VoxBox: a Tangible Machine that Gathers Opinions from the Public at Events

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ABSTRACT

Gathering public opinions, such as surveys, at events typically requires approaching people in situ, but this can disrupt the positive experience they are having and can result in very low response rates. As an alternative approach, we present the design and implementation of VoxBox, a tangible system for gathering opinions on a range of topics in situ at an event through playful and engaging interaction. We discuss the design principles we employed in the creation of VoxBox and show how they encouraged wider participation, by grouping similar questions, encouraging completion, gathering answers to open and closed questions, and connecting answers and results. We evaluate these principles through observations from an initial deployment and discuss how successfully these were implemented in the design of VoxBox.

Author Keywords

Public opinion; gathering opinions; crowd engagement; playful; tangible interaction; design research

ACM Classification Keywords

H.5: Information interfaces and presentation (e.g., HCI): H.5.2. User Interfaces; H.5.m. Miscellaneous

INTRODUCTION

Traditional ways of obtaining public opinions have largely been through marketing people approaching the general public at events or in the street with a clipboard, cold calling over the phone, or sending a text or email with a link to a webpage for people to register and then fill in a survey. More recently, tablet computers have been used to replace the clipboard. However, all of these approaches have their limitations and are susceptible to bias. The reasons include the general public being wary of people approaching them, and an increasing tendency to simply ignore unsolicited messages. Many will avert their gaze, put the phone down or delete the message. Those who do respond are often only a small number of the population and it is therefore unclear how representative they are of the general population at large [8]. An alternative approach is to design systems that gather opinions from the crowd in situ without inappropriately interrupting people or negatively influencing their positive experiences. While previous studies have introduced large screens, social media plug-ins, or simple voting systems, we aimed to design a more playful experience that gathers detailed feedback from the crowd at events such as festivals or fairs, by providing an engaging and playful tangible system that invites people to use it through its affordances. In this paper we present the design, implementation and initial deployment of a novel system, called VoxBox (Figure 1), which used a range of physical input and output devices, based on a set of core tangible design principles. We present and discuss the value of our design approach for creating such a public tangible opinion system.

Figure 1. VoxBox: a system to gather opinions from crowds.

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BACKGROUND

A variety of technologies for eliciting public opinions or feedback have been developed that try to be more inclusive and approachable when placed in situ in public spaces. These include the use of large screens, mobile phones, and voting boxes. Texting or Tweeting are often used as the medium. For example, Schroeter et al. [14] developed an application for public displays to elicit opinions via text or tweet from citizens who otherwise would not have their say. Others have used more traditional input devices, such as keyboards and public telephone handsets to get the public to voice their opinions or concerns. The Opinionizer [2] comprised a large projected display that people added their opinions to via typing at a keyboard. The VoiceYourView system [17] provided an old fashioned telephone in a library to obtain peoples' views about a recent refurbishment, which were represented as colorful visual bubbles on public screens. While many people freely gave their opinions in both settings, some felt uncomfortable and self-conscious doing so. This suggests that the method by which people are asked to give their views and the setting in which they do so impacts the extent to which they will voice their opinions or take part. Taylor et al. [15] found that users did not like using mobile phones to interact with public displays, and preferred to press buttons on the device directly. Müller et al. [9] found that mobile phone interaction with public displays did not receive as high uptake as expected. More recently, MyPosition asked people to vote on local issues through gesturing in front of a public display [16]. While many people stopped to look, only one in four chose to submit an opinion.

While this new generation of opinion-based technologies can be attractive and encourage more people to participate, there is still the problem that others shy away. It is not always clear how to interact with a public display that people have never seen before, especially if it is novel. Moreover, people may not see them in the first place. Such display and interaction blindness has been found to exist for a number of public displays and billboards [7, 9]. People expect them to be advertising material they don't want to look at or that simply do not grab their attention. We would argue that the opposite is true for physical tangible objects, which do have the affordances to draw people's attention. People are drawn to something that is novel, unusual and at odds with the environment. For example, the Periscope was designed as an unusual technological device for viewing videos about the surrounding area. Situated in a woodland, it provoked children to stop, wonder and interact [13]. Houben and Weichel [4] have also found that the introduction of a curious physical object linked to a public display attracted attention and significantly increased the numbers of people interacting with the display. The physicality and tangibility of components with clear and familiar affordances, such as pressing buttons, moving sliders, and turning knobs and handles, clearly indicate that they are there to be interacted with and also they are obvious how to do so. Both curiosity and clear affordances are important, firstly, to attract passers-by attention and secondly, to help them move through the threshold of participation [2].

