

# “Everyone Is Talking about It!”: A Distributed Approach to Urban Voting Technology and Visualisations

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## ABSTRACT

The deployment of technology interventions, such as public displays and mobile apps, in community settings has been found to engage people in sharing and comparing their opinions. Our research is concerned with how to extend this to community-wide participation by devising and deploying multiple voting devices and visualisations. We present an in-the-wild study where a number of shopkeepers along a street participated by placing a novel voting device in their shops to collect locals’ opinions. Results were displayed outside the shops, on the pavement. This distributed set-up was found to promote public debate on local issues, particularly around the perceived divide between people on either end of the street. We outline our design process and describe the impact of distributing voting devices and situated visualisations in a local community.

## Author Keywords

Opinion gathering technology; public visualisations; in-the-wild study; design

## ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

## INTRODUCTION

How can public technology facilitate civic engagement and community building? Active participation and communication are key to the functioning of geographical communities, and ultimately democracy, as they ensure that local views are heard and discussed — and potentially taken into account during decision making processes. Motivated by growing concerns about social connectedness in cities [17], interventions have often focused on engaging community members in becoming more familiar with one another, with the aim of stimulating participation and communication. A number

of projects have attempted to spark civic discourse in communities by deploying input technology (for example voting devices) and publicly broadcasting the output (for example via public digital screens). Though many studies have successfully managed to attract people to the technology, they have been limited in how far they reach out to facilitate ‘electronic democracy’. In particular, most have only made use of a single location for input and output. As a result, the ability of the technology to engage with people in the community is limited to people happening to pass by, or those who are aware of, that specific location. Similarly, projects with specific technical requirements have limited participation to, for example, people in the possession of RFID-enabled transport passes (e.g. [2]) or mobile phones (e.g. [18]).

While it is generally easy to involve a small number of active community members, reaching out to a wider number of the population is far more challenging. How can we engage people living on the ‘poorer’ part of the street, elderly residents, those working nightshift and those only working in the area to take part? In other words, how can we design urban technology interventions for more community-wide engagement? Our research describes how using a more distributed approach can help bridge the gap, by deploying a number of urban voting technologies and visualisations throughout a community setting. While using a single input and output location has several advantages, including the ability to encourage people to congregate at one place, the relatively low maintenance and costs, and the ease of data collection (especially capturing conversation), it also has limitations. In particular, people may not be aware of its existence. We argue that a decentralised approach can be more pervasive, providing multiple entry-points for more people to notice and take part. Furthermore, by facilitating multiple congregations at different locations, more localised conversation can take place.

We present a case study in which low tech input devices were positioned inside shops and cafes, and visualisations were displayed all the way along a high street, enabling customers and passers-by to vote on locally-relevant questions generated by the community and view the results. The aim of the deployment was to encourage people to reflect on local issues and generate conversations about their perceptions about the area and the community. The results from an in-the-wild study of the technology intervention showed our dis-

tributed approach not only facilitated much conversation and reflection, but also evoked several other behaviours, including curiosity, comparison, and competition with neighbouring shops and cafes along the street.

We outline the design process and then discuss how the situated voting technology and visualisations affected the community in different ways. We discuss how engagement was encouraged and which aspects of our design proved key in this process. Finally, we highlight the importance of spreading technology throughout a physical locale, such as a high street or town centre, for encouraging community-wide public debate.

## RELATED WORK

New technologies, such as public displays, interactive installations and sensors are providing new opportunities for civic engagement, also known as urban informatics[9]. While a range of different projects have been conducted in recent years, a popular area of study is the use of technology to encourage social connectedness in cities. This direction is primarily inspired by claims that cities are becoming less and less connected (e.g. [17]). Discourse and reflection on personal opinions and the viewpoints of other people have been deemed important in the process of connecting people and fostering communities. For this reason, researchers have started exploring the role opinion gathering (and sharing) technology can have in the urban environment. A number of studies have used technology to gather and share personal opinions publicly [1, 6]. While these initial deployments made use of conventional input technology, like a keyboard, more recent interventions have explored bespoke technology — allowing people to express themselves in more creative ways. For example, Fortin et al. [8] allowed people to talk into a digital megaphone. Speech recognition was used to parse what people said, and a word cloud-like visualisation was presented on a nearby building. Fischer et al. [7] developed a similar installation, allowing people to ‘shoot’ messages onto a wall using a digital slingshot. The use of body movement to cast a vote has also been investigated, including the use of arm gestures [24] and feet presses [20].

Fewer developments have taken place in the presentation of the gathered data, with virtually all studies making use of either digital screens (e.g. [4, 6, 10, 11, 12, 13, 18, 20, 21, 23, 27]) or projections (e.g. [8, 19, 24]). While these two display techniques allow for the presentation of live data, display blindness [16] and glare have been known to limit what people see and hence subsequent engagement. The vast majority of these opinion gathering and sharing studies are aimed at generating civic discourse (e.g. [13, 20, 24]) and facilitating e-democracy (e.g. [4, 23, 25]).

