the future. We chose text over audio because the devices are placed in public spaces where noise is often a significant and uncontrollable factor.

Enabling Two-way Communication

Visualizing Public Responses. Previous work has shown how visualising people's responses when interacting with voting devices, distributed in a local community, triggered much discussion amongst the locals and passers-by [22]. We developed the *Pinsight* platform as a series of networked devices to enable content creators to author content and view public responses to it. Creators can view how their content was responded to by the public from the authoring tool. This enables them to not only present information but also to collect information from the public.
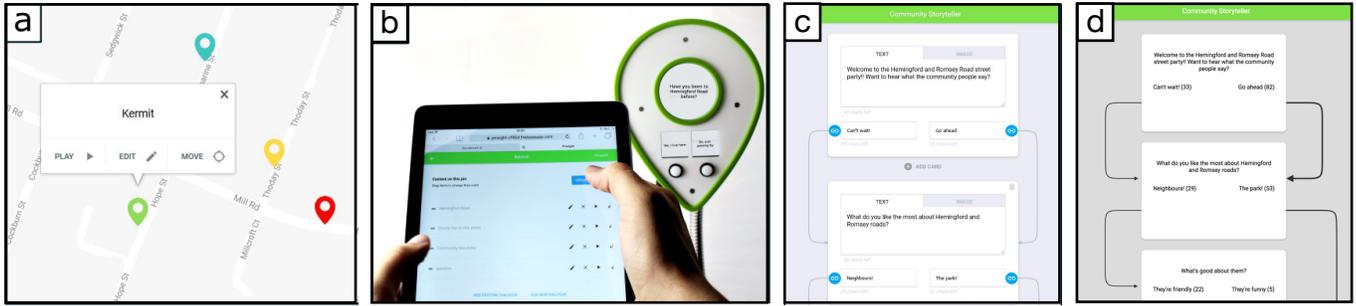
Figure 3. Content creation interface: a) interface showing all the Pins and the green Pin being selected; b) interface on iPad showing the dialogue list in the green Pin beside, uploading content to the Pin by pressing a button; c) interface for creating cards and link them into a dialogue; d) viewing public responses to each card in a dialogue after deploying the Pin in public.

PINSIGHT PLATFORM DESIGN

Much thought went into how to make the *Pinsight* platform easy and intuitive to use. Inspired by early end-user hypermedia tools, such as *HyperCard* [1], we used linked cards as a metaphor to assist in the act of creating interactive content. We designed the content format to enable simple *conversational-style* knowledge-sharing between content creators and public audiences. The basic unit of content is a *Card*, which consists of (1) a statement or question (max 140 characters) and (2) two optional answers (max 40 characters each). Each answer links to the next card or the end of the conversation. This design is meant to encourage authors to phrase content concisely and segment and phrase content in ways that the content is accessible and playful for public audiences to read and respond to. A list of linked cards is then combined into an interactive *Dialogue*, which is ready to load into the Pin devices.

The Pins

The Pins were designed to have an LCD divided into three panels supported by two physical buttons (see Fig. 2). The round area displays a *Card*, which is the current content item (such as question or statement). The two rectangular field show the answer options; each can be selected via one of the two physical buttons. Upon selecting an answer, the next content item is displayed. In this way, the user can navigate through the content, step-by-step at their own pace. A Pin device can host multiple Dialogues, which are made up of Cards, and play them in a sequence defined by content creators. This is to support modular reuse of blocks of content among multiple devices. When no button click has been registered for longer than a minute, the device automatically resets to the first content item. This is to make sure that the next visitor can start the Dialogue from the beginning.

Content Creation Interface

An interactive map was developed to show the location of the Pins, which are represented virtually by coloured markers. Users can drag these around to indicate the location of their physical Pins (Fig. 3a). Clicking on a marker brings up a menu that allows the content creator to *Play* or *Edit* the content on the corresponding Pin. The *Edit* screen (Fig. 3b) Displays a list of Dialogues on the Pin. The content creator can create new Dialogues or edit, remove, and change the order of existing ones. Clicking on *Add Existing Dialogue* allows the content

creator to browse and insert other Dialogues saved in the cloud database. After they finish editing the digital content for the Pin, content creators can click *Update This Pin* to upload the new content to the physical Pin (Figure 3b).

