

OurCity: Understanding how Visualization and Aggregation of User-Generated Content Can Engage Citizens in Community Participation

Will Simm^{*1}, Jon Whittle¹, Adam Nieman², Anna Portman³, John Sibbald⁴

¹School of Computing & Communications, Infolab21, Lancaster University, Lancaster, LA1 4WA, UK

²GovEd Communications, PO Box 1283, Bedford, MK44 1WW, UK

³Department of Sociology, Bowland North, Lancaster University, Lancaster, LA1 4YT, UK

⁴Manchester Communication Academy, Silchester Drive, Harpurhey, Manchester, M40 8NT, UK

*w.a.simm@lancaster.ac.uk

Abstract

OurCity is a site specific digital artwork designed to solicit, aggregate and visualize citizens' views on the cities in which they live. It aims to allow people to have their voice heard in a way which is fun and engaging and reduces the gap between citizens and policymakers. OurCity builds on our previous work, VoiceYourView (Whittle et al 2010) which used similar data aggregation techniques but a completely different visualization of user generated data. This paper revisits the key results from VoiceYourView and hence uses OurCity as an additional validation exercise to assess whether VoiceYourView results are generalizable.

Introduction

OurCity is a site-specific digital artwork, developed collaboratively by digital artists and computer scientists, that solicits, aggregates and visualizes citizens' views on the cities in which they live (see Figure 1). Although OurCity is integrated with social media platforms such as Twitter, the main novelty of OurCity is that it offers a physical visualization of a set of comments that are automatically aggregated using a variety of topic classification, sentiment analysis, and feature analysis algorithms. This physical visualization is intended to be sited within a particular location and is meant to be used as a way to encourage people to comment on that location by providing real-time updates of current opinions in a way that is visually appealing and that can be immediately viewed in a physical manifestation.

Technologically speaking, OurCity uses a similar backend to the VoiceYourView platform (Whittle et al. 2010).



Figure 1: OurCity installed at the FutureEverything festival

VoiceYourView has been widely used in a variety of applications including urban regeneration and planning, public policing, and higher education. The key difference between VoiceYourView and OurCity is the way that data is visualized. Whereas VoiceYourView used somewhat rudimentary visualizations on LCD screens displayed in public places, OurCity was conceived from the outset as an artwork for display in a public gallery space. A digital artist worked with the VoiceYourView team to produce a display designed to be appealing and engaging for citizens; the result was a set of animated summaries projected onto a map showing different aspects of aggregated citizen data.

The other main difference between OurCity and VoiceYourView is the location in which they were applied. VoiceYourView has been used to capture views on a refurbishment of a major metropolitan library, to solicit visions for a university campus regeneration project, and to identify people's views on public policing strategies. In

contrast, OurCity has to date been deployed in the city of Manchester, UK – firstly, incorporated into lesson plans in a school as a way to engage pupils into thinking about the design of their local environment, and, secondly, at a major digital arts festival where attendees used OurCity to comment on the city of Manchester.

These two key differences – the change in visualization and application – give us an opportunity to validate results from earlier studies with VoiceYourView to see if those results can be generalized beyond the specific applications for which VoiceYourView was applied. This paper therefore presents OurCity as a validation case study and compares results obtained by using OurCity with those from VoiceYourView trials.

The rest of the paper is organized as follows. The next section describes the OurCity system and the scenarios in which it has been deployed. Following this, we briefly expand upon lessons learned by VoiceYourView so that these can be revisited in the OurCity context. The paper then goes on to present results from OurCity related to the findings from prior work. These are presented in two parts: first, a quantitative evaluation of the actual comments collected by OurCity; secondly, a qualitative evaluation of focus groups conducted with users and stakeholders of OurCity. Finally, the paper concludes and highlights some areas for future research.