To enable technology interventions to be used more community-wide, however, and by people from different ages, backgrounds and living in different areas, consideration needs to be given to how best to design and deploy the technologies that are intended to gather opinions and facilitate conversation. Design considerations include, for example, accessible design of the input technology and accessible, understandable feedback as output. A practical example

Study	Year	Input location(s)	Output location(s)
Ananny et al. [1]	2004	Web	1
Behrens et al. [2]	2014	1	1
Braun et al. [4]	2013	1	1
Brignull et al. [6]	2003	1	1
Fischer et al. [7]	2013	1	1
Fortin et al. [8]	2014	1	1
Gianluca et al. [10]	2013	1	1
Hosio et al. [11]	2012	1	1
Kriplean et al. [12]	2012	1	1
Leong et al. [13]	2009	1	“Various”
Schroeter [18]	2012	SMS	1
Simm et al. [19]	2012	SMS/Web	1
Steinberger et al. [20]	2014	1	1
Steins et al. [21]	2011	1	1
Tang et al. [22]	2008	SMS	1
Taylor et al. [23]	2012	3	3
Valkanova et al. [24]	2014	1	1
Vlachokyriakos et al. [25]	2014	2	Web
Whittle et al. [27]	2010	1	1

**Table 1. Overview of studies in which opinion gathering technology is situated in public spaces, together with their number of input (e.g. voting technology) and output (e.g. visualisation of votes) locations.**

of this is the consideration of whether to use digital screens and projections. As many digital screens and projections are known to be best visible in a dark setting, deploying these output technologies can limit participation to people able to view them at nighttime.

When deployed in the urban environment, the spatial dimension of inclusiveness also needs to be taken into consideration: how can people easily access the technology? And perhaps even more importantly, how will they find out about its existence in the first place? Most studies have provided one input location and one output location, as shown in Table 1. While the deployment of technology at one key location can prove sufficient, it does require the existence of such a key location — for example a popular public square or train station. As a result, this approach is by default less applicable to residential neighbourhoods or other areas where there is not an obvious ‘common place’ that is frequented by a large proportion of the local community. In those settings, it is important to find out which locations people do visit regularly. A nearby high street is often frequented by many people within a local community, and as such local shops can be used as a location for input and output — as demonstrated by Taylor et al. [23]. In addition to providing communities with goods and services, high streets have fulfilled an important social role throughout history. Mehta et al. [14] describe this role as follows: “*The biggest competitive advantage of the neighbourhood commercial street is its ability to support social interaction as a part of the daily routine*”.

## RESEARCH AIMS

The aim of our research was to explore how a distributed approach to urban voting technology and visualisation can engage a geographic community. By a distributed approach we

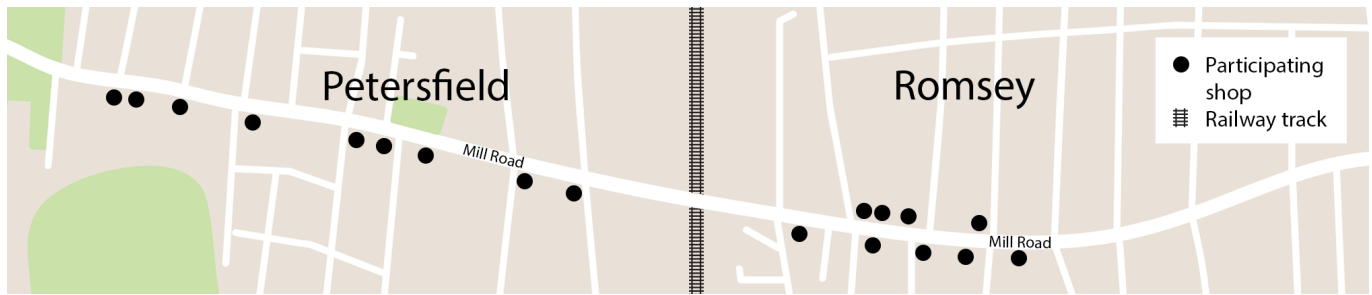


Figure 1. Overview of participating shops in both the Petersfield and Romsey areas of Mill Road (Cambridge, UK).

mean a deployment using multiple input and output locations — as opposed to the use of a single input and output location. Specifically, we were interested in whether a distributed approach can trigger a community to talk about unspoken local perceptions more openly? And can having distributed locations for the technology intervention encourage people to venture into different parts of the community, including areas they do not usually visit?