When viewing or editing a Dialogue, the content creator is presented with the Cards that make up that Dialogue (Figure 3c). Cards are displayed vertically, where each Card's answers can be linked to other Cards via two *Link* buttons. New Cards are created by clicking *Add Card*. The content creator then decides what content the card will have and which answer options link to what Cards. As such, different kinds of interactive content can be created, including interactive stories with or without branches (multi/linear); questionnaires with closed-answer options; or facts, opinions, and other memes, with interjections or non-committal remarks as answer options.

Content creators can view the public responses collected from the Pins by clicking the *Data* icon on the *Edit* screen of any Dialogue. It shows a simple flowchart with numbers of clicks on each card of the dialogue (Figure 3d).

Implementation

Each Pin runs a local Node.js server that hosts a GUI as a website as well as a local database (MongoDB) that syncs with the cloud database when the Pin is connected to the Internet (Figure 4). A local server collects public response data and saves them to the cloud database. The enclosure was made out of PLA (a 3D-printed body), Acrylic and aluminium. It houses the screen, buttons, and a Wi-Fi-enabled Raspberry Pi. The Pins were designed to be battery-powered. They also were designed to be portable and attached to existing objects or stand alone on bases.
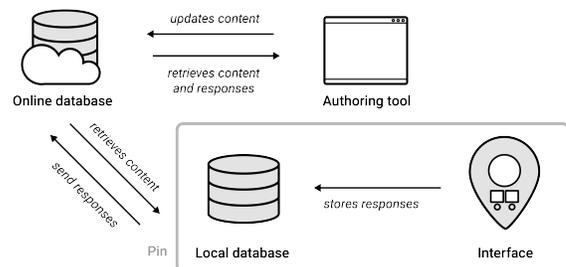

Figure 4. Illustration of the back-end of Pinsight platform.

PRELIMINARY EVALUATION

Two pilot studies were conducted to determine how well the concept and design of *Pinsight* were understood and their usability for both content creation and public appeal.

1st Pilot Study Evaluating Public Acceptance

The first pilot study was run to test public acceptance of the pin-shaped design and gather feedback for designing the content creation interface. Two pin devices were deployed at a university event, where researchers were demoing their work and running discussions. We provided the Pins to help booth owners and event organisers engage visitors. Two booth owners and one event organiser created content with pens and paper in a template we provided. We then hard-coded the content into the devices and placed the Pins at places chosen by the creators. One Pin was placed outside of an exhibition tent to attract visitors to come in. The other was situated close to a discussion table to act as an ice-breaker and invite people to join in.

Findings

A 3-hour observation of the pins showed that they attracted some passers-by. People immediately understood how to interact with the two-button interface. However, content creators experienced difficulties with our chosen content format. In our initial design, content consisted of a sequence of cards, each of which included five elements: a statement/question, two answers, and two responses to those answers. We found creators had to manage too many elements at the same time. Based on this, we simplified the content unit to our current design: only a statement or question and two optional answers. A content creator could choose not to create answers and instead allow audience members to go through a linear stream of content, or create new cards without answers as responses. This made the content structure simpler and more flexible for various purposes, including Q&A, stories, and facts.

2nd Pilot Study Evaluating Content Creation

The second pilot study aimed to evaluate the flexibility of the content creation platform under our newly chosen constraints. Ten volunteers (3 male, 25 to 45 years old) were recruited via a professional mailing list of content designers, to attend a workshop where an interactive Pin without an authoring tool was presented to them. After an introductory demo, they were split into four groups and spent 30 minutes creating scenarios and content and 15 minutes on a discussion. They created content with pen and post-its using an unlimited number of Pins within scenarios where they imagined *Pinsight* being used.

Findings

All participants came up with different use cases and found the constrained content format effective for transforming their ideas and thoughts into content. Group 1 designed a treasure hunt around a park where they envisioned the Pins being placed next to attractions; Group 2 envisioned the Pins being used to facilitate a guided tour around a touristic city square; Group 3 suggested using the Pins to point out exciting places around a train station to waiting passengers, and Group 4 suggested using the Pins to engage conference attendees accessing

Figure 5. Content creation workshop with the local history community.

policy websites. All of the use cases proposed using the Pins as a way to make invisible information visible in-situ, where this hidden information could be hidden histories, surroundings to explore, fun facts, or ongoing activities.