In this light, researchers have designed very simple physical button-based voting boxes for gathering opinions [1, 3, 5, 15]. A benefit of using such simple input devices is that they are cheap to make and can be situated in a range of public places. However, they are limited in how far they can probe people's views and opinions. The question this raises is how best to design a range of tangible input devices that people are drawn to, will find compelling, will know intuitively how to interact with, and will also not feel self-conscious when doing so, or feel that it is too childlike or too technical for them to use. Our approach was to design a large tangible interactive machine that could stand out, was obvious to interact with, was playful and would engage people to gather a diversity of responses and views. We also wanted to maintain the interest of passers-by and provoke further discussion amongst those nearby by showing the collected data in aggregated form as a real-time visualization.

DESIGN PRINCIPLES

The design of VoxBox focused on recreational events, such as festivals or fairs, and aimed to gather opinions on the 'feel good factor' of such events, e.g. do people enjoy the event, do they feel connected to the people around them, and what are the elements that are most memorable? We considered characteristics of online or paper questionnaires and also key issues that were observed with these, and employed the following design principles.

Encouraging Participation

To prevent situations that are uncomfortable for both researcher and participant, such as hassling people with a clipboard, our aim was to design a system that invited people to participate without forcing them or interrupting their event experience. At the same time, it was important to design VoxBox to be able to stand out and draw attention from competing stalls that are also often part of an event. We thus chose to create a large physical system with physical input mechanisms through which people could give their opinions, instead of using, for example, text messages or social media input. VoxBox was designed as a modular system built around a physical shelving unit that lets users move through groups of questions, module by module (Figure 1). Each module used a different input mechanism that people were familiar with and knew how to use, such as sliders, buttons, knobs, and spinners. The first module asked closed questions about demographics, the second about their current mood, the third about the crowd, the fourth about the event, and the fifth and final asked an open question. In addition the system included a transparent tube at the side that dropped a ball step by step as the question modules were completed as an incentive for completion and progress indicator. Finally, the reverse side of the system showed three real-time visualizations of the collected data on small screen embedded in portholes. The aim of our research was to make VoxBox mostly self-explanatory so that it was clear what it was and why someone would want to interact with it [7]. We further designed interactions to require no technological knowledge or skills [3], and made the system, in most cases, usable without instructions.

Grouping Similar Questions

In conventional questionnaires, related questions or questions that require the same way of answering are often visually grouped, for example by putting them on the same page, or separating them with whitespace. We employed a tangible approach to this by designing VoxBox to consist of a number of separate question modules. Each module contained groups of questions that were related, and that used the same input mechanism. In this way we created a questionnaire with a logical flow of questions, and chose to make it not visually intimidating, as grouped questions emphasized that the questionnaire was not long.

Encouraging Completion and Showing Progress

One issue with questionnaires is people dropping out during completion, which is often caused by lack of clarity about length of questionnaire or progress, along with a lack of incentive for completion. In the VoxBox design the entire questionnaire was visible all the time so that users knew how many questions they needed to respond to and how long it may take. Further, a tangible reward (a stress ball featuring the URL of the website with the results) was given to the users to encourage completion; the ball could only be obtained when the questionnaire was completed. By designing a transparent tube that dropped the ball in stages after each part of the questionnaire was completed, the ball also served as a progress indicator. Progress was also shown by lighting up the active panels one by one as the user went through the questionnaire. This light feedback, in addition to lights next to buttons and scales for each corresponding option, provided immediate feedback from the system to show that it was interactive and that it was working, in order to encourage further use [7].

