Exploring Tangible Interaction for Map-based Feedback

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ABSTRACT
This paper describes the development of a series of tangible feedback mechanisms for an analogue map-based feedback interface. By prototyping interactions with simple everyday analogue materials, the goal was to explore playful, tangible input methods for our interface, beyond a more conventional screen-based approach that could inform future development of a digital map-based feedback interface. Four different prototype interactions were developed that could work in a completely analogue implementation. These interactions were installed and evaluated as part of an in-the-wild deployment of a larger project, which was used as part of a community consultation process. By analysing how people used our interaction prototypes and the feedback that they left, data was collected to inform later iterations with the kinds of interaction approaches that can successfully engage participants and the most effective methods of soliciting feedback.

Author Keywords
Map-based feedback; tangible feedback methods; low-fidelity prototyping; community consultation.

ACM Classification Keywords
H.5.2. User Interfaces: Interaction styles, Prototyping.

The InstaBooth is an interactive community engagement installation that combines digital and analogue methods of interaction. (Caldwell et al. 2016; Johnstone, Caldwell, and Rittenbruch 2015) The purpose of the booth is to supplement existing community consultation approaches and provide an in depth way for people to provide feedback about a local area focusing on asking people about the past, present and future of the location. The booth is roughly the size of an old style phone box and is open at two ends. The booth has 2 doors on each of its four sides that keep it secure when it is closed but also provide more space for feedback elements (Figure 1).

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Within the booth are a number of spaces in which different feedback modules can be installed allowing for multiple types of data to be collected. Prior to the development of the map-based feedback prototype described in this paper, feedback modules developed for the booth included hand-written and hand-drawn responses; pin-boards which allowed participants to respond to a question on a scale (e.g. like / dislike); digital responses submitted by text message; uploaded image responses which could be voted upon; and novel physical interactions such as a pillow that can count the number of hugs it has received. (Palleis, Parra Agudelo, and Foth 2015; Schroeter, Foth, and Satchell 2012) The diversity of forms of feedback included in the booth and the use of both analogue and digital feedback mechanisms was a deliberate strategy aimed at allowing as many participants as possible to respond in ways that felt comfortable to them.

Figure 1: The InstaBooth community feedback booth.

Within this range of feedback types, one that had not yet been addressed by the booth was map-based feedback, which would be well suited to gathering information related to the geographical location where the InstaBooth was deployed. We set out to prototype such a feedback device so that it would fit with the feel and ethos of the rest of the booth and be useful for specific feedback questions in a deployment. In this paper we describe our approach to prototyping this feedback device through the use of a low-fidelity analogue feedback mechanism which was included in an in-the-wild deployment of the booth. This allowed us to explore in an authentic context of use what are the desirable affordances of such an interface as well as what kinds of feedback questions it would be suited to asking.

Background

Interactive maps have been used and deployed in many different ways in other studies. The DTMap demo is an

interactive tabletop surface that effectively lets several users to view and manipulate multiple layers of data over the top of a single map. Its flexibility made it easy for users to understand and share information about locations (Furuichi et al. 2005). Similarly, the Simtable, is an interactive map interface originally created for military training purposes that consists of data projected over a table surface covered in sand. The added level of interaction of reshaping the sand according to the overlaid data gives users a better understanding of battlefield terrain and positioning (Wisher et al. 2001).

In order to be used within the InstaBooth a map-based interface needed to be more focused on the community consultation aspect, not only looking to engage the public but also supporting citizens to input rich data effectively. Within the field of community consultation, researchers have begun making use of interactive systems to increase public interest and to gather more in depth data. In many cases these interactive systems make use of embodied interaction techniques and can be seen as either urban or cultural probes. For instance, Ubinion (Hosio et al. 2012) made use of social media services on large public screens to create and facilitate discussions which generated interest and excitement through its interactive approach. The Voxbox (Golsteijn et al. 2015) and the Sens-us project (Golsteijn et al. 2016) are both interactive community consultation tools, that use tangible and partially analogue interaction methods which have both been shown to be appealing to a diverse audience.

Research Approach

To prototype the new map-based feedback interaction, we took advantage of an already planned deployment of the booth in the small town of Pomona. Pomona is part of a larger local municipality which was in the process of renewing their 10-year plan over the coming year. Members of the community were worried that because their town is relatively small within the larger municipality it risked being overlooked in the new plan. They therefore engaged us to set up the InstaBooth in the main street of Pomona for several days to collect data that would be compiled into an independent report to be given to the municipal council. In consultation with members of the community a series of questions were developed and integrated into the feedback mechanisms of the booth to ask about what residents thought of Pomona and what they wanted it to be like in the future.