This format of content creation was found to be useful for structuring their ideas. For example, groups created content that was phrased in questions to trigger interest. The dialogues were also designed frequently as quizzes. One participant mentioned how a quiz makes it less intimidating for the public to find out about something they do not know yet. Another participant indicated that the content should be kept simple so that the readers would not feel pressured. During the content creation session, participants put effort into adapting their content using the binary choice constraint, such as writing hierarchical questions to overcome the limited options. Nevertheless, participants considered the binary choice format to be a positive constraint. They mentioned how the restricted number of answers forced them to keep the content simple. This suggests that having a constrained authoring tool could help creators streamline their content to keep it simple while sufficiently engaging for their audiences.

However, sometimes the sequencing of question-answer content was found to get quickly complicated. Therefore, we chose a simple linear card layout in the authoring interface, instead of a flowchart interface, to encourage authors to keep their content relatively simple.

PINSIGHT STUDIES IN THE WILD

Following these initial pilot studies, we conducted two in-the-wild studies using a set of four Pins to investigate how *Pinsight* is used to create and share digital content in different contexts. The aim was to see if *Pinsight* is an effective tool for enabling different user groups to share digital content in-situ. We were also interested in understanding what new forms of knowledge sharing it supports and how the setting it is placed in affects content creation and consumption.

CASE STUDY 1: LOCAL HISTORY COMMUNITY

In this study, *Pinsight* was used by a community dedicated to preserving and sharing local histories about their town. Although they had a website that archived local histories contributed by the residents, they struggled with limited public
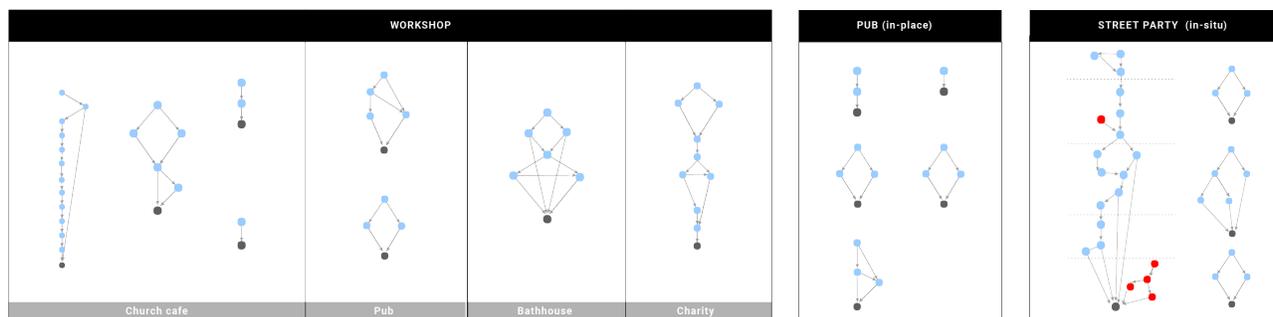
Figure 6. Visualisation of structures of all the dialogues created in Study 1 and 2. Each blue dot is a card and each arrow is a link. A group of connected dots is a dialogue. Black dot represents the End of dialogue. At the street party, a long dialogue was co-created by 5 groups subsequently building on previous content (separated by dashed lines). Red dots are orphan cards that cannot be reached by readers due to the authors forgetting to add links.

visibility of the content. We provided a brief demonstration of *Pinsight* at a community meeting, where interested members then signed up for a free workshop to create content via the web-based CMS. These volunteers created content for four sites along a historical road. The locations were pre-selected by a community champion who based the decisions on the historical material available and practicality for deployment. We deployed four Pins for two days, one for each location, after the content creation workshop.