Gathering Answers to Closed and Open Questions

One problem with questionnaires is a lack, or brevity, of responses to open questions. Rogers et al. [12] found that engaging participants in playful activities resulted in a greater willingness to talk, and that it triggered free thinking. Although most of the questions in VoxBox are closed questions, we specifically designed a playful input mechanism, a phone handset that rang when a user reached this panel and asked them a question when they picked up. The user could then speak their answer into the handset and hang up the phone. We hoped that through this playfulness and engagement our questionnaire would result in more willingness to answer the open questions asked.

Connecting Answers and Results

In traditional surveys there is often a divide between a respondent answering questions and the researcher gathering data and presenting these in reports or papers. Respondents often do not have access to the results of the survey or are not informed where these results can be found. To make VoxBox more enticing to use and to trigger discussions from by-standers, we decided to make the collected results visible to the users [3]. Real-time results were shown in two different ways: on the website (for which the URL was printed on the incentive balls), and on a set of visualizations on the reverse side of the system. By printing the URL on the balls that were obtained after answering questions, we physically linked the users' answers to the results website by symbolizing that the results quite literally rolled out of the system after answering questions. The data visualizations on the system offered an immediate insight into the results. We tried to encourage users to look at these through the physical design by making them walk around the side of VoxBox to collect their ball. The box where the ball dropped was angled backward to encourage users to walk further around the back to see the visualizations.

DESIGN AND IMPLEMENTATION OF VOXBOX

Inspiration for the design of VoxBox came from a number of sources including the archaic computer game 'The Incredible Machine' (in which a user solves puzzles by arranging physical objects, e.g. levers, ropes, and conveyor belts), marble tracks (in which marbles are guided through sometimes complex tracks), and mechanical devices and interactive exhibitions as seen in science museums.

We decided on a final set of questions we wanted to ask based on our own interpretations of what may influence the feel good factor, and inspired by reading through evaluation reports on several organized events [e.g. 6]. As mentioned, these questions were divided into five categories, which were shown on five separate question modules in the system. An overview of the questions that were asked in each module can be seen in Table 1. While the demographics were mainly entered through simple push buttons, for the mood, crowd, and event questions we decided on different variations of input scales, so that people could rate their agreement. Although we could have used similar interactions for each of these groups, we felt it was important to include a variety of interactions to avoid the tedium of having to answer many questions in the same way, and keep the system engaging throughout the whole interaction. For the mood questions we decided to use linear sliders with LED feedback that represented semantic differential scales [10] on which people rate their response between two opposite answers on a scale; these scales were continuous (Figure 2a). For the crowd questions we used rotary knobs with LED feedback to show the answer along the scale. These questions were rated between disagreement and agreement and the interaction provided a discrete scale

Panel	Interaction	Questions
Demographics	Push buttons, rotary knob with 5 ranges for age	What is your age? (0-24; 25-44; 45-64; 65-74; 75+; blanc) Where do you live? (greater London; nearby county;different part of the UK; outside the UK) With whom are you visiting this event? (alone; partner or family; friends; other) Are you? (female; male; other)
Mood	Linear sliders: continous scale	How do you feel? (semantic differential scales: excited – bored; surprised – unsurprised; welcome – unwelcome; inspired – indifferent; safe – unsafe)
The crowd	Rotatory knobs: discrete scale (16)	What is the current mood of the crowd? (The mood is negative – the mood is positive) How well do you feel you fit in with the crowd? (I don't fit in at all – I fit in completely) How connected do you feel to the crowd? (I don't feel connected at all – I feel strongly connected)
The event	Spinners: 5 options	How much do you feel a part of this event? (I feel excluded from this event; I feel somewhat excluded from this event; I feel neither excluded nor a part of this event; I feel somewhat a part of this event; I feel a part of this event) How is the experience provided by this event (The experience is negative; the experience is somewhat negative; the experience is neither negative nor positive; the experience is somewhat positive; the experience is positive)
Open question	Phone handset: asked one randomly selected question from set	If there was an entry fee for this event, how much would you be willing to pay? What will you most remember about this event? How would you describe this event to a friend? If the organisers could change one thing about this event what would that be?