### CASE STUDY: VISUALISING MILL ROAD

We chose a high street, in the heart of a UK city, called Mill Road as the focus of our study (coined ‘Visualising Mill Road’). The street is a bustling community locale with many shops and cafes. But in addition, a railway bridge divides Mill Road into two areas: Petersfield (the part of the street closest to the city centre) and Romsey (see Figure 1). While Petersfield was primarily built by the University of Cambridge, Romsey historically had a more ‘working class’ demographic, resulting in socio-economic and political differences between residents of the two areas. Though a quiet street in the past, the arrival of the railway line in the 19th century drastically changed the character of Mill Road. Nowadays, it is a nationally renowned street, popular for not only its range of independent shops, but also the many local festivities. Despite having a large number of community groups, the divide between Petersfield and Romsey appears to persist. We were interested in how residents and visitors would share their opinions on different aspects of the street, and what they would think of the opinions of others. Our approach was to provide distributed voting technology and situated public visualisations, in order for people to discover more about the perceptions of others — and how those compare with their own. Key to this approach was the goal of engaging a broad range of people into thinking about the local perceptions. Did they think the same or different? Did they know what the others thought about them, especially those living, shopping and working on the two sides of the railway tracks? How ingrained were their views about each other? How could the technology intervention provide them with a better awareness of their community?

### Initial community meetings

At the start of the study, we arranged several meetings with Mill Road community groups, to gather more information on the history, characteristics and challenges of the street. Members from several community groups participated, including a group dedicated to Mill Road’s history, a group dedicated to

‘bridging the divide’ and a group involved in organising local festivities. Several people were actively involved in more than one group. During this pre-study, it became apparent how strong the divide between the Petersfield and Romsey areas is in everyday life. Despite efforts from a community group to bridge the divide, both shopkeepers as well as local residents stated they “rarely go to the other side of the bridge” and that they believed people on both sides of Mill Road had the same attitude towards “not wanting to go over the bridge”. The shop owner of one of the street’s oldest shops explained: “The bridge divides. I suppose it is really a lack of familiarity, actually. Because lots of people don’t go over there. I do go more now, but years ago I never used to go – it was like the two sides of the Thames, you know. The North and the South. It still has a slightly different feel over there. Which is interesting, same as London, curiously enough. What exactly it boils down to, I don’t know”. Another shopkeeper added: “People talk like going over the bridge like it is going to another world”. From the conversations with these shopkeepers and local residents it emerged that the divide between the two halves of Mill Road plays an important role in everyday life. We also found that the views about ‘the other side’ are not often explicitly discussed, despite the fact that everyone seemed to feel strongly about this topic. This lack of discourse was also brought up by members of local community groups.

To explore whether the perceived differences between the two areas of Mill Road could be made more open, we discussed with active community members, who wanted people to move between the two areas more, the possibility of gathering and visualising people’s perceptions publicly, along Mill Road. To do so, we suggested creating voting devices, allowing people to express their views. The aggregated views would then be presented back to the community via public visualisations, located near the voting devices. It was collectively decided that the voting devices would be situated along the street, in the different shops, as there was a strong belief held by members of the community groups that the shops along Mill Road act as a social hub. One local community organiser expressed it as follows: “I believe the shops are the social glue of the Mill Road community”. Based on suggestions from the community groups, council representative and local trade organisation, a list was made of ‘shops to approach’. To ensure a variety of demographics would be able to encounter the voting devices, a range of different types of shops was selected. In addition, an attempt was made at selecting comparable shops

Petersfield	Romsey
Charity shop	Charity shop
Charity shop	Flower shop
Local supermarket	Local supermarket
Liquor shop	Greengrocers
Café	Café
Takeaway	Café
Electronics shop	Café
Computer shop	Homeware
Oriental supermarket	Delicatessen shop

Table 2. Overview of participating shops

on both sides of the railway bridge (see Table 2). Where possible, the same type of shop was approached: a charity shop, local supermarket and cafe on both sides. Whenever this was not an option, shops with a similar number of customers were selected. In total, we approached 23 shops along Mill Road. Of these, 18 agreed to participate. Shopkeepers of the participating shops were given an explanatory leaflet about the project and told the voting devices would be placed on their countertop with the aim of collecting opinions from the community. In addition, they were asked to provide suggestions for questions they would like to pose via the devices.

### Questions and statements

Based on our conversations with the community groups, shopkeepers and local residents, we identified a set of topics that they considered to be relevant to explore the divide and their community as a whole. These topics were then discussed and iterated with the community groups. After several iterations, a set of 7 questions and statements was finalised:

- Q1: How do you feel today? (i.e. *happiness*)  
 Q2: How well do you know your neighbours? (i.e. *neighbourliness*)  
 Q3: Mill Road is safe (i.e. *safety*)  
 Q4: Mill Road feels like home (i.e. *community*)  
 Q5: I like to shop locally (i.e. *local shopping*)  
 Q6: Mill Road is buzzing today (i.e. *street buzz*)  
 Q7: I know lots of people around here (i.e. *social ties*)

A number of shopkeepers and residents indicated they wanted to think about relevant questions for a longer period of time. We therefore decided to gather further suggestions during the deployment. The following two questions were later included, based on their additional suggestions:

- Q8: I am happier on this side of the bridge (i.e. *localism*)  
 Q9: The future of Mill Road is bright (i.e. *future*)

For the purpose of community-wide participation, all suggestions had to comply with one condition: the topic had to be of relevance to people along the whole street. As such, suggestions that were only relevant to the (commercial) interests of one shop or person were omitted. It was also decided that the questions and statements had to be kept short, to allow people to read them at a glance. Slightly ambiguous topics like safety were not clarified (e.g. road safety, risk of pickpocketing) with the hope this would encourage further discussion.