Content Creation Workshop

7 volunteers attended the workshop; 5 senior people and a couple in their 30s. They were split into four groups based on the historical site (Mill Road, Cambridge) they were interested in creating content for: one group of three chose the church cafe (Group 1); one group chose a re-purposed bathhouse (Group 3, one was an admin of the house); one person chose a community pub (Group 2); and one person chose a charity building (Group 4). One Pin and a laptop running the web-based CMS was provided for each group. They were also provided with paper documents about their site. Volunteers were told to freely come up with what topics to create content for (in terms of history, memories, or facts, etc.). Each group had one facilitator to show them how to use the interface and help them overcome technical issues without interfering with their ideation process. Four observers took notes about their comments and creation experiences. We present findings using a Thematic Analysis, conducted on the notes collected.

Content Types and Structures

In the 45-minute session, participants created eight stories of various lengths and structures (Figure 6). They started by spending some time brainstorming topics. They also looked at the historical material provided or searched online for more detailed and accurate information about their site. All dialogues started with a question. None used the first person. The shortest dialogue (with only one card) asked if a particular restaurant had the best breakfast. Three short dialogues (2-4 cards each) were about simple historical facts, such as the year in which particular events happened. Two complex dialogues used branching to tell local histories and archaic lifestyles step-by-step. Two dialogues provided external web links for people to find more information. Three dialogues asked for

people's opinion. Overall the participants created content that had considerably rich structure.

Although most participants created content about historical stories or facts about the place, one participant created a personal poem for their Pin (P1). This was the longest dialogue created; because he did not have enough time to finish it at the workshop, he went to the site where the Pin was deployed and completed it there. This indicates that personal content might create a connection that helps sustain the engagement of content creators in community settings. He commented on the Pins, *"[The Pin] communicates, that's what I like about it. People will engage with this more than with the computer."*

Consideration of Audience

Content creators were considerate of their audience but often forgot to test out their ideas using the physical Pins that were next to them. It appeared that they were completely engrossed in writing the content. Moving between first and third person perspectives was less apparent using the physical device than we had assumed. Instead, participants tried to put themselves in the shoes of the public: coming up with topics that they envisioned would be interesting for passers-by. As P5 suggested, *"Would they be interested in how much it cost to use them and whether there were saunas?"*

They were also concerned about the accuracy of the information they created as it was going to be presented in a public space. P7 also suggested that the content should be structured like a story, from nowadays to the past, instead of following chronological order of history, arguing that people would find this structure more interesting. One group was very cautious of avoiding language and ideas that might put people off and wanted to be polite. Another participant commented on the character limit, comparing it to Twitter but arguing that it would not be appropriate to use Twitter-style abbreviations on the Pin. P4 created a quiz question and added additional information to one of the answers. *"In this way we can feed more information to the user bit by bit."*

Learning About Linking and Branching

Linking and branching required some learning effort of the participants. However, participants quickly understood that they were creating paths for the audience to navigate through

the content. After making a quiz that branched the dialogue, P4 rephrased the follow-up content to reveal the correct answer in both branches, explaining *"Otherwise they could have to go around back again (to know the correct answer), right?"* A similar moment of realization was also observed in Group 1: *"Does every card need an answer? ... I guess it does or it won't move on?"*

We found that handling multiple threads of content can quickly become confusing for participants; indeed, branches were quickly converged after opening them up. The linear layout of cards seemed to be sufficient for their needs while being simple and mobile-friendly. However, participants made mistakes around linking or forgot to link response options. Future improvement of the interface could consider highlighting orphan cards and unlinked answers.

In-place Content Creation

Before deployment, the pub owner, who was not at the workshop, created her own content for the Pin placed in her pub. During deployment, she played an important and voluntary role in engaging the public. The pub owner and her bartender discussed what might be interesting to know about the pub. Aside from a few pointers from the researcher to follow up on branches she had created earlier, the pub owner showed a good understanding of the conversational structure and created humorous responses for different choices. In total, she created five short dialogues with 1-3 cards each (Fig. 6). Four were humorous and related to the pub, and one advertised a community theater show. One example of her content is as following: *"Guinness is our most popular beer. Guess how many pints we sold in 2016?"* with the response options *"2471"* or *"9051"*. While *"9051"* leads to *"Correct!"*, *"2471"* leads to: *"No, that was cider!"*

Compared to participants at the workshop, the pub owner appeared to have an easier time at coming up with content for the Pin. This might be due to the fact that she created the content in place, where she could see the pub and ask the bartender questions while ideating. The physical place seemed to have aided the brainstorming process, as well as 'put her in the shoes of the people' who would encounter the Pin. Moreover, the pub owner experimented where to place the Pin. She first placed it inside the pub, which received limited interaction due to limited footfall, and then decided to move it outside facing the street to attract more audience.