Table 1. Overview of the questions and interaction mechanisms in the different question modules.

with 16 increments (Figure 2b). The event questions were answered through physical spinners with five options between disagreement and agreement similar to a Likert scale (Figure 2c). Finally, for the open questions, we designed a phone handset to employ a familiar metaphor for dialog in an unfamiliar setting, which we hoped would result in surprise and excitement (Figure 2d).

We developed VoxBox as a modular system with separate question modules for the different groups of questions, and incorporated mechanisms for the incentive ball to run through the system (Figure 3a). Early variations of the design imagined the ball completing a track through the physical device in which obstacles had to be removed, or the track had to be completed, by answering questions. Different questions would have different physical mechanisms behind them that would allow the ball to move forward, for example a 'yes' or 'no' question would tip a slope in a certain direction, while a Likert scale may move an obstacle out of the way. Ideas also included mechanisms for encouraging longer answers to open questions, such as gradually moving obstacles away or only running a conveyor belt while the user was still recording an answer.

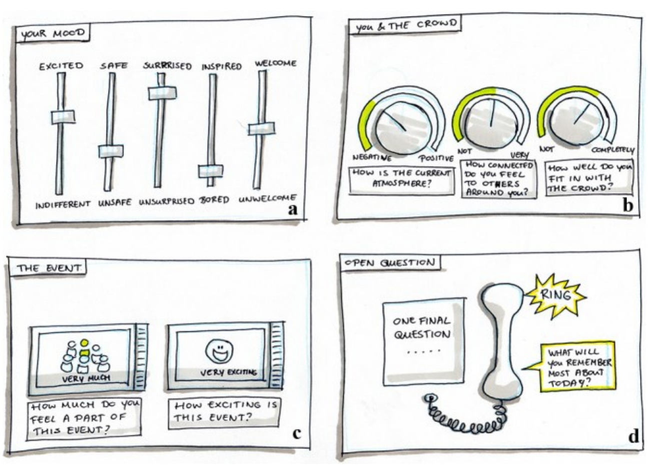

Figure 2. The input mechanisms for the question modules.

Due to feasibility reasons within the time constraints of the project, the ball track was simplified to run through the device and be controlled through physical levers after each question panel (see Figure 3b) and ultimately, replaced by an external tube that dropped the ball after each stage.

Implementation

VoxBox was implemented using three off-the-shelf shelving units to make sure it was sturdy enough to withstand many interactions and unanticipated user behavior. To allow for a flexible and modular system, we designed each question module as a drawer that was slotted into the shelving unit. In this way, question modules could be moved around and the sequence of the questions could easily be changed. Question modules were created from plywood using a laser cutter to give VoxBox an appearance that called up associations of 'a time machine' and 'a mix of Willy Wonka, the controls of the Tardis and those ornate fairground automata', according to initial responses.

Each question module contained a front panel for user interactions, which contained the sliders, buttons, knobs, spinners, or handset. A question module further contained an LED strip around the edge of the front panel that was lit up in green when a panel was active (Figure 4a), and a green submit button that was used to submit the user's answers. This button was necessary to determine when a user had made a final decision on the answers. Along with a

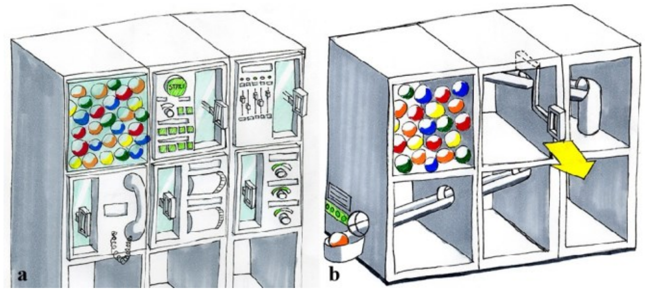

Figure 3. Early sketches of VoxBox: a. design of a modular system; b. design of the internal ball tube.