### Voting technology

To gather opinions of people in the Mill Road area, we designed, built and deployed a set of novel voting devices. We



Figure 2. Voting devices: a) lo-fi Lego prototype, b) hi-fi prototype, c) final version.

aimed to make them attractive, appealing and easy to use by everyone – simply, at the press of a button. To this end we thought a device that was tangible and evocative would be effective. We chose not to design a data collection device to run on an existing technology, such as a touch screen, mobile phone app or web-based interface as this would mean having to ask people to download an app or the shopkeepers to set up and maintain a touch screen in their shop or café. Instead, we chose to design a device that was salient and obvious how to use — by basing it on the familiar input interaction of pressing a button to communicate a choice. Due to its simplicity and familiarity, this type of interaction requires no learning for the vast majority of people. To enable the voting device to be clear to people of different ages and backgrounds requires the questions being asked to be concise and the options to answer them straightforward. The device also has to be low maintenance and robust for it to be able to be used in a range of shops. To fit into the setting of a shop it also has to be able to stand on the counter, without taking up a lot of space or looking out of place, while still being noticed by customers.

After a few iterations, we designed a compact device that contained a set of large colourful buttons designed to attract attention. Each question was placed above the buttons. Below them were smiley faces, intended to provide a canonical set of answers: agree, neutral or disagree. The device only allows one of three choices to be selected. This constraint was intended to provoke public discussion around the voting devices between shoppers and shopkeepers. A low fidelity Lego prototype of the voting device (see Figure 2a) was presented during meetings with local community members, together with sketches of the final version. The feedback elicited during these sessions suggested that the concept of three large smiley face buttons, in order from happy to sad, was entirely clear. However, it also emerged that the device as a whole would have to be larger in size, both to attract attention as well as to display the question in a more readable manner. Based on these findings, a larger high fidelity prototype was built, using a cardboard box (see Figure 2b). Though the initial idea was to use 3D-printed or wooden boxes, the high fidelity prototype revealed that strong cardboard was a suitable, cheaper and more practical material. The final voting devices (see Figure 2c) were built from black cardboard boxes, with Microsoft Gadgeteer hardware modules and an SD card to store a log of all button presses. Devices were connected to the mains. Shops that were unable to provide a plug point were

given a battery-powered device. Neutral but bright colours were selected for the arcade game buttons, to avoid negative colour-emotion associations. The questions and smiley faces were created using a label printer.

### Public visualisations

To make the visualisations accessible to a broad range of community members, we chose to make use of simple representations. We wanted to make it obvious the visualisations conveyed something about the community, and the collected votes, rather than being an art installation. In addition, the visualisations were designed to provoke members of the community to reflect on what they meant and for them to provoke further discussion about the perceived social divide on Mill Road. The public visualisations were designed to be placed in front of the participating shops along the street, on both sides of the railway track, in a way that would catch people's attention as they walked up and down the street. This way, the placement of the visualisation reveals from which shop or café the data is collected. In addition, to ensure we did not compromise people or shops, we decided to only visualise relative data, which allows for comparison between visualisations without revealing sensitive and distracting data about the popularity of shops.

During the sketching process it emerged that making use of the road would cause significant delays, as not only the city council but also the national Highways Agency would have to approve it. When it emerged such approval would involve closing off the road and taking out insurance for all people involved, it was decided that using the pavement would be a more realistic option. An Isotype-inspired visualisation consisting of rows of ten human-like figures was created and informally discussed with members of the community groups to ascertain readability and clarity. For each question posed via the voting device, a row was added, with each figure representing 10% of the votes. Percentages were rounded to 'whole figures'. These figures were coloured in, matching the colours used for the buttons on the voting device (the neutral colours yellow, white and blue, representing happy, neutral and sad). In addition, a keyword summarising the question was added at the front of the row (see Figure 3). This more ambiguous description was chosen to minimise clutter and encourage interaction between residents and shopkeepers to discuss what was meant by it. The visualisation was meant to convey enough information about the question and accompanying votes but also to encourage people to visit the corresponding shop to find out more about what it meant and how it was derived.