The Pin was installed on a table outside of the pub (Fig. 7). 10 out of the 27 observed interactions with the Pin were initiated by the owner. She and visitors were frequently observed laughing at the jokes on the Pin together. Occasionally, visitors were intrigued by the content and asked for more information. One visitor asked about the theater show mentioned in the Pin content and took away a flyer. The owner was delighted to see people laughing. She frequently asked them if they got the right answer. Reflecting on her observations of people using the device, she mentioned: *"What I found interesting is that they all started like 'um.... ' [makes a skeptical face] and they finish with a smile on their face."*

Figure 7. A passer-by interacting with the Pin placed at the pub while talking with the pub owner.

Public Experiences

The Pins were deployed and observed at four sites in the city for ten hours in total over two normal weekdays: (i) outside the pub, (ii) outside of the Bathhouse, (iii) outside the charity center, and (iv) inside of the church cafe. Being like flies on the wall, the observers sat at a distance and noted for each interaction incidence the number of people, group interaction (group decision, honey pot, hand over, shoulder serving, fight for access), the time and duration. An interaction incidence was recorded when an individual or group approached a Pin, and ended after all of them finished interacting with it.

The summary of quantitative observation data (Table 1) shows that across the different sites, Pins received very different public interactions. 77 interaction incidences were observed in total, involving 35 individuals, 33 groups of two and 9 larger groups. There were fewer group interactions at the Charity building (13.6%), which was next to a random pedestrian street, and the church cafe (12.5%), which had very little foot traffic and people mostly sitting in. Pins at the Bathhouse (40%) near a playground and the pub (33.3%) had more, possibly due to the places being more social and leisure-purposed. The average interaction time was the longest at the pub due to social interactions with the owner and within groups. In addition, we noticed that people were more likely to interact with the Pin at idle times than at busy times at the pub. They seemed to be more available for such experiences when they were not occupied by social activities, unless interacting with the Pin became part of the social experience.

Participants at the workshop predicted with confidence that the Pin G at the Bathhouse would be the most popular because it was on a busy street. Although low footfall probably led to the low interaction number at the Church cafe, we observed that

Location-Pin	Interactions	Group Interactions	Average Duration (Minute)
Charity-R	22	3	1
Bathhouse-G	20	8	0.7
Church Cafe-B	8	1	0.4
Pub-Y	27	9	1.9
Street party-R	24	11	0.9
Street party-Y	36	17	0.8

Table 1. Overview of observed public interaction incidences with the Pins (10 hours for Study 1, 1 or 2 hours for Study 2). The number of Interactions is the sum of individual and group interactions.

people on a busy street (Pin G) tended to rush over without interacting. Moreover, when they interacted with a Pin at a random place (Pin R), they did so cautiously and hesitantly. When a Pin was placed inside the cafe or pub, it enabled passers-by to ask the people working there what they were for. For example, 3 out of 8 visitors at the Cafe asked baristas about the Pin. As mentioned above, the pub owner played the role of local champion, inviting and giving 'permission' for people to interact with it. This was in line with previous research on the effect of spatial factors on public engagement [2].