The OurCity System

OurCity is an interactive digital consultation tool commissioned for FutureEverything 2011, a festival dedicated to celebrating the latest developments at the intersection of art and technology. Researchers from Lancaster University collaborated with data visualization artist Adam Nieman, Manchester Communication Academy, and FutureEverything facilitators to produce an installation which aimed to reflect the mood and thoughts of the Manchester population in a real-time display of comment summaries. OurCity was located within “Data Dimension”, FutureEverything’s 2011 exhibition, which explored how artists and designers approach the immaterial world of data. OurCity was exhibited for 11 days in May 2011, in a prominent Manchester city centre location at 4 Piccadilly Place and received widespread press coverage.

Both prior to and after the festival, OurCity was incorporated into lesson plans and used by pupils at Manchester Community Academy, a new school located in a deprived area of Manchester designed in part to lift the aspirations of local children and communities. A series of workshops was designed to elicit the students’ fears and aspirations for Manchester’s future, and the students responded with a number of text comments which were used in class discussions and exercises. In addition,

students were taken on escorted tours of Manchester city centre and they used OurCity to comment on new and historical developments in the city. Despite these all being local some pupils had not previously appreciated the history and provenance of the city centre. Text comments and images were left by the pupils using mobile phones and smart phones linked to OurCity.

The OurCity data visualization (Figure 1) takes the form of a surface with printed, located maps and a striking top projection of comment summaries. The comment summaries are in two modes – one shows hotspots of comments – highlighting areas which had many comments. The other mode displays summaries by topic and sentiment. The data visualization is live – users are encouraged to contribute by SMS, website and mobile apps. As comments are received they are displayed on the installation and the data summaries update in real-time.



Figure 2: ViewKi System Overview

OurCity is powered by an evolution of the VoiceYourView system (Whittle et al, 2010) called ViewKi (shown in Figure 2), which acts as a store, tagging system and interface for short text comments. Comments are accepted by native and HTML5 mobile apps, SMS text messaging and web site. When commenting by web and mobile apps the user’s location is automatically captured. Since OurCity was a located display within a defined context of Manchester and the festival, comments left via SMS were correlated to the festival venue location.

After the FutureEverything festival, OurCity was relocated to the foyer of Manchester Communication Academy, allowing the pupils the unique opportunity to interact on a regular basis. The use of the system was integrated into lesson plans designed to raise awareness of the environment and community in which the pupils live.

Comment Tagging Process

The ViewKi system (Figure 2) utilizes a number of Natural Language Processing (NLP) systems to instantly tag each text comment. Themes are identified in a given comment by interpreting tags applied to the text by the Wmatrix system (Rayson 2008). Sentiment of comments is

estimated using the Senora lexicon-rule based sentiment analysis system (Piao et al 2009). ViewKi also analyzes comments for actionability. We define a comment as actionable if it identifies a specific problem and provides a suggested solution. A comment is non-actionable if there is no content that could be acted upon to solve an issue, and a comment is somewhat actionable if it points out a problem but a solution is not explicit. Although topic extraction and sentiment analysis have been studied extensively, actionability analysis is novel and is crucial in directing where decision makers should focus their attention in large volumes of data (Ferrario et al 2012).

These three types of analysis allow powerful live visualizations of comment attributes to be displayed by OurCity. OurCity currently visualizes theme and sentiment but not actionability, since the latter is more relevant for decision makers rather than members of the public.

Below, we briefly describe OurCity tagging methods.

Theme Tagging

Wmatrix is an NLP software tool for corpus analysis and comparison. It is built on the USAS and CLAWS corpus annotation tools, which tag each word in the text with its Part Of Speech (POS) and semantic category (SemTag).

```
<w pos "RG" svo "" lemma "very" sem "A13.3"> Very</w>
<w pos "JJ" svo "" lemma "helpful" sem "S8+"> helpful</w>
<w pos "CC" svo "" lemma "and" sem "Z5">and</w>
<w pos "JJ" svo "" lemma "friendly" sem "S1.2.1+"> friendly</w>
<w pos "NN" svo "" lemma "staff" sem "I3.1/S2"> staff</w>
```

Figure 2: Tagging for “very helpful and friendly staff”.