The visualisation was stencilled on the pavement through the use of non-permanent brightly coloured chalk spray. This method of presentation was previously demonstrated to successfully communicate data in the Tidy Street project [3, 26]. More obvious presentation choices would have included the use of digital displays or digital projections, however, keeping in mind display blindness, electricity requirements and the need for visualisations to appear clearly in bright sunlight, we opted for this novel, eye-catching and low tech approach. The aim was to attract people's attention while walking into



**Figure 3.** Left: sketch of the visualisation of votes cast within a participating shop, with each figure representing 10% of the votes. Right: visualisation outside a shop.

shops or cafés while not being offensive or appearing as art or vandalism. A benefit of using chalk in this way is that it stays there for a while. Natural elements such as wind and rain cause the chalk to slowly fade, thereby creating an organic way of ending the project. Besides providing a gradual ending, the use of chalk also pacified shop owners and members of the city council, as they trusted all visualisations would automatically disappear again. The visualisations were created using laser cut polyester stencils and were placed at the doorstep of the participating shops. They were updated when the question on the voting device was changed. A final comparative visualisation was created on the bridge to allow for comparison between the Petersfield and Romsey area as a whole. For this visualisation, the data from the different sides of the railway track was aggregated, and shown as a bubble chart. This visualisation was also discussed with members of local community groups, to ensure it was easy to interpret. To avoid compromising people or shops, only relative data was shown. Furthermore, the decision was made to only show data relating to the positive (happy smiley) votes, thus focusing on the positivity from both sides of Mill Road.

### In-the-wild study

The voting devices, together with a small explanatory poster, were deployed in 18 different shops along Mill Road. All devices were placed on the shop counters with the idea that the period of waiting that often takes place before customers pay and leave the shop would be an ideal time to quickly voice their opinion. Shopkeepers were asked to decide upon the exact location of the device on the counter, informed by their knowledge of customer behaviour.

The devices were deployed for 24 days in order to enable sufficient time for each question to be posed, discussed and new questions to be suggested by the community. It also allowed for a gradual build up of the visualisations, for the project to be publicised and for a range of people to come in and participate, take a look, and discuss. During the first two weeks, the questions on the devices were changed every other day and the data from the previous question was collected from the SD memory cards in the boxes. This process was done at the end of the afternoon, to coincide with the closing time of the majority of the shops. Shopkeepers were asked to only vote once a day themselves. They were also told that they did not have to encourage customers to vote, but that were free to do so if they would like to, and that they were not in any way responsible for the safekeeping of the voting device. The visualisations outside the shops were sprayed onto the pavement on alternating days, by a team of four local artists accompa-

nied by the researchers. This was done at dawn, when all businesses were still closed and there was little traffic. The comparison visualisation on the railway bridge was created after the data from the seventh question was collected (see Figure 6). Permission was sought from the local council beforehand, to ensure the chalk graffiti visualisations would not be removed by street cleaners.

To see how the distributed voting technology and public visualisations engaged this urban community, an in-the-wild study was conducted. A mixed method approach was adopted, and the following data was collected: (i) logged votes from the devices; (ii) observations in situ, both inside the shops as well as outside, near the shop and bridge visualisations throughout the deployment; (iii) brief semi-structured interviews were conducted with shopkeepers and customers when the shops were visited to replace the question and collect the data from the voting device (iv) additional more extensive semi-structured interviews were conducted with shopkeepers, at the end of the study. A total of 43 semi-structured interviews were carried out with shopkeepers (23 from Romsey, 20 from Petersfield) and 22 with customers and passers-by (12 from Romsey, 10 from Petersfield).

## FINDINGS

Throughout the deployment, the 18 voting devices and public visualisations attracted a lot of attention in the Mill Road area. The visualisations lured people into the shops, who then asked the shopkeepers what was going on. Once aware of the project, people returned regularly to answer the different questions and to view and compare results, as observed by the shopkeepers and the researchers present. Some even ventured across the bridge to find out more about the results ‘on the other side’. The project sparked conversations on the various topics addressed via the posed questions both inside the shops, and outside near the visualised results — including topics not usually spoken about. From the observations and interviews, it emerged that the study triggered discussions on previously ‘hidden’ topics. In the following sections these findings will be described in more detail, starting with an analysis of the factors that encouraged participation, followed by descriptions of the votes and the types of engagement the project elicited.

### Factors encouraging engagement

The eye-catching visualisations and voting buttons successfully enticed people to ask questions and participate. However, two additional factors were found to greatly encourage community-wide engagement: the participating shopkeepers and the media.

By leveraging on the existing social role of the shops along Mill Road, described as ‘social glue’ by a community organiser, the shopkeepers acted as community champions. As all shops had an existing customer base, using them as input locations embedded the project in the existing community practices. Furthermore, many shopkeepers voluntarily took up an active role in encouraging customers to vote. The variety of the shops involved proved crucial for engaging a broad range of people. For example, while students and families

with young kids frequented Shop P3, Shop R9 had a significantly older group of regular customers. The shopkeeper explained many come from a nearby retirement housing complex: “*They came in the other day to say “What is it? What have we missed?”. So we told them about the question, they came in, did the box [i.e. voting device] and they will be back at the end of the week.*”. Apart from age, demographic differences like cultural background, location of residence and the amount of time people have lived in the area also varied greatly between the customers of the different shops. For instance, while Shop R8 sells very common products, and as a result is primarily frequented by local residents, Shops P5 and P9 sell highly specialised products — attracting customers from all over the city and beyond. Similarly, while some of the older shops have many customers the shopkeepers have known for years (many of them having been born in the area), some of the cafes and newer shops attract people that have only started living near or on Mill Road in recent years.