Visitors also 'personified' the Pins. One found an abandoned cap on the street and placed it on a Pin. Another described the pin as having *"a lot of personality"* (P2). At the pub, people referred to the Pin as a 'quiz machine' or guessing game, whereas the Pins were called a 'robot' or 'questionnaire' at other sites. Occasionally people were observed to go through the content again to explore the other route of the dialogue (charity), or "win" the guessing game (pub). At the pub, an older audience member did not recognize the pin metaphor. After being told, she suggested a potential intergenerational issue in metaphor use: *P73: "In my generation we don't use Google that much. For me it looks like a lamp."*

Discussion of Study 1
Pinsight succeeded in enabling community members to create content for the general public by considering where it would be located and how it would be used. Local community members transformed their initial ideas for various topics including history, facts, opinions, poems, jokes, and advertisements. Participants were able to put themselves in the shoes of the public who might come across their content on the Pin. The easiest was when the content for a Pin was created in the actual location - the context and affordances of the drinks sold in the pub triggered in an ad hoc way examples of specific questions and quizzes. In contrast, it appeared much more difficult to know what to include for a participant who had done research and reading about a historical site beforehand. They were much more cautious and worried about whether the information was accurate and covered what was important and interesting.

The physical and digital constraints proved to be effective at guiding the content creation process and also eliciting different ways of presenting content about a place. For example, some of the participants used the authoring tool's constraints to reflect on how content could be structured differently, such as writing about the history of a place in reverse chronological order for the audience. The character limit also forced participants to come up with concise questions and ways of describing a place. It was also found to encourage the content being phrased in engaging ways (e.g., as quiz, in witty tone, in first person). However, it was also found that managing multiple threads of content was demanding and error-prone. Although participants were able to learn how to create content for *Pinsight*, it still required lot of effort. As such, it suggests short interactive narratives and quizzes are most suited for this type of public device.

Creating content in the place of interest can provide a source of inspiration when deciding which questions or facts to in-

clude in the content. As noted, the pub owner talked with the locals at her pub (something that is a natural practice) to get them to suggest ideas and give their approval of ideas. Being in place also allows authors to experiment themselves with different content and placement, as well as getting a sense of achievement when seeing people enjoying their content. Closer coupling between the location of where a Pin device is to be situated and the act of content creation appears to be a more successful approach. To explore this possibility further, we report on the second in the wild study which explored how content is created in-situ - this time at a local street party.

CASE STUDY 2: NEIGHBORHOOD STREET PARTY
Pinsight was next deployed at a street party taking place on a residential street and organized by the local neighborhood. For the initial authoring process, we set up a booth with a table; a laptop, an iPad and two Pins were placed here. The aim was to make it attractive to passers-by to have a go at creating content and uploading it to the pins (Figure 8). Two researchers were present at the booth to facilitate content creation, while another was noting down the comments and behaviour of participants.

Two further Pins were installed at opposite ends of the street party (about 30 - 50 meters from the booth) that had pre-loaded stories on them about nearby buildings. These were created by the researchers to provide an example of what the pins were. Both Pins also prompted passers-by who had interacted with them to then go over to the booth and create their own content.

Creating Content In Situ
Throughout a three-hour deployment, 8 groups of attendees at the street party (4 individuals and 4 groups with a mixed demographics from children to retired) created content for the Pins. Figure 8 shows one participant creating content and another group interacting with a Pin. At each site we observed much social interaction and discussion among the groups.

Content Types and Structures
The groups created a number of different dialogues using a question and answer format. 5 out of the 8 groups wrote in the first person, concerned with local topics, relating to the street, nearby areas, or the residents living there. One example question was, *"Do you think people are welcoming?"*

The dialogues created were typically short. As seen in Figure 6, the structures were simple, similar to the ones generated in the pub in Study 1. Most dialogues, likewise, had elements of wit and humor, for example, one person wrote a question: *"Do you know who lives next door?"* with two possible answers: *"Can't get rid of them!"* and *"Never seen them."* Another couple, likely referring to themselves, asked: *"What do you think of the strange people in Vinery Road?"*

Co-creation of Content
The most surprising observation was the creation of a long dialogue, built by five groups of strangers at different times (see Fig. 6). This seemed to result from fact that people when first coming to the both, interacted with the content created by others, and then added a further question(s) and answers.

Such chain writing enabled a more creative dialogue to be generated without anyone worrying too much about ownership.

Figure 8. In-situ content creation at the street party in Study 2.