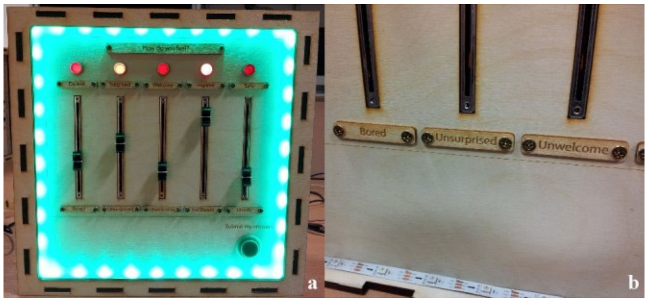

Figure 4a. Green LED strips showed that a panel was active; b. Separate question and answer labels were screwed on for easy changes.

large green start button, elements in this color were thus deliberately used to navigate the users through the system. Although buttons and sliders were fixed in the panels, questions and answers were cut from separate labels that were screwed on (Figure 4b). This allowed for questions to be easily changed (within the constraints of number and type of question in each panel) for different events where different questions may be desired. Most question panels used off-the-shelf components, for example the sliders, knobs, and buttons. We created a tailored rotary dial for age input and spinners for the event questions (Figure 5). Similar to the easily changeable question labels, the paper inlays of these spinners could also be replaced to show different answers.

VoxBox was controlled by open source Arduino technologies. To enable a modular design each question module contained its own Arduino board that controlled the I/O for that module. In addition there was a 'Master' Arduino and one to control the ball tube. The Master had overall control of the VoxBox operation and a WiFi connection to a backend server and database. On startup the Master downloaded the ordered list of currently attached question modules. It then proceeded to go through the list in sequence (Table 1), activating the next question module in the list, waiting for it to send back its data and then deactivating it again. All communication between Arduinos within the VoxBox was via I2C. Once the Master reached the end of the list it collated all the data it had collected from the question boxes and uploaded this to the backend server and database via its WiFi link. This architecture allowed VoxBox to be easily adapted, as question boxes could be added, removed or swapped around without needing to make any changes to their code or the code inside the Master. Even extra connectors for possible additional data cables between modules were already implemented in the system. The only change required was an alteration to the ordered list of currently attached question modules in the backend server.

Figure 5. Tailor-made spinners; paper inlays could be changed to show different answers.

The ball tube was implemented by creating a tailored construction from plywood and a transparent tube (Figure 6). The tube was divided into six parts and a servo motor with a long arm was mounted in each part to stop the ball from moving through. After pressing the start button, and each of the submit buttons the servos rotated in sequence to drop the ball step by step. The ball tube was connected to a ball compartment within the VoxBox unit and although balls were fed into the tube manually in this implementation, an automatic feed was imagined for potential redesigns. The ball tube thus functioned as an incentive to complete the survey and as a physical progress bar. Because the tube consisted of separate parts that corresponded to each question module, this element of the system could also easily be adapted to account for more or fewer attached question modules.

Data that was sent from the Master Arduino to the server was used to created visualizations that were shown on the website and on the system itself. VoxBox was designed to not only allow people to share data on their demographics and views, but to also give them the opportunity to learn more about the opinions held by others. Similar public visualizations of people’s perceptions have served as a talking point [e.g. 5, 16]. To enable passers-by to view and discuss the data gathered at the front side of the VoxBox, eye-catching and simple visual representations were shown on the reverse side (Figure 7a). To ensure the aesthetics of

Figure 6. The ball tube at the side of the system functioned as an incentive for completion and progress indicator.

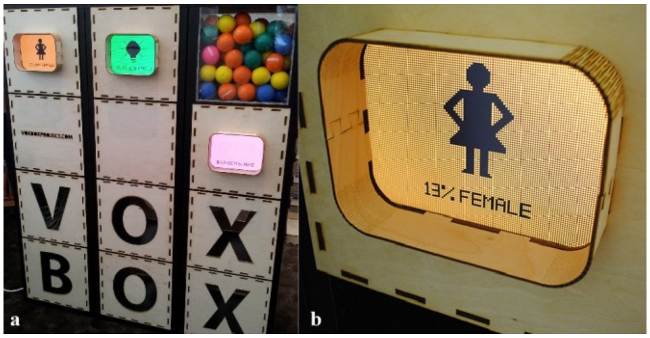

Figure 7a. The reverse side of VoxBox showed real-time visualizations of the data; b. visualization screens were embedded in portholes.