The local media and social media also played an important role in raising awareness of the project. During the deployment, the project was featured in local radio shows and newspapers. Via Facebook and Twitter, people discussed the results and shared photos of the visualisations. This media activity directly impacted participation. For example, after a front page publication in the city’s newspaper, shopkeepers noticed an increase in people coming into their shops, asking if they could cast their vote. One shopkeeper explained: “*It is getting to be known that this thing is going on. People realise that something is happening, and they are curious about it.*”.

### Votes

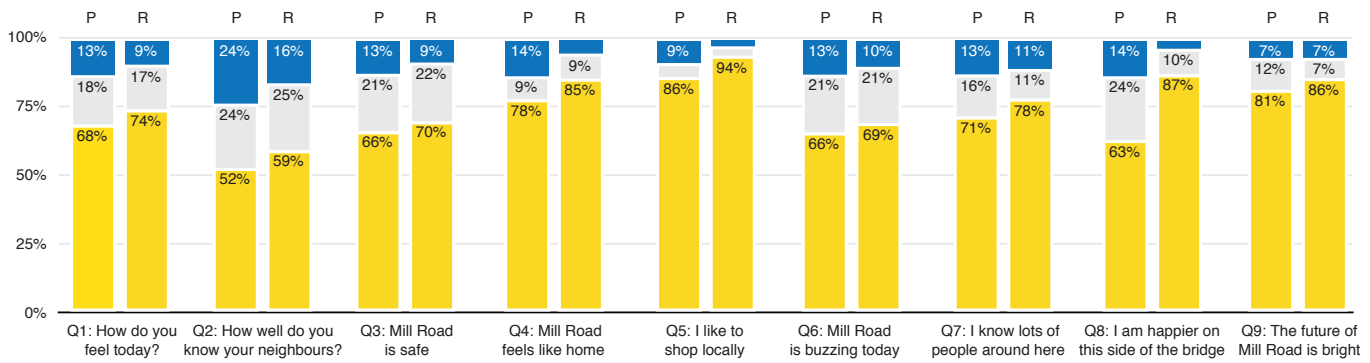
In total, 11610 votes were cast during the deployment, of which 4879 (42%) were identified as genuine (i.e. not obvious repeat votes; a vote cast within 5 seconds of the previous vote was classified as a repeat vote and discarded). The number of presses peaked during the second day of the deployment, with 388 genuine presses. As to be expected, the least votes were cast on Sundays and Mondays. The majority of button presses occurred during the daytime, particularly between 11:00 and 18:00. The number of votes differed greatly between shops, as shown in Table 3, with local supermarkets and shops with long opening hours receiving far more votes than any other shops. The type of votes also differed slightly per area, with relatively more ‘happy’ votes being cast in the Romsey area for each question (as shown in Figure 4).

### Types of engagement

To identify the types of engagement, a thematic analysis [5] was conducted on the collected data. Five different types of engagement with the distributed voting devices and visualisations were identified, which we have labeled as curiosity, contemplation, conversation, comparison and competition.

#### Curiosity

From the moment the voting devices were deployed and the visualisations started appearing on the pavement, people became curious about what was going on. From our observations it became apparent that the majority of people walking



**Figure 4. Comparison of votes per question per area (P = Petersfield, R = Romsey). Happy votes shown in yellow, neutral in grey and sad in blue.**

Ques.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Days	3	2	2	2	2	2	2	3	6
P1	30	15	16	0	24	13	16	17	27
P2	11	5	1	6	19	2	8	12	18
P3	42	31	25	21	16	25	19	25	58
P4	90	14	23	31	37	0	35	40	43
P5	162	76	49	62	73	66	12	0	0
P6	90	23	35	27	38	10	20	2	0
P7	29	8	7	12	52	8	3	34	41
P8	23	2	2	10	12	2	14	13	35
P9	65	40	30	43	35	19	27	18	66
R1	177	85	78	110	133	52	99	88	102
R2	81	72	24	79	35	55	32	31	0
R3	13	13	9	7	15	3	7	0	0
R4	57	11	17	22	37	14	26	39	55
R5	23	14	13	27	25	19	25	20	32
R6	20	14	2	6	12	17	6	11	20
R7	57	27	30	42	31	25	28	42	102
R8	16	38	33	21	40	24	24	0	0
R9	14	8	14	8	14	17	7	0	24
Total	999	496	408	534	648	371	408	392	623

**Table 3. Overview of votes (excluding obvious repeat votes) per shop (P = Petersfield, R = Romsey) and the deployment length of each question. Question number legend can be found in Figure 4.**

down the street noticed the visualisations, and many stopped to have a look. Shopkeepers started noticing passers-by coming into their shop to ask questions about the project. Several shopkeepers commented on the benefits they believed this had for them, including a shopkeeper at Shop R6: “I think it is probably actually beneficial to us, because people are curious, they see the little stick people and because we are one of the shops that has a box [i.e. voting device] they come in. And then they may buy something.”. Passers-by and local residents also started explaining the visualisations to one another. This behaviour was observed by the researchers at several occasions. The owner of Shop R3 noted: “There is always someone out there explaining it to someone else”.

