Online Map Interface for Creative and Interactive Music-Making

Sihwa Park, Seunghun Kim, Samuel Lee, and Woon Seung Yeo
Audio & Interactive Media Lab
Graduate School of Culture Technology, KAIST
Daejeon, South Korea
s.h.park, seunghun.kim, lsme007, woon@kaist.ac.kr

ABSTRACT

In this paper, we discuss the musical potential of COM-Path - an online map based music-making tool - as a novel and unique interface for interactive music composition and performance. COMPath provides an intuitive environment for creative music making by sonification of georeferenced data. Users can generate musical events with simple and familiar actions on an online map interface; a set of local information is collected along the user-drawn route and then interpreted as sounds of various musical instruments. We discuss the musical interpretation of routes on a map, review the design and implementation of COMPath, and present selected sonification results with focus on mapping strategies for map-based composition.

Keywords

Musical sonification, map interface, online map service, geo-referenced data, composition, mashup

1. INTRODUCTION

COMPath (Composition with Path) is an interactive map interface for musical sonification of local information. Users can specify an arbitrary route by marking "nodes" - central points for data collection - on the map. Selected local information (e.g., traffic volume, temperature, wind speed, and social events) related to each node is then obtained through major Open APIs (i.e., set of technologies for interaction between different web services), and sequentially converted into musical events along the route. COMPath suggests a new approach to musical sonification which can display the regional characteristics of an area - reflected by the local information - at many different scales.

As a continuation of our previous study [12], this paper extends the discussion of the musical significance of interactive online maps as a tool for algorithmic composition (especially for chance music), and reviews the design and implementation of COMPath. Several mapping results are also presented to demonstrate the effects of place, path, and time on map-based music making procedure.

2. LITERATURE REVIEW

Sonification, or auditory display, is defined as the transformation of data relations into perceived relations in an acoustic signal, based on the idea that synthetic non-verbal sounds can represent the data and provide support for processing a variety of information [8].

In this paper, we focus on sonifications of geographical or geo-related information (i.e., information which can be referenced by a map), with emphasis on musical application rather than practical navigation.

2.1 Geographic Sonification

Many attempts have been made to display geographical data with sound for navigation purpose. Zhao et. al. presented the "interactive sonification" strategy [19], which enables vision-impaired people to perceive geographical distribution patterns of statistical data on both familiar and unknown maps. The PocketPC-based system by Strachan et. al. [15] combines the functionality of a mobile Global Positioning System (GPS) with that of a portable music player to guide the user via continuously adapted music feedback, and Ontrack [16] provides navigation cues by modifying the spatial balance and volume of mobile music player sound to direct listeners to their destination.

2.2 Musical sonification

In the context of algorithmic composition, sonification usually means the process of turning non-aural information into musical sound for artistic purpose [5] and has been called as 'musical sonification' [1]. Examples include the MUSE (Musical Sonification Environment) [10], which generates musical and engaging sounds allowing interactive and flexible mapping of scientific data to six different sound parameters. The Climate Symphony [13] was an attempt to sonify the 110,000 years of ice core history into music. Ben-Tal and Berger also applied their sonification methods (by filter settings and by timing information) to musical application for composition [2].

In Sonic City [6], Gaye et. al. explored the field of psychogeography through musical sonification of a city space. With many kinds of sensors, this project converts aspects of the city into generative electronic music in real time by walking through and interacting with the urban environment. McCallum sonified local Wi-Fi coverage data while riding a bike [11]. The Copenhagen Channel audio application [9] and Davos Soundscape [14], although not strictly classified as sonification, are examples of location-based music in the urban field.

2.3 Data mapping framework

The overall data mapping scheme of COMPath is similar to that of wave terrain synthesis [3, 4] and SonART [18] in that it is a mapping from a path on a surface (two-

dimensional space) to music/sound (one dimensional space) but at a higher level (i.e., mapping to symbolic notes rather than to non-symbolic sonic events). Moreover, it is an example of a *scanning* process along a path with local *probings* at each designated node, as described in [17].

3. SYSTEM OVERVIEW

3.1 Interactive Map Interface for Musical Sonification

In addition to being popular and easy-to-use, interactive online maps are ideal as interfaces for a variety of georeferenced information such as location, climate, demographics, etc.

3.1.1 Temporal arrangement

Music is an art of time: every element in music is presented to the listener sequentially over time. Similar temporal arrangement is performed when tracing a route on a map; while being scanned, nodes on the route will be encountered in order and then "organized" in time.

Based on this conceptual analogy, COMPath allows users to intuitively determine the overall structure of their music by placing nodes at desired places on a map. Figure 1 illustrates the correspondence between nodes on a route and phrases in music.