An example of tagged text is shown in Figure 2. ViewKi processes tagged text by identifying themes in each comment. The first noun in each sentence is used as the first theme indicator. This is based on the assumption that the most important theme tends to appear as a noun at the beginning of a sentence. If no noun is present, the first adjective is identified as the theme indicator. Further themes are taken from the second noun or adjective. In the example in Figure 2, nouns are identified by the POS tag “NN”. In this case, the first noun is “staff” with SemTag “I3.1/S2”. This correlates to the USAS tags “I3.1: Work and Employment: Generally” and “S2: People”. Since there is no second noun, the first adjective (identified by POS tag “JJ”) is taken as a second theme. The first adjective is “helpful” which correlates to SemTag “S8+: helping”. In prior work, we found this method identifies an acceptable theme 78% of cases (Whittle et al 2010).

Sentiment analysis

We used the lexicon and rule based method described by Piao et al (2009) to score comments for sentiment. This method combines syntactic structure analysis, a scoring algorithm based on a subjectivity lexicon compiled by Wilson et al (2005) and a set of rules. The method takes

clauses as the basic units of analysis. So the main focus of this method is to detect the sentiment orientation of the clauses involved, and then aggregate the clause analysis results into the sentence sentiment score. Here the aggregation process does not simply sum up the scores, but applies a scheme to weight different types of clauses according to their relative importance in determining the sentence sentiment orientation. Simm et al (2010) report on an experimental comparison of the accuracy of this method with other state-of-the-art sentiment analysis techniques.

Lessons Learned by VoiceYourView

Recall that OurCity is an evolution of a similar system, VoiceYourView, the principal difference being the way that aggregated data is visualized. One objective of trialing OurCity was to see if findings from two years’ worth of VoiceYourView deployments also hold when applied with a very different visualization method and in very different contexts. In particular, VoiceYourView was mainly used as a digital consultation tool for urban design and planning where the users were members of the general public. In the case of OurCity, users were both members of the general public (during FutureEverything) and school children at Manchester Communication Academy.

VoiceYourView uncovered a number of interesting findings, which are revisited here in the OurCity context. Firstly, the nature of the data collected using VoiceYourView tends to differ from traditional consultation paper-based questionnaires. Experimental comparisons of VoiceYourView and paper-based methods have shown that VoiceYourView results in significantly more positive comments but also significantly fewer actionable comments, when compared to paper-based methods. The reason appears to be that traditional surveys are highly dependent on response rates and, if response is optional, it tends to be mostly those with a negative opinion who respond. However, VoiceYourView is deployed and is always operational, 24 hours a day. It seems to encourage more positive comments both because of increased availability but also because its playful, interactive nature and ease of use tends to encourage those to comment who view things positively.

Traditionally, those with negative views are more likely to comment because reporting requires a lot of effort and only those who feel strongly about an issue will go to the trouble. Decision makers, however, are very interested in hearing positive feedback because it allows them to get a balanced view from users and to identify good practice.

Interestingly, however, VoiceYourView tends to solicit fewer actionable comments than traditional paper-based methods. The reason for this seems to be that positive comments are generally less actionable – which makes

intuitive sense because actionability is associated with solving problems. In summary, then, VoiceYourView data differs from traditional collected data in that it has more positive but fewer actionable comments. This means, in particular, that VoiceYourView cannot be used simply as a replacement for traditional consultation methods. Although it has a number of advantages over traditional people-based surveys (namely, it is always available and can provide instant analysis of results), it is best used as a complement to existing methods; the use of both types of methods encourages fairer representation.

The second major finding from VoiceYourView is in the role that real-time visualizations of user-generated data plays. VoiceYourView trials showed differences in levels of citizen engagement according to how data is presented. LCD screens displayed in public spaces with real-time updates were positively received but, in a controlled experiment did not significantly encourage a greater number of comments. However, a similar controlled experiment showed a very significant difference if social media was used to disseminate comments: in this case, the level of engagement increased drastically. The conclusion seems to be that interesting visualizations do not necessarily increase the quantity of data collected but do encourage engagement as users may enjoy seeing others' views even if they do not record their own view.

In the OurCity work, we wished to revisit these two key findings and see if similar results were found using a different data visualization in a different setting.