these representations would match the look and feel of the input technology, inspiration was sought from retro display technology: flip-disc displays, the electromechanical dot matrix displays traditionally used for destination signs on buses. While these signs are originally of ultra-low resolution, recreating digital screen-based flip-disc displays allowed for the display of higher resolution infographic-like visualizations. By flipping the discs row by row, the display scrolled through real-time visual summaries of the data. By creating side panels around these digital screens, we created the illusion of a porthole via which people could look into the VoxBox (Figure 7b). Apart from protecting the screens from direct sunlight, the portholes were also meant to spark curiosity and lure people to the screens — thereby overcoming common display blindness [9].

INITIAL DEPLOYMENT

In addition to numerous people in our research institute coming by our lab to try out VoxBox, we ran an initial deployment at a one-day conference on technology concerned with the relationship between the government, digital democracy and the public (Figure 8). At this event, over 50 academic researchers, people from industry, and government organizations were present who were interested in novel technologies. VoxBox was set up in the area where coffee and lunch breaks took place, and over lunch there was a dedicated slot for interactive demos. As such, VoxBox was available for the attendees to use for a total of 1.5 hours. Around 30 people used the system, who all completed the whole survey and took an average of three minutes to complete. Below, we describe our observations on how VoxBox was used at this event. Based on these we discuss how our design principles played out in this context. We end by describing possible improvements to the design.

Overall, VoxBox was well received and gained a lot of interest. In the first break, we witnessed one person walking with a brisk pace towards our system as soon as he spotted it and immediately started interacting with it, eager to be the first one to engage with the system. On several occasions a queue formed as people waited for their turn. Others deliberately chose to watch others interact first while taking their turn afterwards. Many attendees were interested in the thoughts behind the system and how it was built, and reacted enthusiastically to its visual appearance. Small groups of attendees who knew each other often came up together and each had their turn. One person thought out loud: 'With whom did you come to this event?' 'Are you guys my friends?' which resulted in laughter from the group. The phone handset, which rang shortly after the users had submitted the answers on the previous panel, caused surprise, and many users could be seen grinning while picking up the phone. Most users answered the open question through the phone, and several gave quite elaborate answers, e.g.: 'If there was an entry fee for this event, how much would you be willing to pay?' 'I'd sell my children. And possibly my mother. But I get less money for my children – aye.' Another example of an answer was: 'What will you remember most from this event?' to which they replied, 'I'll remember the VoxBox most.'

Among many utterances of 'Wonderful, fantastic. Thank you.' and 'that was fun!' there was one attendee who questioned whether the data shown on the system was the data we were actually collecting there and then. He wondered if he was the only one who would question if the data representations were manipulated by the organizers of the event to show favorable results. He was the only one at this event to raise this concern, but it would be worth exploring further to what extent people trust the accuracy of the data visualizations. Among those that did 'believe' the data, there was substantial interest and several people remained watching the visualizations scroll through different results. One speaker teased another by commenting: '23% feel bored, that was your talk!' Users did not always immediately notice the ball dropping down the side of the system – this happened mostly in early interactions where people had not seen others use it yet, and had not yet had a chance to walk around the device. They sometimes seemed surprised that they could keep the ball but were always pleased when we informed them. One or two people opted to give their ball back to 'save us money.'

Figure 8. User interacting with VoxBox during the initial deployment at a one-day conference.

Finally, we noticed that some users did not realize that the start button needed to be pressed before any other interaction could take place. They usually figured this out quickly, or had it pointed out to them by other attendees.

DISCUSSION

Our observations based on the initial deployment confirmed that VoxBox is a novel and engaging system that succeeds in gathering opinions from crowds at events. We were interested in how our observations were able to validate the choice of our design principles for creating interactive features that were able to draw people to answer all the questions thoughtfully. From these principles we consider more generally which tangible features are effective and how to combine them to make a compelling and enjoyable experience for answering questions at other kinds of events.