Based on existing literature, and our previous experience with the InstaBooth we felt that simple tangible methods would be the best candidates for making an interactive map interface playful and engaging. Although our long-term intention with the map-based feedback module is to develop it as a digitally augmented tangible user interface, this was not feasible to achieve within the time available to us before the planned deployment to Pomona. Instead, we decided to take advantage of the fact that the booth includes both analogue and digital feedback mechanisms to develop a non-digital prototype using only analogue materials. This allowed us to explore a range of candidate tangible interaction metaphors as part of an actual deployment.

During the deployment of the booth, we gathered data on peoples' use of the prototype map-based feedback device through a variety of methods, the main form being informal observation. We always had at least one attendant manning the booth during its opening hours. Their job was to make sure that everything ran smoothly, but also to observe the way participants interacted with the different interactive components, engaging the participants if necessary. Feedback was also collected from participants in the form of interviews about their general interactions with the booth. This was a general interview about their experience with the booth as a whole, including the map interfaces. Finally, the results left on the map each day were studied to see how participants used the map and how well it worked compared to the other configurations.

Design Approach and Plan for Deployment

The final design for the prototype map-based feedback was made using a number of simple household items. A street map of Pomona was printed in black and white at A1 size, laminated to protect it from damage, and mounted on a matching sized cork board. Over the top of this was laid a grid of clear plastic drawing pins that were used as a method of keeping the interactive elements attached to the map. At the bottom of the corkboard, a tray was attached to hold the tangible items that people would use to interact with the map. The whole assembly was mounted on the inside of one of the doors of the InstaBooth.

Table 1: Questions asked for each interaction

Day	Material	Question
1	Pipe cleaners	How did you get here today?
2	Rubber bands	What parts of Pomona do you love? What parts need more love?
3	Post-it notes	What new facilities do you want to see in Pomona?
4	Modelling clay	Where in Pomona do you spend your leisure time?

A number of simple household materials were chosen that could be attached to the board in different ways (pipe-cleaners, rubber bands, modelling clay, and post-it-notes). Despite their simplicity, these materials allowed a range of methods of interaction such as: creating areas, creating paths, mark making, marking single points, leaving additional notes, or even modelling little figures. Each of these materials was then paired with a different question to be asked with the map-based feedback prototype over the four days of the deployment (one question/material per day). The questions asked with each of the interactions are listed in table 1.

RESULTS

The Booth was deployed on the sidewalk of Pomona's main street in between the local fruit and veggie shop and the town pharmacist. For each of the 4 days that the booth was used, we trialled a new map interaction approach.

Day 1 – Pipe Cleaners

While our participants were relatively cautious in using the InstaBooth in general, our interactive map became popular quite quickly. Members of the public would approach the map and touch the pipe cleaners in the tray in a subconscious tactile manner while they were taking in the map and the responses of previous participants. Once satisfied that they understood the activity, participants would take their own pipe cleaners from the tray and place it on the map. In most cases participants that played with the interactive materials while initially comprehending the map were much more likely to respond than participants that did not make any physical contact.

By the end of the day, 23 pipe cleaners were placed on the map. Participants generally used the pipe cleaners as expected, weaving them between pins following the roads marked on the map. Although in some cases a single pipe cleaner was not long enough for participants to mark their whole journey. To remedy this, participants would often connect additional pipe cleaners of the same colour to the first to make up required length.

An unexpected occurrence was that participants who lived in homes that were beyond the border of the map, did not feel that the interaction was relevant to them. Unless encouraged otherwise, participants that could not find the rough location of their home would walk away from the map.

Day 2 – Rubber Bands

Over the course of the day, 26 different locations were identified on the map by the participants 16 of which were places that participants loved and 17 were locations that participants felt needed more love. Green rubber bands were used for places they loved and pink were used for places needing more love. The rubber bands had limitations in that they could not stretch far enough to cover some of the larger areas participants wanted to highlight. However, when this was the case, participants would simply use multiple rubber bands. Just like the previous day, participants would pause and take in the responses already submitted before putting up their own ideas. There were several cases where people would ask the booths attendant or other participants where a particular location was on the map, before placing their responses on the board.

Of the 26 different locations identified, 7 were marked as being in both categories. This indicates that citizens had diverging perceptions of the same location. However, in many of these cases it was observed that some participants would place rubber bands of both colours on the one location. When asked why they made this decision, participants responded that they love the location currently, but also feel like it could be even better if it was given more attention.

Figure 2: Results for day 1 (left) and day 2 (right)

As well as this, some participants would layer multiple rubber bands on the same location to create more emphasis on the location. If they highlighted multiple areas but wanted to show that one area was much more important to them, they would use multiple rubber bands to mark that area. When questioned, participants said they felt that the number of rubber bands on a location was a good indicator of its popularity and importance.