Quantitative Analysis

Data collection using OurCity falls into three groups: Comments from the city tours with school children and teachers (A), where the participants were asked to leave comments about the places they visited. Comments collected during the period the system was live at the FutureEverything festival (B), left largely by festival goers. In this case, they were asked to comment on anything and everything related to Manchester and the festival. Comments collected during classroom sessions from school children (C), who were asked specifically to comment about places in their community that related to their school values which are summarized by the words Trustworthy, Helpful, Inspiring, Straightforward and Heart. The three data sets have different contexts and in this section we will characterize and contrast separately.

We manually rated each comment for actionability and sentiment, to characterize each set of comments. Two researchers independently tagged each comment, and any differences were then reviewed and agreed.¹

¹ Our algorithms can also estimate sentiment and actionability, but here we used a manual analysis as a more reliable method.

Table 1: Comment Analysis Results

Dataset	Total (%)	Actionability			Sentiment		
		A (%)	SA (%)	NA (%)	Pos (%)	Neu (%)	Neg (%)
A Tours	88 (100)	2 (2)	18 (21)	68 (77)	50 (57)	20 (23)	18 (21)
B Festival	143 (100)	7 (5)	13 (9)	123 (86)	59 (41)	51 (36)	33 (23)
C Class	168 (100)	1 (1)	2 (1)	165 (98)	136 (81)	28 (17)	4 (2)

Table 1 shows the result of this manual analysis. Sentiment was rated on a 3-point scale Positive (Pos) e.g. "Victoria Baths is buzzing today", Neutral (Neu) e.g. "manchester is different today", and Negative (Neg) e.g. "annoying helicopter is circling". Where a comment contained both positive and negative statements, for example "The home of rubbish beer, but lots of good nights..." the comment was assigned the Neutral tag. Actionability was rated on the 3-point scale of Actionable (A) e.g. "faster trains would make a huge difference to this city", Somewhat Actionable (SA) e.g. "commuters are not very cheerful", and Non-Actionable (NA) e.g. "shopping will kill us".

As we can see from Table 1, the comments, despite being drawn from very different contexts and demographics, have similar characteristics. The comments received are mostly Positive and mostly Non-Actionable. This data should be interpreted with care. In particular, we cannot draw any conclusion about whether OurCity generally tends to solicit more positive comments (as VoiceYourView did) because there was no formal comparison with a non-digital method. In addition, there is a weighting in the classroom data towards positive comments because the children were asked to comment on things relating to their (wholly positive) school values. However, even taking this caveat into account, the data does allow us to compare sentiment and actionability. It is clear from the data that a set of comments with high positivity is likely to have low actionability. This trend toward positive comments having low actionability has been observed in prior VoiceYourView trials (Whittle et al 2010, Binner et al 2011) and this adds further evidence.

Qualitative Analysis

Manchester Communication Academy is one of seven new Manchester academies; each is linked to a future growth sector of the city's economy such as finance and business, health, and communication. The school is very tech-savvy, with the pervasive use of interactive whiteboards, and cloud based learning portfolios, and so is open to working with emerging technologies.

To discover how staff and students from the school engaged with OurCity, focus groups with school staff were held at the Academy, led by an independent social scientist, to obtain evaluative feedback from participants.

Viewing this session as an interaction between pedagogical and sociological paradigms, the format was largely unstructured as opposed to a 'question and answer' session, to avoid the omission of feedback through the imposition of a sociological agenda. A further advantage of this methodology was to create a relaxed environment likely to encourage participation from all staff irrespective of their place in the school's hierarchy. Whilst no restrictions were placed in terms of what could be discussed, a checklist of relevant areas for discussion was composed prior to the session and consulted at the end to ensure that no areas for discussion had been omitted. Three senior staff participated in the group and will henceforth be referred to as S1, S2 and S3 to preserve anonymity.

Below, we highlight some of the findings from these focus group evaluations.