As such, several people decided to contribute to the existing dialogue instead of creating a new one. In doing so, people drew inspiration from and built upon others' contributions. For example, a woman built upon the last question from the previous contributor by responding to that question with a related question: *"Do you know who has been living here the longest?"* was followed up with *"We know of a family who has been living here for 40 years. Did you know that?"* She then pursued the topic of local street life by creating a number of related items (e.g., *"Were you born in this street?"*). Others followed suit by asking about the neighbors and the local food store. In another instance, a man who created some of these follow-up items first scrolled through all the previous items before adding his own. In sum, people co-created a coherent dialogue series about the local life of the street.

Sometimes new content was left hanging when the authors forgot to link their new cards to existing ones (Fig. 6). This meant their questions and answers were not able to be cycled through by subsequent visitors. At which point the facilitator would remind them or help out making the link.

Learning About and Adapting to Constraints
Half of the creators used the authoring interface with minor assistance (e.g., correcting a link), while the other half spelled out the content for the researchers to type in, mainly due to practical issues (e.g., people carrying a baby or holding drinks). Two contributors experienced some initial difficulties with aligning what they wanted to ask using the constrained authoring tool template. After overcoming this initial hurdle, both came up with branched content to achieve their goals.

Audiences Becoming Creators
Having a Pin close to the content creation booth also motivated people to have a go at both. 7 content creators said they had interacted with the other Pins further away before coming to the booth. In general, people appeared to be delighted to hear that the content of the Pins at the booth had been created by people at the street party. Half of the content creators (4 of 8 groups) came back to see the public's responses to their created items. One teenager, for example, returned several times to the booth to see how people answered his voting question. One woman, who came to create content after interacting with the further Pins, suggested that the Pin interface could show percentages of others' responses after the reader answers a question.

Public Experiences with the Other Pins
As shown in Table 1, the two Pins with pre-loaded content attracted 47% group interactions, that was higher than in the first Study. We also observed that people were much more comfortable and proactive in the street party setting, where performances and exhibitions were also happening. In many ways it legitimizes looking at and taking part in what is made available, and hence makes it easier for passers-by to feel comfortable interacting with a novel technology in a public setting.

When asked after why they had interacted with a Pin, most people said they were attracted by the Pin's shape and color (I1). They were also curious to find out more about it (I2, I3). The Pins were considered fun and easy to use (I1, I3, I4, I5). One person commented that it was a 'a great technology about micro local history', and liked that it was about regular people rather than historical figures (I4).

Discussion of Study 2
This second study showed how coupling content creation and engagement with *Pinsight* in the same social setting triggered much curiosity among people at the street party, who often came in groups to have a go at interacting with a preloaded Pin and then going to the booth to create content. This suggests that places like street parties, festivals and pubs, where social gatherings take place and talking to strangers is legitimized, can facilitate the honey pot effect leading to diverse participation. Here, passers-by were encouraged to have a go by looking at others or by becoming part of the group creating content. In contrast, people often walked past the Pins without stopping when they were placed in a busy main street in Study 1. Even though the Pins were striking, they were unfamiliar and strange looking - making it uncertain for passers-by to know whether they could be approached or interacted with.

Being part of a group when visiting a Pin led to members collaborating and sharing ideas about content. Moreover, many of the street party goers took on both roles: being content creators and audiences. This suggests that bringing the creators and audiences closer, both socially and spatially, helps creators place themselves in the shoes of their audience and come up with content that is interesting for them. However, the trade-off for creating content on the fly is that people typically only create a short dialogue. This is not a problem, however, if the authoring tool allows for this kind of consequences 'parlour game', where each person takes a turn writing a phrase forming part of a set structure in order to generate a story. If anything, it can encourage more creativity and humour as participants having added their bits then subsequently see how it fits in with the others. A future application of *Pinsight* could be to explicitly provide a structure for playing consequences with coupled Pins connecting their content.

FINAL DISCUSSION
The in-the-wild studies have demonstrated how *Pinsight* was approached and appropriated in different urban settings. While it is well known that context is central to the success of public installations, here we demonstrated how it affects whether and how the general public is prepared to generate content and

leave it for others to see. Holding a workshop helped one community to produce material about the history of buildings in their street. Having a makeshift booth located in the street during a street party provided a space where local people felt both intrigued and comfortable creating content and observing what others have written.