3.1.2 Instruments

COMPath can collect various types of information. Examples include location (latitude and longitude), climate (temperature, wind speed, etc.), demographics (population, traffic, etc.), and social events (photo locations, cultural events, etc.) as well. Each of these datasets can be mapped to "play" an instrument by controlling its pitch, loudness, and/or timbre; in figure 1, a polygon shape (e.g., triangle, circle, and star) represents certain information type.
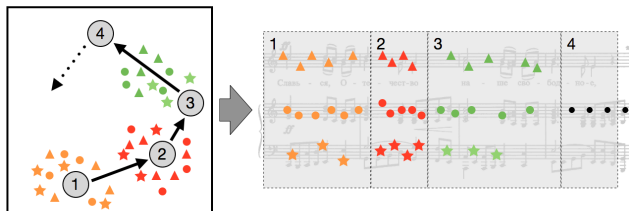

Figure 1: Conceptual analogy between a map route (left) and music score (right), in terms of temporal arrangement (node number and phrase) and instrument (polygon shape).

3.1.3 Time and space

Information gathered by COMPath reflects the local characteristics of an area, thereby resulting in different music from that of other areas. Moreover, results from two different routes - even within the same area - would not be identical to each other. This highlights the potential of COMPath as a sonification tool for practical applications, such as identification of regional demographics by sound.

At the same time, COMPath is also time-dependent; as most information (except location) is updated, music from the same route can vary according to the time it is sonified. In figure 2, change in traffic volume at each location on a map (top left) is depicted (at 9 am, 2 pm, and 2 am, top

right); variation of musical results from node 3 (bottom) shows the fluctuation in traffic over time.

Furthermore, computerized online maps allow users not only to access virtually any place in the world but also to increase or decrease the scale as desired, thereby providing unlimited resource for composition. This, together with the indeterminacy in time, makes COMPath a unique music-making tool - especially for chance music.
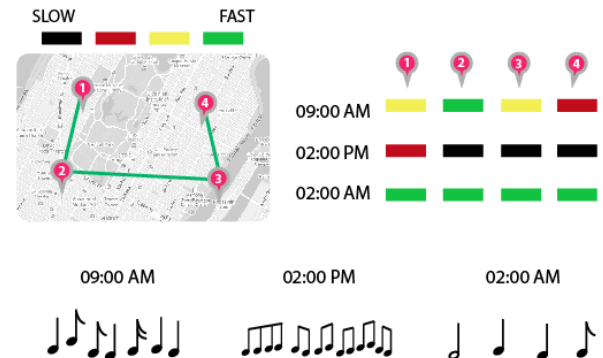

Figure 2: Musical representation of traffic volume changes over time.

3.2 System Design and Implementation

COMPath consists of three parts: user interface, data mashup module, and data mapper for sonification. The building blocks and information flow of the system is illustrated in figure 3.
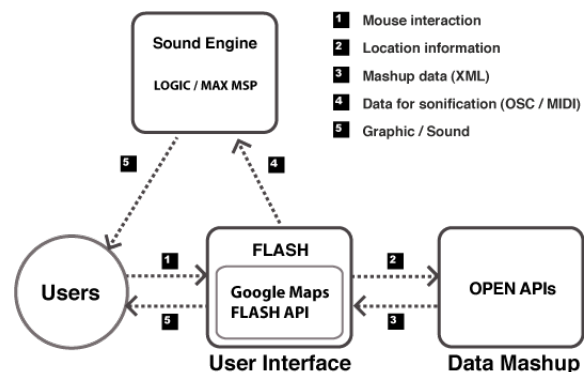

Figure 3: Schematic diagram of COMPath.

3.2.1 User Interface

The user interface of COMPath provides full control over the map (figure 4); based on Google Maps FLASH API, users can easily locate the area of interest, zoom in and zoom out at various scales, and create/modify/delete nodes (and hence routes) by placing markers on the map.

3.2.2 Mashup Module

At the core of COMPath is data mashup module; it combines data from external sources to provide a customized set of information for sonification. Commercial web services such as Google, Yahoo, and Flickr support this feature and provide public Application Programming Interfaces (APIs) for custom software development [7]. Selected web services with "Open API's" and the type of information that are queried for mashup by COMPath are listed in table 1.
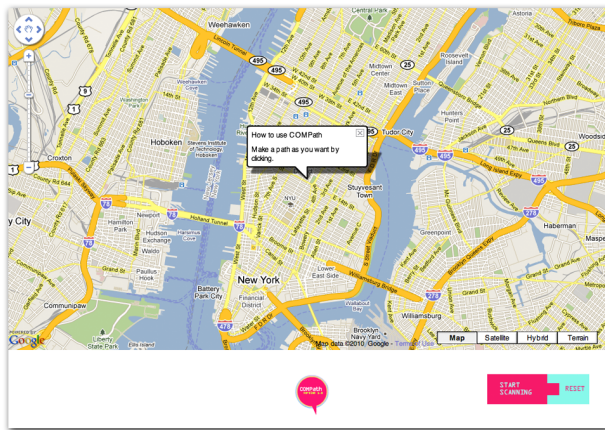
Figure 4: User interface of COMPath.