Considering our first aim was to *encourage participation*, we saw that the appearance of the system was very attractive, drawing many people to it like a honey pot [2]. Although the deployment took place at an event with predominantly attendees that were excited about technology, there were also a number of attendees from industry or governing organizations that had less affinity with technology but were still very enticed by VoxBox. As researchers, we deliberately took a stand-back approach: instead of inviting people to have a go, we let them approach it by themselves. Many people took initiative and used it from start to finish. The ball tube and ball compartment appeared an unanticipated attention catcher as people were intrigued by the function of the colorful balls and by the appearance of the ball tube. The system appeared to be mostly self-explanatory although a few usability issues were observed. Users did not always notice the start button without which none of the panels were activated. We had noticed this before during informal trials in the lab and had created a large arrow to point out the start of the interaction sequence but this was insufficient to fully solve this issue. We further noticed that some users were surprised at first about the sequence of the panels, although the green light navigation helped to make this clear. Apart from these small issues, VoxBox was very effective in encouraging people to give their opinions.

As mentioned, VoxBox *grouped similar questions*, by separating them on several question panels. Although this did work well in giving the appearance of a short survey, some people got a bit confused at first about having to go through the panels in a fixed sequence. This fixed sequence was introduced in part by technology constraints, and in part by this being a common approach in traditional questionnaires. It was thus unanticipated that users would be confused by having to follow a sequence. It seems that by transposing characteristics from paper or online questionnaires to a physical device, we had created new affordances that invited different behaviors, e.g. all the questions were visible at the same time and some interaction mechanisms may have looked more enticing than others. We realize that VoxBox does not need to incorporate a fixed sequence of interaction and we can consider other ways in which the affordances of a physical system are exploited to create a more appropriate, less constrained form of interaction. Similarly, in traditional questionnaires there are often options to activate different flows of questions based on previous answers. We could think of ways in which such more sophisticated functions could be integrated in the physical design of VoxBox.

We aimed to *encourage completion and show progress*, mainly through the ball tube that provided the ball as an incentive and showed the progress in the questionnaire. In our initial observations we saw that this did not work as well as planned. Because of the location of the ball tube at the side of the system, users did not always notice straightaway that something was happening. Many users had to be notified afterwards that they had now earned their ball. We saw that once people noticed that the ball dropped after each panel they were enthusiastic about this and often stepped aside after each panel to check their progress. This issue can easily be solved by moving the ball tube forward along the side so that it is more visible while standing in front of VoxBox. Furthermore, although most users were pleased when informed that they could keep their ball, it did not seem as strong an incentive as the joy of interacting with Voxbox. Nevertheless, the ball functioned as a link to the survey results and showed the URL of our website.

A further aim was to *gather answers to open questions* by enticing people to speak their answers into a phone. This method proved to be effective as shown by the number of people who listened intently to the question and then spontaneously gave a, sometimes elaborate, verbal response after being pleasantly surprised by the phone ringing.

In showing the results of the data collection on the system, we also wanted to *connect answers and results*. As a result of the ball tube position not being ideal, the ball rolling towards the back to encourage the users to walk towards the visualizations did not work as strongly as hoped. Although plenty of users did see the visualizations (albeit sometimes prompted) and enjoyed seeing the results, it is important to consider other ways to link the data input and visualizations more strongly, for example, by not placing them at the reverse side of the system but bringing them closer to the location of the input so that users do not have to divide their attention as strongly [11]. We further considered ways in which to link data from the user more explicitly to that of the crowd so comparisons are possible between personal opinions and those of the crowd, e.g. by showing current and aggregated data on different screens at the same time. Such additions and improvements could connect answers and results more strongly than was currently the case.

Finally, privacy is an important concern when asking people to give personal information, such as their age or views, in a public place. We considered placing the VoxBox in a booth with a curtain that could be drawn by the users to prevent people looking over their shoulders. However, this would mean it would lose its attractive visibility that was central to how we envisioned it drawing people to it. We found that no-one was worried about their privacy in this context and that those using it were given a wide berth from onlookers – akin to how people stand back when waiting to use an ATM machine.