Our studies showed that sharing ideas, jokes, local history and local knowledge through this physical device was effective at bringing content creation and consumption closer together - in ways that previous attempts have had limited success at achieving (for example, by asking the public to send text, tweets, etc., to public displays). Moreover, the coupling between generating and seeing content can be achieved using the same device, enabling people who would not typically send anonymous messages to a public forum to take part. As we witnessed, a diversity of people - often in groups - took part, rather than it being a single person typing a text message on their mobile phone.

The location-marker metaphor was useful in helping content creators elicit situated content; on the ther hand, the public did not seem to recognise it immediately and some referred to it as a robot or history kiosk when being interviewed. This suggested a barrier to applying digital metaphors in the physical world, possibly due to varying user demographics. However, this did not deter passers-by to interact with it. In fact, it still triggered curiosity - a significant reason for their interaction.

An obvious limitation of our approach is that it requires the public to discover the physical location of a Pin and to be in that place to use it. Mobile apps or websites have more potential to reach a wider audience across a larger space; however, event organisers are often disappointed at the low level of take-up with such approaches. Another limitation of our approach is that physical devices require more effort to produce and maintain than digital pins on an electronic map. Making the Pins low-cost and easy to set up may lower the barrier to adoption and encourage ownership, especially in community settings [36].

The events we deployed the pins at were designed as one-off events. It could be argued that this, in itself, is enough as a way of engaging a community in enabling them to share local knowledge and the likes with each other. It is also possible to consider other application areas where there would be more sustained use. For example, a participant expressed much excitement about how *Pinsight* can be used in her class to teach children to write interactive narratives. The Pins could also be used in college dorms, care homes, holiday resorts and conferences, where large groups of people have to live together for different reasons but do not know each other that well. The deployment of a set of distributed Pins and content generation booths could be installed by communities in ways they choose, to optimise new forms of social interaction, promoting new playful ways of sharing thoughts, ideas, jokes, and concerns.

Future Work
We deliberately designed a constrained authoring tool to encourage specific forms of interactive content creation. Our approach made it difficult at times for participants to fit their more free-flowing notes and ideas into such a constrained template of questions and answers. Future developments of the authoring tool could experiment with more flexible and less constrained ways of allowing people to generate content. There are however likely to be trade-offs in doing so. The constraints were found to help people to know what to do next and to get easily started. Having a blank page with multiple choices can be overwhelming for people, especially when they are not familiar with the toolkit. For the same reasons, alternative interfaces, including speech and multi-modal, may constrain in different ways, changing how easy, usable and intuitive it is for first time users.

To be used as a toolkit by local communities by themselves, long-term deployments are needed to develop these features further and investigate their effects. How and where to reveal audience responses in different community settings are essential design choices to make. Bodker et al [5] investigated ways to foster visitor participation for commenting on artwork in exhibitions by allowing both local write and global read. Although global read did not succeed in sustaining participation in their case, they remained positive about its potential. In our case, using Internet-connected devices allows creators to edit content and access audience responses remotely. Accessing real-time answers and being able to view other community members' content and responses may help to sustain the engagement of creators and trigger social interactions online and offline. Although creating content in-situ was found to be more accessible to begin with, creators may appreciate the convenience of remote access in the long run. Furthermore, other ways of supporting authors to interact with the audience or perceive audience experiences, perhaps remotely, are yet to be explored.

CONCLUSIONS
We have presented a novel way of supporting the sharing of local knowledge and ideas in public, by providing a simple authoring tool that opens up content creation of physical installations. *Pinsight* achieves this by turning the digital inside out, by making digital pin icons for locations on a map into physical entities that are intended to invite local people to place content in them for others to discover and contribute to. Moreover, the physical interactive devices are designed to be movable, to be placed in a physical setting chosen by a community. The *Pinsight* approach differs from previous ones, such as locative media, by bringing the digital world into the physical, making what usually is 'hidden' on the Internet, physically visible to the public. By tightly coupling the content creators and audience, we have tried to enable a new way of connecting people in a lightweight and playful way. In doing so, we hope to encourage more people to look up and look away from their phone screens to discover more about their local environment and history.

ACKNOWLEDGMENTS

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