

## A SOCIAL PLATFORM FOR INFORMATION SONIFICATION: MANY-EARS.COM

*Anton Schertenleib*

University of Canberra,  
Information Sciences & Communication,  
ACT 2601, Australia  
**anton.schertenleib@canberra.edu.au**

*Stephen Barrass*

University of Canberra,  
Faculty Of Arts & Design,  
ACT 2601, Australia  
**stephen.barrass@canberra.edu.au**

### ABSTRACT

In this paper we describe the Many Ears project that will develop the first example of a social site for a community of practice in data sonification. This site will be modeled on the Many Eyes site for “shared visualization and discovery” that combines facilities of a social site with online tools for graphing data. Anyone can upload a dataset, describe it and make it available for others to visualize or download. The ease of use of the tools and the social features on Many Eyes have attracted a broad general audience who have produced unexpected political, recreational, cultural and spiritual applications that differ markedly from conventional data analysis. The Many Ears project seeks to find out what will happen when data sonification is made more available as a mass medium? What new audiences will listen to sonifications? Who will create sonifications and for whom? What unexpected purposes will sonification be put to?

### 1. INTRODUCTION

From the beginnings of email in the 1970’s, the internet has always been a social medium. The online newsgroups in the 1980’s allowed people from all over the world to chat about computers, science, recreational activities, social issues and an ever increasingly diverse array of alternative .alt directions. The invention of the HTML browser in the 1990’s allowed people to produce graphical pages with distinct URL addresses, and the world wide web bloomed with individually authored sites. Search engines made it possible to surf the web using keyword topics and phrases. In the 2000’s Web2.0 technologies such as the Wiki provided a framework for the distributed authorship of a site such as Wikipedia[1]. The hugely popular Facebook[2] site is composed of more than 350 million pages produced as a consequence of self representation and social interaction. Online Content Management Systems, such as Drupal[3], enabled communities to develop sites such as the ICAD[4] site in a bottom up manner. Content from different sites can be recombined in a Mashup constructed from material that has been aggregated and recomposed using RSS feeds. Sites such as Flickr[5] and Google Maps[6] provide Application Programming Interfaces (API’s) that allow other sites to access content from their online databases. Government departments, bureaus and agencies, museums, galleries and historical archives are similarly making data collections available online

and accessible through API’s. Beyond access, online service providers provide data processing such as a text to speech synthesizer that can be embedded into another site.

Many Eyes[7] is a site that combines social facilities with online services to enable “shared visualization and discovery”. The social facilities of the site include personal member pages, discussion topics, comments, ratings, watches and content sharing from the site. Participants can upload a dataset, describe it and make it available for others to visualize or download. The data can be visualized in 15 different ways that include line graphs, scatter plots, column/bar, pie, scatter and bubble charts. Data from different data sets can be mashed together to explore new questions. The extension of data visualization as a mass medium to a general audience has resulted in unexpected political, recreational, cultural and spiritual applications that differ markedly from the scientific analysis of data[8].

Music is a mass medium that has been an important cultural force throughout the 20th century in movements such as Folk, Rock and Tropicalismo. The social power of music combined with the social extension of Many Eyes raise the question of what would happen if data sonification was to become a mass medium too? What new audiences would sonification reach, and what new purposes would it be put to?

This paper describes the Many Ears[9] project that seeks to answer these questions. This project is based on the development of the first social site for data sonification. The following sections begin with background on the motivation for data sonification and the techniques they provide. The next section then provides an overview of the facilities provided by online sites for social visualization. The main section then presents a specification and plan for the development of the Many Ears site that integrates the key aspects of social visualization sites with key sonification techniques. The final section briefly describes future work on data collection that will be used to answer questions about the audience and applications of the site.