Website	Type
Yahoo traffic	Realtime traffic volume
Flickr	Shooting locations of photos
NOAA	Climate information
Eventful	Number of culture events
Outside.in	Local news at a certain region
Socialight	Comments and reviews

Table 1: List of major OpenAPIs

For each user-marked node on a route, mashup module retrieves its geographic location and sends queries to get desired information (e.g., temperature, traffic volume, local social events, favorite photo locations, etc.) from the internet. Location and type of each query is displayed on the map as colored markers, as shown in figure 5.
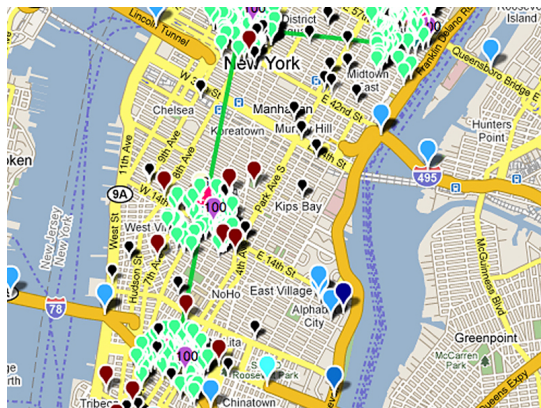

Figure 5: Mashup query results along a route.

3.2.3   Data Mapper

For sonification, information collected by mashup module must be transmitted to any sound source. COMPath can handle both OSC (Open Sound Control) and MIDI (Musical Instrument Digital Interface) messages and hence supports most major sound synthesis software; currently we use virtual instruments in Apple's Logic (via MIDI) as well as custom-made patches in Max/MSP (via OSC) as our sound sources.

4.   TEST RESULTS

In this section, we present selected examples of COMPath sonification to highlight the unique features of the system discussed in section 3.1 (more sound/video samples of COMPath sonification results are available at `http://aimlab.kaist.ac.kr/COMPath`).

- Area of interest: we selected two highly contrasting locations - one in Manhattan, NY (figure 6(a)) and the other in Palo Alto, CA (figure 6(b)) and performed sonification at the same time. Compared to the complicated music with richer sound in the Manhattan area, music from Palo Alto (with less query results, as shown in the figure) sounds simpler and more "sparse."

- Path: figure 6(c) shows the same Manhattan area as in figure 6(a), but with a different route. Although the overall atmosphere of music from figure 6(c) bears a strong resemblance to that of figure 6(a), both songs are not identical to each other.

- Time: results from the same path may vary depending on when it is created. Figure 6(d) depicts the result of data query along the identical route as in figure 6(a), but at a different time; changes in marker distribution pattern (and hence sonified results) show the time-dependency of COMpath. In addition, the lack of precise control over the value/amount of collected information implies the indeterministic characteristics of the system.

In general, we received highly positive user feedback. Regarding the usability of the interface, almost every user understood the concept instantly with little learning curve, and recognized its potential as an interactive interface for music-making. Furthermore, the majority of users were satisfied with the quality of music COMPath produced, and suggested its use as a tool for algorithmic composition.

5.   CONCLUSION

COMPath provides a unique environment for creative music making with an interactive map interface. This intuitive musical sonification tool utilizes virtually unlimited amount of georeferenced data, and has a strong potential as a new interactive musical interface which can serve for both artistic and practical purposes.

In addition to technical improvements to COMPath (e.g., full control over the scanning speed/direction, simultaneous "playback" of multiple routes in the same area), future work will include:

- control by mobile devices. With COMPath on mobile devices, users can perform tracing (and real-time sonification) by physically "walking" on the route.

- locative performance *for* COMPath. This collaborative project aims to actively control local social data (e.g., traffic, events, photos) to influence the sonified outcome of a pre-determined route.
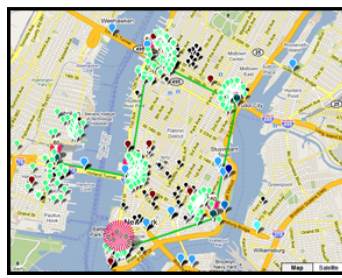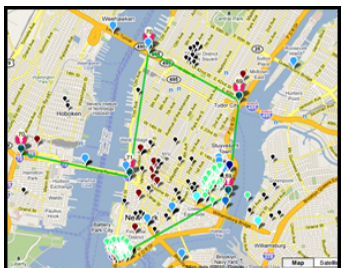
(a) Default route in New York.
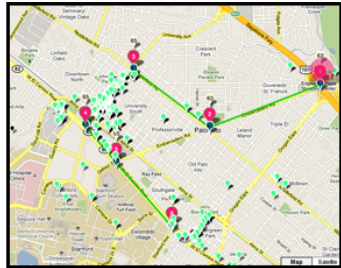
(b) Palo Alto.
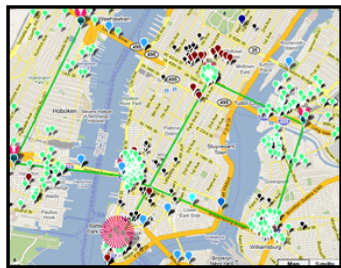
(c) New route in New York.