Curiosity remained high throughout the deployment, with even those already familiar with the project returning to vote and view the updates regularly (“They’ve literally run in, said ‘what’s the question?’, answered it and gone again”). During conversations with passers-by, it emerged that many people had been casting their vote on a daily basis, even if they

were not buying anything from one of the shops. A number of shopkeepers took an active role in encouraging curiosity, by ensuring their customers would see the voting device. In one shop, this meant the owner placed the voting device at an angle to increase visibility, in another shop the owner used her battery operated voting device to regularly approach all customers at the different tables in her cafe.

Towards the end of the study, when the summary visualisation was sprayed onto the pavement of the railway bridge that connects the two parts of Mill Road, the initial response was far less noticeable. During the informal conversations we had with customers, shopkeepers and passers-by, it emerged many people had heard of the visualisation and the final results through word of mouth — but had not yet seen it themselves. All indicated they would visit it later that day or week, an action that often seemed to require conscious planning. The stark difference in the level of response towards the shop visualisation and summary visualisation suggested people were still resistant to walk to or across the bridge from both sides. While the bridge is one of the few places that is visited by both sides of the street, few people cross it regularly, and our results also showed that likewise, few people made the effort to go out of their way to visit the summary visualisation.

### Contemplation

From the informal conversations with passers-by, customers and shopkeepers, it emerged the questions and results from the Visualising Mill Road project had made them reflect upon a) their views and what these views are based on, and b) the changes on Mill Road over the years. The latter was mainly the case for people who have been living in the area for a long period of time, with many reflecting on their youth (e.g. “Mill Road has changed a lot in terms of the kind of feel of the place. When I was kind of around 16, 17, 18, it was always seen as a really dodgy area and over time it has become much more sort of multi-cultural and therefore a more accepting area.”; “They used to warn you, you must not go down to Romsey, it is a very rough area. I don’t think that’s true now.”). Reflections on the questions and results also made some people doubt their own views (e.g. “Maybe it is just a feeling [that she finds the other side of the road unsafe], I don’t know.”; “I don’t know if [my view on the divide between the two areas] is perception or reality”; “One or two people,



**Figure 5.** Passers-by looking at and discussing the visualisations sprayed on the doorstep of the participating shops

*in pressing the button, were suddenly questioning themselves, as to how they should answer - and therefore, you posed a question to them, which up to that moment, they did not seem to have considered”).*

### Conversation

During the observations it became clear that the questions displayed on the devices led to many discussions between customers and shopkeepers, which in turn drew other people into these conversations (cf. [6]). For example, in Shop P2, P7, R1, R7 and R9, it was observed that customers started sharing anecdotes of unsafe situations that they had experienced or heard of on Mill Road. The ambiguity of the questions also resulted in additional discussions. In Shop R7, a customer asked the shopkeeper “*What kind of safety would they mean? Traffic or something else?*”, which was followed by a conversation on the different types of unsafe situations on Mill Road. In the informal conversations and semi-structured interviews the occurrence of these discussions was further confirmed by shopkeepers: “*You have got everyone talking about it!*”; “*It has encouraged people to talk about their environment*”; “*It has definitely made people talk about issues, like community, safety, general trendiness of Mill Road itself. Most people wouldn’t bat an eyelid, normally*”; “*It has been a really good talking point*”. The majority of the shopkeepers indicated that the question on safety led to most discussion, followed by the question on neighbourliness.

The voting devices and visualisations appeared to generate different types of discussion. Whereas the conversations held inside the shops largely focused on personal perceptions and the sharing of anecdotes, the conversations around the visualisations tended to be towards comparisons with others. For example, comparison of one’s own perceptions versus those of the other customers of that shop, as well as comparisons between shops and areas. In many ways, the visualisations provided people with evidence to vindicate or refute their individual prejudices, and as a result reactions to the discussions were often focused on either agreement (e.g. “*[nods while looking at results] we are the safer side*”) or surprise (e.g. “*I am surprised neighbourliness did not score more positive, this is a very friendly area*”). The results from the voting results sparked most debate, as the findings were contrary and surprising to what most people had assumed: the side



**Figure 6.** Passers-by looking at the visualisation on the railway bridge, representing the differences in votes between Petersfield and Romsey

that is historically seen as poorer and more unsafe (Romsey) voted more positively for all questions.