## 2. BACKGROUND

### 2.1. Sonification

Sonification is generally defined as the design of non-verbal sounds to convey useful information[10]. The advantages of non-speech audio for conveying information include:

- Sensitivity to temporal relations and rapid changes
- Multi-sensory perception of multi-parameter datasets
- Accessibility for the visually impaired,
- Explore datasets in frequency rather than spatial dimensions
- Identify new phenomena that current display techniques miss
- Find otherwise hidden correlations and patterns masked in visual displays
- Monitor data while looking at something else (background event-finding)
- Complement existing visual displays (since the ear is sensitive to different frequency bands and patterns than the eye)

The invention of the MIDI protocol in the early 1980's allowed scientists to connect computers to pop-music synthesizers and listen to data-sets from their experiments. In the 1990's sound cards for computer gaming enabled a broader range of sonifications that were not constrained by the MIDI palette of musical instruments. In parallel with the developments in audio hardware there have also been developments in software tools for sound synthesis. Many sonification researchers today use sound tools designed for computer music like those listed in Table 1. These tools are standalone applications that are compiled for different platforms. They provide a general range of synthesis techniques that typically include additive, subtractive, FM, formants and granular algorithms.

	Csound [11]	Max/MSP [12]	SuperCollider [13]	Pure Data[14]
<b>User interface type</b>	graphical	graphical	document	graphical
<b>API / interface</b>	shell script, Python, TCL, Java	C, Java, Python	shell script	shell script, Java, Python
<b>Development status</b>	mature	mature	stable	mature
<b>Cost</b>	free	495\$	free	free

Table 1: Tools for computer music and sound synthesis.

However sonification involves a concern with data that is peripheral in computer music. This concern entails a focus on data formats, selection, statistics, signal processing, mapping and representation. Sonification researchers have developed strategies for mapping data into sounds that include audification, parameter mapping, model-based and stream-

based approaches. Sonification tools have been developed that focus on importing data and various sonification strategies and techniques, as shown in Table 2. These are also desktop applications for individual use.

	SoniPy[15]	Sonifyer [16]	Sonification Sandbox[17]	xSonify[18]
<b>Development status</b>	prototype	stable	stable	prototype
<b>Import data</b>	TXT, binary, SQL	EEG <sup>1</sup> format, TXT	MS Excel, CSV	TXT, Web Service Interface
<b>Technology</b>	Python	Cocoa	Java	Java
<b>Sound synthesis</b>	n/a	FM Synthesis	MIDI-fication[19]	MIDI-fication[19]
<b>Sonification type</b>	n/a	parameter mapping, audification	parameter mapping	parameter mapping
<b>Sound rendering</b>	Audio file	Audio file	MIDI file	MIDI file
<b>Cost</b>	free	free	free	free

Table 2: Sonification tools.

### 2.2. Collaborative Visualizations

A summary of the most popular collaborative visualization projects currently available in the internet is shown in Table 3. All projects are free of charge but Swivel also has an optional monthly fee for access to additional functionalities related to group collaborations.

	DEVise [23]	Data360 [24]	Swivel[25]	Many Eyes[7]
<b>Data types</b>	numerical	numerical	numerical	textual, numerical
<b>Visualization techniques</b>	2	-	7	15
<b>Upload own data</b>	-	✓	✓	✓
<b>Online data manipulation</b>	-	-	✓	✓
<b>Collaboration/forum</b>	-	✓	✓	✓
<b>Registered users</b>	-	n/a	16.445	37.847
<b>Visualizations</b>	n/a	n/a	n/a	50.009
<b>Uploaded datasets</b>	-	6.831	n/a	96.736
<b>Audience</b>	research	industries, research, politics, general public, education	industries, research, politics, general public, education	industries, research, politics, general public, education
<b>Costs</b>	free	free	starting at 12\$/month	free

Table 3: Online data visualization projects.

<sup>1</sup> EEG: Electroencephalography

The idea of collaborative visualization began in the late 1990's with the DEVise project that consists of a Java desktop application and a Java Applet[22]. The visualization was prepared offline with a desktop application that allowed you to import data, define the data schema description and the visualization parameters, and then visualize the data. The Java Applet called DEVise JavaScreen then made it possible to share the visualization over the internet. The initiator of a sharing session can control the application and views of the current visualization, and other people can join the session as viewers. However the shared interface did not support interpersonal communications which had to be done through other channels such as email, phone or chat.