CONCLUSIONS

In this paper we have presented the design, implementation, and deployment of VoxBox, a tangible system to gather opinions from crowds at events. We have shown through an initial deployment how appealing and engaging VoxBox was considered to be, and how successful it was in drawing people in and gathering opinions in a novel way. We have extensively discussed our rationale behind designing this system and have reflected on the extent to which we have successfully implemented our design principles based on observations with an initial deployment. VoxBox opens up discussions around the design of novel systems that can encourage the sharing of opinions by engaging users in playful interactions. Our findings have shown this is an important area for researchers to explore because gauging opinions and knowing what people think is considered an increasingly important part of community engagement. Our future plans include deploying and adapting VoxBox for a variety of other events in different contexts and settings. Finally, we argue that our tangible questionnaire approach – asking people to walk up to playful and attractive life-size machine and provide answers to a set of questions about how they feel – shows much promise at getting people from all walks of life to voice their opinions.

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REFERENCES

1. Braun, L., et al. SkyWords: an engagement machine at chicago city hall. In *Proc. CHI '13 Ext. Abstr.*, ACM Press (2013), 2839-2840.
2. Brignull, H. and Rogers, Y. Enticing people to interact with large public displays in public spaces. In *Proc. Interact 2003*, Rauterberg, M., Menozzi, M., and Wesson, J., (eds). IOS Press, 2003, 17-24.
3. Dade-Robertson, M., Taylor, N., Marshall, J., and Olivier, P. The political sensorium. In *Proc. MAB 2012*, ACM Press (2012), 47-50.
4. Houben, S. and Weichel, C. Overcoming interaction blindness through curiosity objects. In *Proc. CHI 2013 Ext. Abstr.*, ACM Press (2013), 1539-1544.
5. Koeman, L., Kalnikaite, V., Rogers, Y., and Bird, J. What chalk and tape can tell us: lessons learnt for next generation urban displays. In *Proc. PerDis '14* (2014), 130-136.
6. Maennig, W. and Porsche, M. The Feel-good Effect at Mega Sports Events. Recommendations for Public and Private Administration Informed by the Experience of the FIFA World Cup 2006. *IASE/NAASE Working Paper Series 8*, 17 (2008), 1-28.
7. Marshall, P., Morris, R., Rogers, Y., Kreitmayer, S., and Davies, M. Rethinking 'multi-user': an in-the-wild study of how groups approach a walk-up-and-use tabletop interface. In *Proc. CHI 2011*, ACM Press (2011), 3033-3042.
8. Miller, K.W., Wilder, L.B., Stillman, F.A., and Becker, D.M. The Feasibility of a Street-Intercept Survey Method in an African-American Connmunity. *American Journal of Public Health 87*, 4 (1987), 655-658.
9. Müller, J., et al. Display Blindness: The Effect of Expectations on Attention towards Digital Signage. In *Pervasive Computing*, Tokuda, H., et al., (eds). Springer Berlin Heidelberg, 2009, 1-8.
10. Osgood, C.E., Suchard, G.J., and Tannenbaum, P.H. *The Measurement of Meaning*. University of Illinois Press, Urbana, 1957.
11. Price, S. A representation approach to conceptualizing tangible learning environments. In *Proc. TEI 2008*, ACM Press (2008), 151-158.
12. Rogers, Y., et al. Never too old: engaging retired people inventing the future with MaKey MaKey. In *Proc. CHI 2014*, ACM Press (2014), 3913-3922.
13. Rogers, Y., et al. Ambient wood: designing new forms of digital augmentation for learning outdoors. In *Proc. IDC 2004*, ACM Press (2004), 3-10.
14. Schroeter, R., Foth, M., and Satchell, C. People, content, location: sweet spotting urban screens for situated engagement. In *Proc. DIS 2012*, ACM Press (2012), 146-155.
15. Taylor, N., et al. Viewpoint: empowering communities with situated voting devices. In *Proc. CHI 2012*, ACM Press (2012), 1361-1370.
16. Valkanova, N., Walter, R., Moere, A.V., and Müller, J. MyPosition: sparking civic discourse by a public interactive poll visualization. In *Proc. CSCW 2014*, ACM Press (2014), 1323-1332.
17. Whittle, J., et al. VoiceYourView: collecting real-time feedback on the design of public spaces. In *Proc. Ubicomp 2010*, ACM Press (2010), 41-50.