Designing Engaging Data in Communities

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Abstract
We present two sets of 'data technologies' that we have designed to collect and display local data, both derived from our engagement with a community. The first, *Bullfrog*, is a bespoke voting device. The second, a series of physical charts, respond to the increasing sophistication of data visualisations by making playful use of pie charts and bar graphs, reimagining them in mechanical forms that are compelling but easily readable.

Author Keywords
Data; data-in-place; information visualization; tangible; spectacle; voting; digital civics; community.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
These days 'Big Data' is a big issue. From daily newspapers to new scientific journals, and from TV and radio to blogs, the proliferation of data is presented as a new horizon in our understanding of ourselves and the world we live in. The associated datasets are vast and varied, encompassing census results, local statistics on crime, education, property prices, but also shopping habits, tweets, Facebook likes, and other measures that 'quantify' self. If we are to believe the hype, the bigness and heterogeneity of the data are enabling unprecedented access to who we are as individuals and citizens, what we want, and even the nature of knowledge [3].

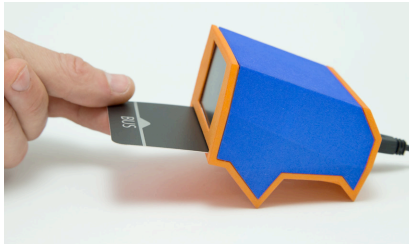


Figure 1. Bullfrog voting device.

Paper-based voting cards readable by device.

Devices in use at Tenison Road street party.

However, with each new advance in the amount and variety of data we can glean, store, analyse and present, the questions posed of our datasets and the techniques we use to find and present answers seem increasingly removed from the everyday experience of data: the context in which it is produced and the nuanced ways in which it is interpreted. How do we actually live with data and experience it in daily life?

To redress the gap between the promises of what we call the 'data-everywhere' paradigm and the day-to-day experience of data, we have been working with the residents and proprietors on the road that our lab is situated on, Tenison Road. Engaging with a community that we in a sense are part of, our concern has been with comprehending everyday understandings of data: 'data in place' if you will (see also [4]).

Several classes of data have emerged as important in the community. There is data that helps us negotiate better facilities and protect our environment. Traffic data is of particular concern at present to the community in question, and measuring the effect that traffic and building projects have on air quality indicators provides data that is useful in discussions with the council about local traffic calming provisions. In view of this, we have deployed a thermal camera on our building to measure traffic volume and speed, and residents have positioned Air Quality Eggs [1] outside their homes. Another interesting set of data is made up of materials that help tell stories about Tenison Road. Residents have been working with us to produce an historic archive of the road, and we have been looking at geo-temporal mapping as a way to record local knowledge.

Then there are the questions we would like to pose to others who live nearby—questions relating to local issues like the provisioning of new street signs and road designs; pragmatic issues like borrowing a ladder; and general community building, like queries about local plant and wildlife. We see this as a class of hyperlocal polling of voting data.

In this interactivity, we present two sets of 'data technologies' that we have designed to collect and display local data, both derived from our engagement with the community. The first, *Bullfrog*, is a bespoke voting device that we have deployed in 33 homes on Tenison Road. The second, a series of physical charts, allows for the public presentation of data derived from sensors on the street (e.g., traffic and air quality) as well as from voting devices (e.g., BullFrogs and PosterVote [5]). The charts have been displayed in our lab's large glass front that faces onto Tenison Road allowing the public to vote and view results from local sensor readings and polls.

Bullfrogs

Bullfrogs (Fig 1.) are small dedicated devices that can be used by residents to pose and answer questions. While much of the functionality they offer could readily be achieved within a web page or smartphone app, we decided to create a device that necessitated a physical interaction so as to foreground data collection during the project and highlight the very material act of generating data. Although questions (and detailed results) require web access, votes are made by inserting machine-readable paper-based cards into a card reader and simple results are presented on the small display.

The Bullfrog devices are based on two printed circuit boards (PCBs) soldered together. The bottom PCB looks

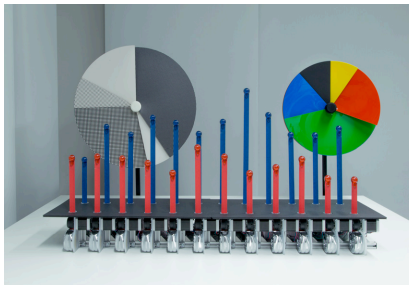
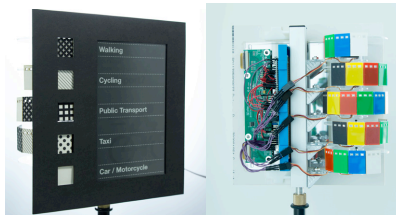
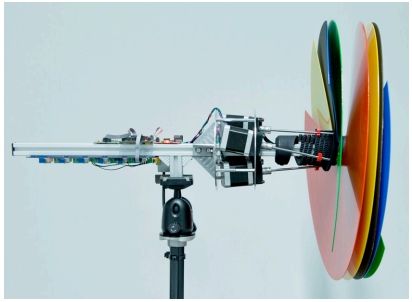


Figure 2. Physical charts with two pie charts in rear and two sets of bar graphs in foreground.



Front and rear of e-ink keys.