A web2.0 site called Data360 site came online in 2004 as a "Wiki for Data" that provides facilities for uploading datasets and visualizations. Users can create a platform and start uploading data sets they want to visualize. If a platform is declared public other data360 users can start to subscribe and access the data sets and visualizations as viewers. They can start discussions about the data and even create reports based on the data.

Swivel and Many Eyes launched at almost the same time around the end of 2006. Many Eyes now has over 37,000 registered users, more than double the number in the Swivel user base. Many Eyes offers 15 kinds of visualization (including word clouds) while Swivel offers 7. Data from different data sets can be combined to explore new questions.

### 2.3. Sonification Community

The communal website of the International Community for Auditory Display[4] has been build with a Web2.0 tool called Drupal. Anyone who is interested in Auditory Display may register, and then contribute to the site through the various community forums and discussion lists. The navigation bar on the site has links to pages titled About, Conferences, Awards, ICAD Board, Knowledge Base, Press, Community Area, Audio, News Aggregator, and Contacts.

The Conferences page provides links to previous and current International Conferences on Auditory Display beginning from 1992 in Santa Fe. The Awards page shows awards made at those conferences. The Board page shows the current Board members and their affiliations. The Knowledge Base includes 10 Papers to Start, 10 Audio Examples, a ToDo list, the NSF Whitepaper on Auditory Display, a Bibliography of all papers published in the ICAD conference proceedings, and many more resources. The Media page shows Stories about ICAD on TV, radio, in newspapers or other media.

The Community Area lists the registered Members of the site, Editors who can change pages at the request of Members, Forums, Mailing Lists, Polls, and Treasure Hunt 2008. The Audio page provides a place for sonification audio files. Currently there is only one sonification there, with 2541 downloads and 850 plays. The page does not provide an upload mechanism so presumably a Member must send their sonification file to an Editor for it to be uploaded. The News aggregator has RSS feeds from relevant and interesting articles on the internet. The Contact page provides email links to the site Editors.

The ICAD community has also been developing a more general public awareness and appreciation of sonification through a series of concerts that began at ICAD 2004 in Sydney. This first concert titled Listening to the Mind Listening was staged at the Sydney Opera House and attracted an audience of more than 350 [20]. The concert consisted of 10 sonifications of EEG brain data recorded from someone listening to a piece of music. These sonifications were selected from thirty submissions. The public concert of sonifications was repeated at ICAD 2006 at the ICA in London in which there were 8 sonifications of data from the CIA factbook on world population and resources [21]. A social web2.0 style website was developed for the sonification competition at ICAD 2009 in Copenhagen. This website provided online access to a dataset of DNA from yeast. Participants were able to download the dataset, and upload a sonification with a description and credits. There were 50 sonifications submitted in categories of musical and scientific. Only three sonifications were submitted in the scientific category. Anyone could listen to and rate the sonifications on a around 10 descriptive scales such as boring, fascinating, confusing and others. The submissions typically received more than 100 plays over a period of two months. However the site is no longer visible and the sonifications and related data about engagement with them are unfortunately no longer accessible.

## 3. PROJECT PLAN

### 3.1. Phase 1: Initial site

Step 1 was to register the URL [www.many-ears.com](http://www.many-ears.com) as a reference to the concept of social visualization established by Many Eyes. Next we needed to find a technology that could enable the implementation of a site with social features as well as tools for online sonification. After some feasibility studies we chose to build the back end of the web application with Java J2EE[26] and associated web development frameworks. For persistent data storage we chose MYSQL[27] for the database as well as the option to store files directly in a file store structure referenced by a unique identifier. This backend provides a login and file upload functionality. The front end is HTML[28] based with Adobe Flash[29] elements embedded e.g. an audio player.

The initial site consists of a short introductory animation that introduces the Many Ears project followed by a mock up of the user interface in Flash. The establishment of the site provides the basis for the ongoing collection of data about usage. The screenshot from Google Analytics[30] in Figure 1. gives an overview of traffic to the site during the month from 10 January to 9 February 2010. This shows there were at total of 15 visits on 5 days, and that the largest proportion of the traffic came from referring sites. Google Analytics will be used to monitor the activity on the site throughout the project, and to analyse the effect of the introduction of the social features and online tools in each phase.