(d) Default route in New York, but at a different time.

Figure 6: Comparison results.

6. REFERENCES

[1] R. Bain. The aims project: Creative experiments in musical sonification. In *Proceedings of the International Computer Music Conference*, Miami, USA, 2006.

[2] O. Ben-Tal and J. Berger. Creative aspects of sonification. *Leornardo*, 37(3):229–232, 2004.

[3] J. Bischoff, R. Gold, and J. Horton. Music for an interactive network of microcomputers. *Computer Music Journal*, 2(3):24–29, 1978.

[4] A. Borgonovo and G. Haus. Musical sound synthesis by means of two-variable functions: Experimental criteria and results. In *Proceedings of the International Computer Music Conference*, pages 35–42, 1984.

[5] P. Burk, D. Polansky, M. Repetto, and D. Rockmore. *Music and Computers: A Theoretical and Historical Approach.* Key College Publishing, Emeryville , CA, 2005.

[6] L. Gaye, R. Maze, and L. E. Holmquist. Sonic city: the urban environment as a musical interface. In *Proceedings of the 2003 conference on New Interfaces for Musical Expression*, pages 109–115, NIME, 2003.

[7] Gibson, Rich, and S. Erle. *Google Maps Hacks: Tips & tools for Geographic Searching and Remixing.* O'Reilly Media, January 2006.

[8] G. Kramer, B. Walker, T. Bonebright, P. Cook, J. Flowers, N. Miner, J. euhoff, R. Bargar, S. Barrass, J. Berger, G. Evreinov, W. T. Fitch, M. Grohn, S. Handel, H. Kaper, H. Levkowitz, S. Lodha, B. Shinn-Cunningham, M. Simoni, and S. Tipei. *Sonification report: Status of the field and research agenda.* 1997.

[9] J. Lemoradant and A. Guerraz. Mobile immersive music. In *Proceedings of the International Computer Music Conference*, Copenhagen, Denmark, 2007.

[10] S. K. Lodha, J. Beahan, T. Heppe, A. Joseph, and B. Zane-Ulman. Muse: A musical data sonification toolkit. In *proceedings of the 1997 International Conference on Auditory Display*, pages 1119–1134, Palo Alto, CA, USA, 1997.

[11] D. N. G. McCallum. Warbike:a mobile artistic sonification of wireless networks, 2005.

[12] S. Park, S. Kim, S. Lee, and W. Yeo. Composition with path: Musical sonification of geo-referenced data with online map interface. In *Proceedings of the International Computer Music Conference*, New York, NY, USA, 2010.

[13] M. Quinn and L. D. Meeker. Research set to music: The climate symphony and other sonifications of ice core, radar, dna, seismic and solar wind data. In *Proceedings of the 2001 International Conference on Auditory Display*, Espoo, Finland, 2001.

[14] J. C. Schacher. Davos soundscape, a location based interactive composition. In *Proceedings of the 2008 conference on New Interfaces for Musical Expression*, NIME, 2008.

[15] S. Strachan, P. Eslambolchilar, R. Murray-Smith, S. Hughes, and S. OModhrain. Gpstunes: controlling navigation via audio feedback. In *Proceedings of the 7th international conference on Human computer interaction with mobile devices & services*, pages 275–278, New York, USA, 2005.

[16] N. Warren, M. Jones, S. Jones, and D. Bainbridge. Navigation via continuously adapted music. In *CHI '05 extended abstracts on Human factors in computing systems*, pages 1849–1852, New York, USA, 2005.

[17] W. Yeo and J. Berger. Application of image sonification methods to music. In *Proceedings of the International Computer Music Conference*, Barcelona, Spain, 2005.

[18] W. Yeo, J. Berger, and Z. Lee. Sonart: A framework for data sonification, visualization, and networked multimedia applications. In *Proceedings of the International Computer Music Conference*, Miami, FL, USA, 2004.

[19] H. Zaho, B. Smith, K. Norman, C. Plaisant, and B. Shneiderman. Interactive sonification of choropleth maps: Design and evaluation. *IEEE multimedia, Special issue on Interactive Sonification*, 12(2):26–35, 2005.