Side view of pie chart mechanism

after the sensors that read the unique patterns on the voting cards. The board contains an array of 8 by 6 photo-sensitive diodes arranged in groups of four around light-emitting diodes (LEDs). The upper PCB takes serial data from the sensor board. It consists of an SD card, an ADXL345 accelerometer, a Bluegiga WF121 WiFi chip, and a N18 colour display (128 by 160 pixels). Power (5v) comes through a micro-USB connector which is also used to program the top processor, but is not used for data transfer during normal running. The two boards and the screen are housed in a purpose designed housing laser sintered from nylon powder. The server tier for Bullfrogs, which supplies the necessary files (graphics and code assemblies) and receives the votes, runs in Azure and is written in the ASP .Net Web API and tSQL, with breakout gateways to and from a purpose built front/backend web service supporting community polling and voting.

Physical Charts

The physical charts (Fig. 2) are an attempt to make data and data visualisations easily legible (see also [2]). In response to the increasing sophistication of data visualisations and the seemingly unquestioning quest for novelty, the charts make playful use of long established and highly familiar representations: pie charts and bar graphs.

Also, beyond making data more eye catching, the charts are part of an effort to engage people with their data and enable them to use it to actively participate in communal life. By materialising data using large, mechanically driven charts, the aim has been to produce both a spectacle and forms of data that people find compelling and want to engage with.

The pie charts are mechanically actuated using an assembly of motors and custom-built gearing. The rotation of five discs is driven by data delivered to the charts from the ASP .Net web server on Azure (fronting the SQL database), and each disk can be individually turned to create the effect of a pie chart with different slices. The charts can receive data in real-time and cycle through multiple data sets. The bar chart consists of two rows of 12 individually actuated tape-measures (each driven by a separate motor). As well as displaying data in real-time, the two rows can show two different data sets, allowing data to be compared and contrasted. Both chart types have dedicated e-ink screens to display keys and, in the case of the bar charts, quantities or duration.

Lessons Learnt So Far

Thus far, the feedback to the physical charts and Bullfrogs has come from exhibiting them at two events, both open to the public (Fig. 3). The first was a street party on Tenison Road to which the neighbourhood was invited. Approximately 150 people attended this event. The second was a weekend-long exhibit at the Victoria and Albert Museum as part of the London Design Festival. Footfall at this event was 13,000 people. To offer a flavour of what we've learnt from these initial public engagements, we summarise three insights—insights that we've continued to work with in preparing the longer-term deployments on Tenison Road.

One, we've found people to be delighted by the immediacy of using the Bullfrogs and seeing their votes reflected in the charts. The very physical qualities of both give people a palpable sense of the effect they're having, materially, on the data. This is a helpful reminder that we need to think carefully about showing the rela-

Figure 3. Charts on display at Tenison Road street party.

Devices in use at Victoria and Albert Museum, London Design Festival.

tions between cause and effect when the Bullfrogs and charts are deployed on Tenison Road, and not shown side by side. Key for us here have been explorations of on and offline techniques that give an immediate indication a vote has been made.

Two, in the setting of public events, the data devices have spurred a lot of conversation not only about the qualities of their design and their interactions, but also about how data is relevant to a community and has the potential for local impact. Interest in data is hard to sustain when it's unclear how it has relevance and how it could be used. This has highlighted how we need to feed collected data into existing social and communication (infra)structures in the community. Rather than the data standing for itself, we're looking for ways to weave it into how the Tenison Road community communicates and instigates changes.

Three, as we've said, one of the aims of the physical charts has been to present data in an intelligible way. Broadly, people have been receptive to this. However, their simplicity also losses something of the fluid and emergent qualities of data, how data comes to mean different things to different people, at different times [3]. The comments, stories and criticisms get lost in pairing down the results. Moreover, they limit the way data might provoke other questions, producing other branches of questions and more data. It's clear from this that we need to support lightweight ways for people to overlay the data with their commentaries and questions, and that the charts should in turn reflect the emerging data. In short, they should be responsive to the environments in which they are installed.

As well as shaping our ongoing research, we also hope to build on these early ideas to present our work at CHI Interactivity. We conclude by briefly outlining a plan for an Interactivity exhibit.

Engagements at CHI 2015

Our exhibit aims to involve the CHI community by asking visitors to vote using Bullfrogs at the conference. Resulting data will be displayed at the Interactivity session on the physical charts. Topics for voting will be solicited from the CHI community, just as they are in the Tenison Road project, but, as a starting point, set questions could range from distance travelled to reach the conference, to number of peers travelled with, to best/number of sessions attended. We'd also seek to extend the data into existing communication platforms, by threading it into Twitter and Facebook discussions (and other lively social media platforms). Overall, the broad aim will be to provoke discussions about data, public data displays and community.

References

[1] Air Quality Eggs. http://airqualityegg.com.

[2] Jansen, J., Dragicevic, P., and Fekete, J. 2013. Evaluating the efficiency of physical visualizations. In *Proc.* CHI '13. ACM Press (2013), 2593-2602.

[3] Prensky, M. H. sapiens digital: from digital immigrants and digital natives to digital wisdom. *Innovate 5* (3, 2009).

[4] Taylor, A., Lindley, S., Regan, T., Grainger, L., Sweeney, D., Vlachokyriakos, V., Lingel, J. Data-in-place: thinking through the relations between data and community. Submitted to CHI 2015.

[5] Vlachokyriakos, V., Comber, R., Ladha, K., Taylor, N., Dunphy, P., McCorry, P. and Olivier, P. PosterVote: expanding the action repertoire for local political activism. In *Proc. DIS 2014*, ACM Press (2014), 795-804.