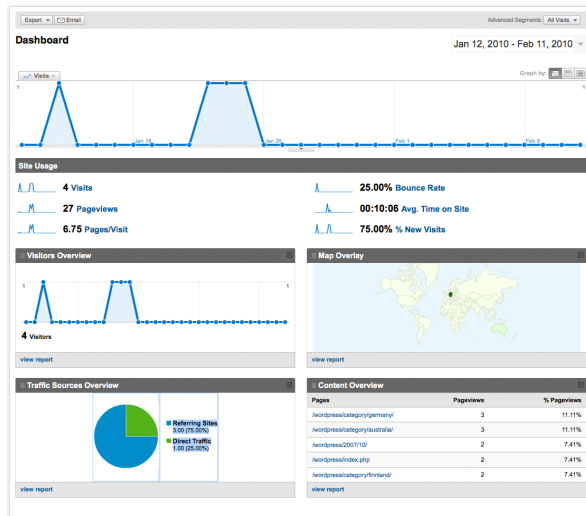


Figure 1. Google Analytics for www.many-ears.com

### 3.2. Phase 2: Social features

Many Ears is a social site in which the content is generated by the community of practice. Registered participants have a personal page similar to Facebook where they can provide their personal profile, upload datasets, and upload sonifications.

The personal profile consists of a text ID, a visual ID, a sonic ID, a tag list, and a text box for describing contacts, affiliations, interests, external links or anything else.

The data area allows the upload of datasets, subject to a file size limit. Data sets each have a tag-list, a text description box, and a checkbox for public or private access. Public data sets have an additional comments box, and a recommendation icon. Registered participants can leave comments and recommendations, and can download public data-sets.

The audio area allows the upload of audio files in WAV or MP3 format, subject to a file size limit. Audio files each have a tag-list, a text description box, a checkbox for public or private access and an audio player. Public audio files have an additional comments box, and a recommendation icon. Registered participants can leave comments and recommendations, and can download public audio files.

Visitors to the site can browse the personal pages in the Lounge area, shown in Figure 2.

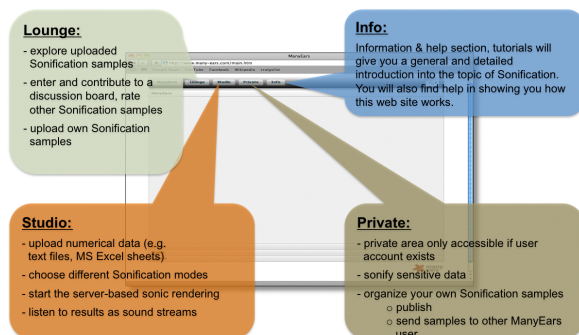


Figure 2. Many Ears with function descriptions

The social feature is currently designed to support online submissions to the ICAD 2010 concert event [31]. For this we would like to provide basic functionalities for people to upload their compositions, adding meta information like title, descriptions etc. All the compositions can be displayed in a list which could be ordered by different categories. Registered users can also rate and evaluate the sound samples. Commenting functionalities are also planned to encourage discussion of the submissions. This will also provide a starting point for collection of data about the effect of social features. Quantitative data about traffic on the site will be collected with Google Analytics. Qualitative information about the higher level socialisations will be analysed from comments, ratings and recommendations.

### 3.3. Phase 3: Online Sonification

Phase three will introduce online tools for data sonification into the Many Ears site. This will consist of the addition of a new area where participants can select a tool to apply to a dataset in their data area to produce a sonification in their audio area. A Sonification Template comprises a list of settings and parameters which will be handed in the next step to the back end sound render software. The number of templates is scalable and can be extended. In future it may also be possible for participants to design and upload their own sonification templates into the site.

The initial templates will be based on the sonification algorithms that were implemented previously in the xSonify[18] tool based on Java MIDI API:

- MIDI Notenummer parameter mapping - each data value is mapped to the notenummer of a MIDI instrument at constant volume
- MIDI Loudness mapping – each data value is mapped to the volume of a MIDI instrument at constant pitch.
- The average value over a certain number data values is mapped to the repetition rate of a MIDI instrument at a constant pitch and loudness.