Day 3 – Post-It Notes

Observations from this day noted that participants were just as quick to approach the interaction and take in other people's contributions as on previous days, but it took noticeably longer for them to put up their own ideas.

Overall, this form of interaction had less users interacting with it, but seemed to work well as a conversation starter. The participants would look over the already submitted ideas and as they did so, verbally agree or disagree with them often telling whomever they were talking to why they felt this way. As interesting as these musings were, participants did not leave any physical evidence of this feedback. In addition, when adding their own contributions, they would disregard any ideas that were already on the map, resulting in no answers being placed on the map more than once.

At the end of the day, 19 post-it notes, each with an individual idea, had been placed on the map. The responses ranged from suggestions for more public transport, to a golf course. However, one particular shortcoming of the method was that it did not record the popularity or weight of a suggestion, even though some ideas had been vastly more popular than others. The reason for that was that participants felt that if an idea had already been posted, it did not need to be posted again. It also meant that the first participant that suggests a facility to go on the board was the only participant that had any input in the location it should be placed.

Figure 3: Results for day 3 (left) and day 4 (right)

Day 4 – Modelling clay

The modelling clay was put in the tray at the bottom of the map in single, large blobs of each colour, requiring participants to tear away the amount of clay they required. Each colour of clay was assigned an age group and participants were requested to respond using their relevant colour. In most cases, participants would take just small pinches of clay and use it to mark single points on the map. The action was very similar to how one would normally use pins to mark positions on a map. There were some participants that decided to use the modelling clay to mark out areas as opposed to single points, but it was not common. The expectation was for there to be both large areas and small points being marked on the map, however it was not expected that the results would be so skewed towards the later.

In total there were 69 blobs of modelling clay placed on the map over the course of the day. The 31-60 age bracket (green clay) had the largest number of responses and clearest evidence of same colour clustering in particular locations. The 16-30 age bracket (blue clay) was the least represented on the map with only 6 responses. The 0-15 age bracket (pink clay) and 60+ age bracket (yellow clay) both came in around the middle with 18 responses each. There were definite clusters of all colours that appeared on the map in popular parts of the town. There were however very few cases of clay being used to build over previous responses. If a point someone wanted to mark had already been covered participants would not overlap, but instead place their mark as close as possible to the existing one. As a result, it became difficult to distinguish which marks belonged to which locations.

We anticipated that the modelling clay would provide the greatest opportunity for participants to respond creatively, however the results suggest that this was not necessarily the case. There was a single instance where a participant marked the local mountain on the map by making a small clay mountain. However, this was the only occurrence of a participant taking advantage of the flexibility provided by the material to add extra context to their response.

DISCUSSION

Despite their different materials and affordances, all of the interaction methods that we tested successfully engaged participants. Each of the four interaction methods that were used in the prototype gave us some clear ideas of interactive affordances that would be useful to include in further iterations of our map-based interface. Having the results of previous participants on display informed new participants and encouraged them to think about topics that they may not have considered otherwise. When using all four of the interaction approaches participants took time to look at and consider the responses that were already on the board.

We also found that residual data from previous users can, in some cases, interfere with how participants want to interact with the map. Through observing participants using the modelling clay and post-it notes we found that participants were generally very respectful of the responses already placed on the map, in many cases not wanting to interfere or obstruct previous answers. Only the rubber bands interaction method deviated from this pattern. In this map, participants happily overlapped other responses as they realised that a larger number of rubber bands on a location was a way of measuring its popularity. The key difference between the rubber band and modelling clay approaches was that the rubber bands only outlined locations, creating a transparency that meant the participants did not feel they were obstructing what was underneath.

Another key finding was that while some of the interaction approaches allowed for a wide range of creative expressions, they were predominately used within a context that was considered appropriate for the given tasks and activities. For instance, the modelling clay could have resulted in a wide range of sculptures, however our outcomes suggest that the way the material was used was informed by the way the activity was designed, and the previous responses that participants could see.

The use of entirely analogue interaction techniques offered a range of advantages throughout the design, prototyping and evaluation processes. Our different interaction mechanisms were very quick to build and adjust, arguably much quicker than a digital prototype, while also negating many of the technical problems that can emerge during the deployment of digital prototypes.

By creating something that went beyond plain paper prototypes, we achieved a level of fidelity and material quality that proved to be engaging and playful, yet robust enough to withstand the rigors of a public trail. While this work is still in its early stages it has generated some valuable insights that seem promising for the further development of a mixed digital / analogue ambient media approach (Lugmayr 2012). Having identified the rubber band method of interaction as balance between easy to use and a rich method of data collection, further iterations of the prototype will look at how this form of interaction can enhance digital maps.

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