Concerns: The largest concern of the staff was over access to take part. Many students do not have a smart phone (for the mobile app usage), and students do not often have "free" SMS messages. There is widespread usage of the free Blackberry messenger system that would solve the issues. On city tours students shared mobiles to leave comments, and in the classroom a web interface was used.

Learning Outcomes: The staff were asked about what the students got out of taking part in OurCity. S3: *"it's that added dimension of how people feel about their community and instantaneous messaging that you can see; what people think about it; it's actually down, it's there."* They also liked the way they can see comments contributing to an installation that others can explore, read and perhaps act upon – S2: *"I think that was good in that it wasn't just something that they wrote in their book that only them or whoever marks their book are ever going to read. This was like in a wider sort of context really of them saying what they thought about something. It was **them** it was quite good."*

Classroom Integration: The staff were asked how the OurCity concept fitted with the syllabus and learning objectives – S3: *"(The lessons were) about values within our school and then we'd looked at a wider concept of that in the community and it just lent itself really well really to what the students were doing."* The OurCity system integrated well into the classroom and staff want to reuse in future – S2: *"it fitted really well with what we were doing"* S3: *"This is a scheme of work that we will continue to do with our Y7 in the first term when they join, and hopefully, we can try and keep that bit in"*.

Engagement: In discussion the staff liked the OurCity visualization, and felt it encouraged engagement. The OurCity projection was installed in the school foyer -

however, they indicated it might be better to display on the public displays already around the school or project onto walls to increase visibility and engagement. The website engaged the students – they all wanted to go to their areas and see what people had said or make a comment about their street, and found it more engaging than just looking at the projection. They knew that their comments were being held, and could see their comments at home which added value. Some of the students continued leaving comments beyond the classroom – at home etc. S1: *"it really engaged them because it was about them and where they live"*.

The students enjoyed the novelty and instant nature of feedback – S3: *"that was really instantaneous wasn't itwe put on a comment and they could see it, and it was really exciting"*. Connections to their lives and communities were made – S2: *"They were saying that's where my Primary School is! so it became very immediate and personal to them really"*. The students had previously hand drawn maps of their communities, highlighting places of interest. The transition from hand drawn maps to using OurCity further engaged the students – S2: *"it was kind of an extension of what they'd done, I think for some of them, the technology brings it to life, doesn't it"*.

The Academy from conception was seen as a community space – S2: *"a community resource with a school"*, and so is keen to develop active links into serving the community and adding value. The staff are keen to take the project forward, and see OurCity as a mechanism for engaging students with the communities in which they live.

Related Work

OurCity is a digital tool for civic engagement, which uses advanced real-time NLP (natural language processing) and data visualization to encourage engagement. Although the application of sentiment analysis and topic extraction is now commonplace in many such applications, the vast majority of these are web-based systems rather than located physical representations. OurCity is also novel in its ability to extract actionable data, which appears to be an under-researched area in social computing.

The OurCity data visualizations draw on research on the design of civic engagement systems: avoiding protrusive design (Kristoffersen and Brattenberg, 2008), which makes people feel uncomfortable; the importance of catering for specific user needs, including the 'extreme' ones, rather than focusing on a generic notion of 'community as a gloss' (Hope et al, 2006); and the need for systems to stand out so they are noticed by visitors.

The results in this paper show the added value in the school environment of instant displays of users comments. This relates to research on how feedback encourages the use of systems. For example, Rashid et al. (2003) have

found that providing subtle and integrated feedback does motivate under-contributors to more actively engage..

OurCity is a type of public issue-reporting tool. Whilst the visualization is fixed in a specific location as well as being web-based, the use of mobile devices to input comments means that OurCity relates to the growing number of mobile and online applications aimed at civic engagement. There are many examples; here we merely mention CitySourced, SeeClickFix and PledgeBank. None of these use NLP to understand comment semantics.

Conclusion

This paper has presented OurCity, a digital consultation tool which uses data aggregation and visualization as a way to engage citizens with their community. The findings from OurCity have been compared with prior trials of the VoiceYourView system, which has the same back-end but a completely different visualization.