Once these templates have been established based on existing Java technology we will progress to more sophisticated sonification techniques that will include audifications, multi-parameter mappings, redundant mappings, model-based and stream-based, and metaphors such as a Geiger-counter. These sonifications will be implemented by linking Many Ears to sound synthesis engines such as Pure Data[14] or SuperCollider[13] that offer application programming interfaces (API) based on Java technologies.

Once the general online synthesis capability has been implemented it will be made accessible through an online API to create an online sonification service that can be embedded in any website. This enables 3rd party applications/systems to use the Many Ears platform as external sonification rendering tool. The purpose of this feature is to enable data visualization sites to use sonification as an alternative to their already existing visualizations.

From the technical side we are planning to use Java Servlet Technologies[32]. In Many Ears registered 3rd party

applications/systems upload the data attached with sonification parameters and receive a unique identifier in return. This unique identifier can be used to download the rendered sound sequence by invoking a download servlet or if not finished the progress information of the rendering taking place on Many Ears. An example of a similar internet based service provider is a text to speech application from Vozme[33].

### 3.4. Phase 3: Data collection and analysis

After the deployment of the sonification tools in Phase 2 we will measure if there is an increase in users, traffic, comments, number of datasets being uploaded, social interactions and actual sonification activities. The goal is to develop a better understanding of the relevance sonification might have on the general public. For this we would like to gain insights in the acceptance and behaviors of people from different backgrounds using sonification and also to attract new audience to this field.

For the collection of quantitative information from the participants we suggest two categories of data acquisition:

#### 3.4.1. *Passive data collection: Logging information in the background*

Data acquisition where the user doesn't have to play an active role will be Many Ears' logging mechanisms running in the background. We will use this data to answer the following questions:

- Where does the user come from? Which country and even city?
- The visitors loyalty. If and how often is a user returning to Many Ears?
- Which functionalities of Many Ears seem to be the most interesting?
- Which sonification tools/methods seem to be the most popular in terms of certain kinds of data, applications or particular audiences?
- Which association is there between the users discipline and their sonification preferences?
- Number of registered users, amount uploaded datasets and sonification samples?
- Number of contributions to discussions?
- Numbers of downloaded sonification compositions?

#### 3.4.2. *Active data collection: Surveys and forum*

Active data collection is where the participants are encouraged to discuss their experiences with other users. All discussion are stored in Many Ears database and accessible to all other Many Ears users. Going through all the written comments will be the most challenging and laborious part of the data analysis at the end of the project, but we expect it will be invaluable and very exciting.

The rating option, also mentioned above, will also provide information about the participants preferences for sonification compositions along with information of the participants personal profile. Other qualitative comments about the site will

be collected by online surveys that will appear as a dialog when entering the website.

## 4. SUMMARY

Many Ears is the first example of a social site for online sonification. The social features of the site will allow the participants to generate the content in a manner similar to Facebook and other web2.0 sites. These social features will include a personal page where participants can provide a profile and upload datasets and sonified audio files. Visitors to the site will be able to browse these pages to discuss the data sets and sonifications and provide give ratings. The site will also be the first example of an online sonification rendering engine. Participants will be able to apply a sonification technique to a data set to produce an audio rendering online in their page. The range of sonification techniques is scalable and it is intended to allow participants to add new techniques. The rendering engine will be made available to other websites through and online API. The effects of the site will be monitored and analysed through quantitative analysis of site traffic, and quantitative analysis of social discourse on the site. We hypothesise that the introduction of a social site with online tools will enable sonification to reach new audiences and extend it towards a mass-medium that will have new and unexpected applications.

## 5. FUTURE WORK

We are planning a long term collaboration with the Shirohisa Ikeda Project[35] in Puerto Rico. This collaboration is aiming on the introduction of sonification to high school students. The teaching methods in schools as we know it are laid out visually. Many Ears could act as an alternative way of working with data.