### Comparison

The situated visualisations successfully supported three types of comparisons: between questions, between shops, and between areas. The use of relative data, rounded to tens, allowed people to easily compare and remember results between different locations (e.g. “*I was really interested to see that at [shop] there’s a 100% neighbourliness. You know, 10 little men, in yellow. Whereas some of the other places, quite nearby, are not saying that. Like the [shop] just here, I think there is only one or two for neighbourliness*”). This encouraged a number of people to visit ‘the other side of the street’, to see how the results there compared to those on ‘their’ side. News about the differences between the two areas spread rapidly, with people on both sides sharing their findings, and the latest hearsay, in gossip-like conversations in the different shops and cafes (e.g. “*I have heard some rumours that it is more positive on the other side of the bridge [Romsey] than it is from over here*”). The unexpected outcome, with Romsey scoring more positively on all questions, fuelled speculation (“*Maybe everyone gets positive here and then moves to that side of the bridge [and votes there?]*”), as well as pride (“*We are the best side*”; “*Good. That disproved the local theory then, doesn’t it?*”).

### Competition

The ability to vote in different locations and compare results also promoted a sense of competition. This feeling was present at a shop-level (e.g. a shopkeeper was observed asking a customer to please vote positively, as they had “*so many blue people outside already*”). The customer did not comply, as he did not agree with Q4 because in his view there are many drunk and homeless people frequenting Mill Road) as well as at an area-level (e.g. “*A lot of my customers have been quite possessive about insisting “this is the happy side, this is the strong community side”*”). By voting multiple times, some customers as well as shopkeepers attempted to influence the results. While most shopkeepers explicitly said they did not vote themselves and instead focused on getting customers to vote, two admitted to casting repeat votes (“*The first time I saw it I had a bit of a symphony [on the buttons]. But yeah, I’ve been a good boy [since]*”, “*Sometimes I might press it twice, between you and me*”).

## DISCUSSION

Based on these findings, we argue that if there is not one central place that unites a geographical community, distribution to a number of places that have existing social functions (e.g. pubs, libraries, stations, etc.) can provide a solution. Key to community-wide participation is the integration of technology into the rhythms and routines of the community. Below, we discuss five core lessons learnt for the design of opinion gathering and sharing technology interventions facilitating more community-wide engagement:

### *Simple input technology*

The use of physical voting devices offers an *accessible, simple, and familiar design*, which can be readily understood by people who may or may not be familiar with modern technology. This proved crucial for the participation of young kids and elderly people (cf. [23]). In addition, such simple voting devices can easily be placed in many different locations. A limitation of using such simple devices is the possibility of enabling people to vote more than once [23, 25]. However, it is possible to reduce such noise by further developing criteria for removing false positives (e.g. people voting in quick succession) and false negatives (e.g. ‘slow’ repeat votes from one individual).

### *Community-generated questions and statements*

Involving different community groups, shops, and local residents, in generating questions and statements makes them more accessible and *relatable to the community*, including local residents and visitors. While this may require considerable investment of time, it ensures that the questions and statements will be more relevant and topical, and thereby more likely to spark public debate.

### *Controversial topics*

Including controversial subjects is a good way of triggering debate in a community. They can often relate to prejudices around socio-demographics, such as socio-economic status and race. As these themes are universal, yet highly personal, they can engender rich discussions. It can help to *identify topics that are not spoken about, yet many people feel strongly about*, such as, a perceived differences and divides in a community.

### *Multiple community champions*

Involving shopkeepers by placing the voting devices in their shops can ensure that the technology is *embedded in the existing community practices*. Furthermore, it can enable *multiple community champions* to be involved and to encourage different community members to participate, thereby eliciting different perspectives.

### *Simple public visualisations*

*Relative data* is a powerful representation method to use when designing public visualisations intended to be understood by everyone. This kind of representation can capture the essence of the data collected and show at a glance difference in opinion, enabling both those familiar and unfamiliar with information visualisations to compare results between questions, shops, and areas. Furthermore, situating them

close to the input devices shows where the opinions were derived [15] which allows passers-by to *link the output to the input* at the various locations.

The system presented in this paper, and systems like this, have the potential to facilitate community consultation and to evoke community-wide public debate. In the context of local politics, such technology can play an important role in decision making processes — both top-down (e.g. council asking for community’s input) and bottom-up (e.g. local activists polling the community). Whereas often a subset of active people are involved in these processes, systems like these allow for low effort, community-wide involvement. Several local residents and shopkeepers of Mill Road expressed seeing value in the use of situated voting technology as a tool, to be used when issues arise in the community. However, a range of challenges need to be overcome in order for such a distributed system to become a widely accepted method of encouraging and facilitating civic participation, such as the need for more reliable and actionable data and coordination between sites.

## CONCLUSION

Accessible community technology, such as the one we have described and studied in this paper, can play a valuable role in engaging a range of people in a community to participate in, for example, local discourse and decision making. We have presented an in-the-wild study using multiple voting devices and public visualisations distributed along a street. Our novel approach has shown how affordable, low tech solutions, that can be easily set up and placed throughout a locale can lead to more community-wide involvement, especially when the technology is embedded in existing community practices. Our study has also shown how this approach can help address sensitive issues that can arise in a community. In sum, our distributed approach offers an engaging way of encouraging and facilitating civic participation, offering much potential for opening up public debate and challenging local perceptions.

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