The results provide further evidence for findings from VoiceYourView (Whittle et al 2010). Firstly, the comments collected using OurCity show that positive comments generally tend to be less actionable. This is in keeping with earlier results from VoiceYourView. Secondly, qualitative research showed some advantages of OurCity for engaging citizens, particularly school children, in local issues. Focus groups, consisting of teaching staff at the school where OurCity was used and integrated into lesson plans, said that OurCity extended prior teaching methods where students would make paper-based maps of their local area and comment on them. The advantages of OurCity, according to the focus group are that: (i) students like seeing what other pupils have written and OurCity allows this in an easy way; (ii) students like the instant feedback they get from OurCity and like the fact that their opinion is instantly displayed both in a prominent place within the school and on an associated website for all to see. It was clear from the focus group that OurCity improved engagement with civic issues in the school. The experiment has shown very clearly that social technologies such as OurCity can be effectively integrated into existing teaching practices in a way that engages pupils.

A future version of OurCity is now being developed and will be used to gather opinions on a major University's facilities during Visit Days. This version is using Microsoft Kinect to track a user's movements across a large projected map of the campus and to display comments relevant to the part of campus upon which the user is standing. We hope to discover whether the increased level of playfulness afforded by movement tracking affects engagement.

Acknowledgments

VoiceYourView is supported under the Digital Economy

Programme, a research theme led by the EPSRC (Engineering and Physical Sciences Research Council) on behalf of RCUK (Research Councils UK). We also acknowledge the support of staff and students from Manchester Communication Academy, and the FutureEverything festival for commissioning OurCity.

References

- Binner J, Whittle J, Simm W, Ferrario M, Lawlor Wright T, Woodcock A, Frankova, K, Garton L, Osmond J, Ariyatun A. "Digital Innovation with VoiceYourView Contributions to Knowledge and Lessons Learned." Digital Engagement 2011. 15 17 November 2011.
- Ferrario, M.A., Simm, W., Whittle, J., Rayson, P., Terzi, M., and Binner, J. "Understanding Actionable Knowledge in Social Media: BBC Question Time and Twitter, a Case Study", International Conference on Weblogs and Social Media (ICWSM), Dublin, Ireland, 2012.
- Hope, T., Hamasaki, M., Matsuo, Y., Nakamura, Y., Fujimura, N. and Nishimura, T., "Doing Community: Co construction of Meaning and Use with Interactive Information Kiosks." In Proceedings of Ubicomp, 2006, pp. 387 403.
- Kristoffersen, S. and Bratteberg, I., "Designing sociable IT for public use." In Proceedings of the 10th International Conference on Ubiquitous Computing, Seoul, Korea, 2008, pp. 252 261.
- Piao, S., Tsuruoka, Y. and Ananiadou, S.. "Sentiment Analysis with Knowledge Resource and NLP Tools." The International Journal of Interdisciplinary Social Sciences, vol. 4(5), Common Ground Publisher, ISSN 1833 1882, pp. 17 28.
- Rashid, M., Ling, K., Tassone, R.D., Resnick, P., Kraut, R. and Riedl, J., "Motivating participation by displaying the value of contribution." In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI), (2006), pp. 955 958.
- Rayson, P. "From key words to key semantic domains", International Journal of Corpus Linguistics, 2008, 13 (4). pp. 519 549. ISSN 13846655
- Simm, W., Ferrario, M.A., Piao, S., Whittle, J., and Rayson, P. "Classification of Short Text Comments by Sentiment and Actionability." IEEE SocialCom 2010, pp. 552 557. Minneapolis, USA.
- Whittle, J., Simm, W.A., Ferrario, M.A., Frankova, K., Garton, L., Woodcock, A., Nasa, B., Binner, J. M. and Ariyatun, L. "VoiceYourView: Collecting real time feedback on the design of public spaces." In Proceedings of the Ubicomp Conference, Copenhagen, Denmark, 2010, pp. 41 50.
- Wilson, T., Janyce W. and Hoffmann, P. "Recognizing Contextual Polarity in Phrase Level Sentiment Analysis." In Proceedings of HLT EMNLP 2005, Vancouver, CA, pp. 347 354