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## 7. REFERENCES

- [1] Wikipedia, Online Encyclopedia - <http://wikipedia.org>, retrieved 4 February 2010
- [2] Facebook, Social Networking - <http://www.facebook.com>, retrieved 4 February 2010
- [3] Drupal, PHP based Content Management System - <http://www.drupal.org>, retrieved 4 February 2010
- [4] ICAD, International Community for Auditory Display - <http://icad.org>
- [5] Flickr, Online photo sharing platform - <http://flickr.com>, retrieved 4 February 2010
- [6] Google Maps, Online street map platform - <http://maps.google.com>, retrieved 4 February 2010
- [7] Many Eyes Project, data visualization web site - <http://www.many-eyes.com>, retrieved 4 February 2010

- [8] Fernanda B. Viégas, Martin Wattenberg, Matt McKeon, Frank van Ham, Jesse Kriss, *Harry Potter and the Meat-Filled Freezer: A Case Study of Spontaneous Usage of Visualization Tools*, IBM T. J. Watson Research Center, 2008
- [9] Many Ears Project, acoustical data visualization web site - <http://www.many-ears.com>, retrieved 4 February 2010
- [10] Gregory Kramer, Bruce Walker, Terri Bonebright, Perry Cook, John Flowers, Nadine Miner, John Neuhoff, *Sonification Report: Status of the Field and Research Agenda*, National Science Foundation, 1998
- [11] Csound, Sound synthesis software - <http://www.csounds.com>, retrieved 4 February 2010
- [12] Max/MSP, Sound synthesizer software - <http://cycling74.com>, retrieved 4 February 2010
- [13] SuperCollider, Sound synthesizer software - <http://supercollider.sourceforge.net>, retrieved 4 February 2010
- [14] Pure Data, Sound synthesizer software - <http://puredata.info>, retrieved 4 February 2010
- [15] SoniPy, Python sonification tool - <http://www.sonification.com.au/sonipy/index.html>, retrieved 4 February 2010
- [16] Sonifyer, Sonification tool - <http://www.sonifyer.org>, retrieved 4 February 2010
- [17] Sonification Sandbox - Sonification tool - [http://sonify.psych.gatech.edu/research/sonification\\_sandbox/index.html](http://sonify.psych.gatech.edu/research/sonification_sandbox/index.html), retrieved 4 February 2010
- [18] xSonify - NASA sonification project - <http://spdf.gsfc.nasa.gov/research/sonification/sonification.html>, retrieved 4 February 2010
- [19] Schaffert, N., Mattes, K., Barrass, S., Effenberg, A.O., *Exploring function and esthetics in sonifications for elite sports*, 2nd Int. Conference on Music Communication Science, Sydney, 2009
- [20] Barrass, S., Whitelaw, M., Bailes, F. A. Listening to the Mind Listening: analysis of reviews, sonifications and designs Leonardo Music Journal vol16: 13-19, 2006
- [21] ICAD 2006, ICAD conference in London - <http://www.dcs.qmul.ac.uk/research/imc/icad2006>, retrieved 4 February 2010
- [22] Java Applet Technology - <http://java.sun.com/applets>, retrieved 4 February 2010
- [23] Devise, data visualization web site - <http://pages.cs.wisc.edu/~devise/index.html>, retrieved 4 February 2010
- [24] data360, data visualization web site - <http://www.data360.org>, retrieved 4 February 2010
- [25] Swivel, data visualization web site - <http://www.swivel.com>, retrieved 4 February 2010
- [26] Java J2EE Technology -
- [27] MYSQL, Relational DBMS - <http://www.mysql.org>, retrieved 4 February 2010
- [28] HTML, Hyper Text Markup Language - <http://www.w3.org/MarkUp>, retrieved 4 February 2010
- [29] Adobe Flash - <http://www.adobe.com/products/flash>, retrieved 4 February 2010
- [30] Google Analytics, Web traffic analysis platform - <http://www.google.com/analytics>, retrieved 4 February 2010
- [31] ICAD 2010, ICAD conference in Washington D.C. - <http://www.icad.org/icad2010>, retrieved 4 February 2010
- [32] Java Applet Technology - <http://java.sun.com/products/servlet>, retrieved 4 February 2010
- [33] Vozme, Online text to speech service - <http://www.vozme.com>, retrieved 4 February 2010
- [34] Shirohisa Ikeda Project - <http://www.shirohisa-ikeda.org>, retrieved 4 February 2010