N.A.G. (Network Auralization for Gnutella)

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ABSTRACT
N.A.G. (Network Auralization for Gnutella) is interactive software art designed to actively involve a lay public without musical training in a creative musical experience. Users enter search keywords, and the software looks for matching music files on the Gnutella peer-to-peer file-sharing network. As it downloads music, it plays an audio collage whose structure is based on the relative download rates of the files.

Categories and Subject Descriptors
J.5 [**Arts and Humanities**]: *performing arts.*

General Terms
Algorithms, Experimentation.

Keywords
peer to peer, file sharing, MP3, Gnutella, software art, Java, remix, auralization, sonification, music, audio

1. INTRODUCTION
Gnutella [8] is a powerful peer-to-peer file-sharing technology. It is an open protocol implemented by dozens of applications, and it has a large base of active users. Gnutella's decentralized structure offers many benefits, but it can also lead to frustration. Keyword searches are slow to return results, and downloads are often thwarted by the limited bandwidth of the peers from whom they are obtained.

These shortcomings of Gnutella are exactly what fascinate me most about the network. Even when I cannot find the file I need, I am surprised and amused by tangentially related results. And wildly varying download speeds present a captivating and chaotic drama. The process of finding and obtaining content becomes an end in itself.

I created N.A.G. (Network Auralization for Gnutella), software art for Mac OS X and Windows 2000/XP, in order to capture this fascinating search process in a new way. Since many of the files shared on Gnutella are audio files, I turn the process of searching and downloading for music into an audio collage.

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2. IMPLEMENTATION
The software creates an aural collage from audio files by playing segments of them as they are downloaded from the Gnutella network. The structure of the collage is derived from the relative download rates of each file.

N.A.G. regularly computes the download rates for each file and prioritizes music for playback accordingly. When a file's download rate is faster, musical segments from that file are played more frequently, at a louder volume, and at a faster speed. Audio segments are always taken from the most recently downloaded data, even when that necessitates skipping over previously downloaded segments which have not yet been played.

N.A.G. was written in the Java programming language, developed with Apple's Project Builder IDE [1] and optimized with the help of EJ-Technologies' JProfiler [5]. MP3 decoding and multitrack audio playback are handled by Apple's Quicktime for Java API [2]. The Gnutella client is based on Limewire [9], an open-source Java Gnutella client.

3. USER INTERFACE
The entire N.A.G. user interface is contained within a single window with three tabs. Users begin by typing keyword searches into the search tab (see Figure 1). As matching MP3 files are found on the network, they are displayed and automatically queued for download. Users can override the system to manually add and remove songs from the download queue at any time. They can also tell the software to automatically generate new keyword searches by parroting queries made by Gnutella peers.

A second tab in the interface provides information about the audio collage which users hear as files are downloaded. It shows the content of the collage at any moment by indicating which music files are being played and from where in the file the audio is being extracted. Users can also control several parameters of the algorithm to "play" the software as a simple instrument; they can change the polling interval, the amount of variation in playback speed and volume, the maximum number of files to play simultaneously, and the algorithm's behavior when downloads stall.

The final tab of the user interface controls how N.A.G. interacts with the Gnutella network. Changes to many of these parameters — the maximum number of results to retrieve for each search, the maximum number of simultaneous downloads, and the means by which to filter out duplicate search results — indirectly affect the audio collage as well.

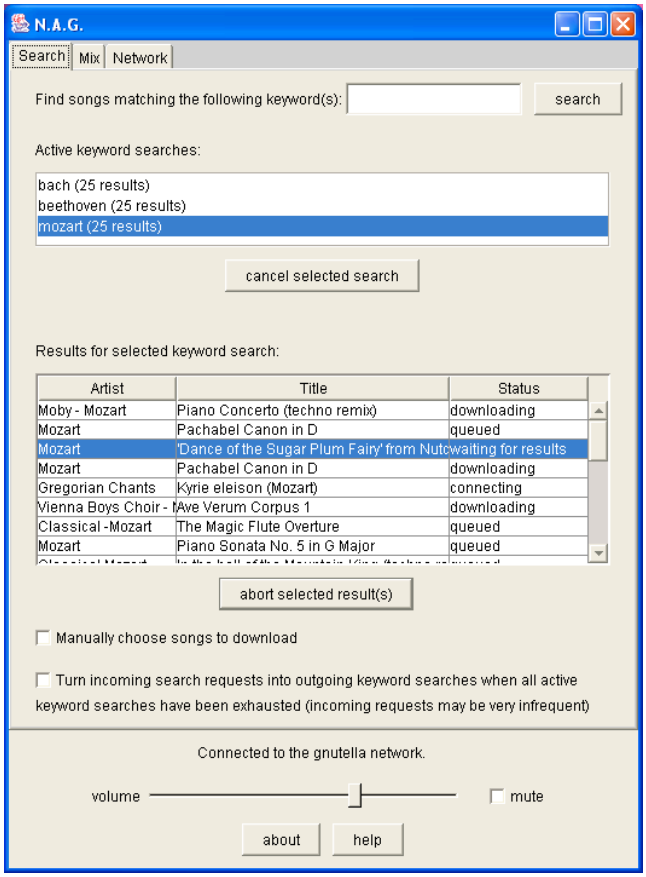

Figure 1. The search tab of the N.A.G. user interface.

4. DISCUSSION

N.A.G. draws inspiration from the field of data sonification [7]. (The use of the word "auralization" in the work's title, instead of sonification, facilitates a more memorable acronym.) But while most sonification algorithms transform data into sound, N.A.G. works directly with the data, which is already in an audio format. Network structure is expressed not through low-level audio content (e.g. pitch, timbre, spatialization), but rather through a higher-level selection and transformation of pre-existing audio sources.

John Cage's *Imaginary Landscape No. 4* (1951) [4] takes a similarly direct approach to sonifying a different kind of network. Twenty-four performers manipulate the controls of twelve radios as specified in Cage's score. While the performers' actions are identical in each performance, the music is always different, changing with the local radio stations, the frequencies on which they broadcast, and the material they broadcast at that moment.

N.A.G.'s approach to sonification is also quite flexible; numerous aspects of the algorithm can be modified by the user in real time. Following in the tradition of interactive computer music works such as Tod Machover's *Brain Opera* [10] and Gabi Braun's *3D Music* [3], N.A.G. seeks to actively involve a lay public without musical training in a creative musical experience. By selecting keywords and manipulating algorithmic parameters, users influence the music they hear without ever completely controlling it. In extreme cases, users may make continuous, dramatic changes to algorithmic parameters such that their manipulations are the dominant characteristic of the audio collage. But they always remain, to some degree, at the mercy of the network.

N.A.G. was conceived as software art, but it blurs the line between a work of art and a creative tool. Experimental DJs have used N.A.G. in live performances [11], and users have posted their own N.A.G. "remixes" online [6]. Some N.A.G. users discover the software through Turbulence (http://turbulence.org), an online exhibitor of net art, but many find it in a very different context: popular software download sites which list N.A.G. in a general category for file-sharing programs.

No matter how users discover N.A.G. or how they conceive of it, the software still aims to break down the traditional barriers between composer, performer, and listener, to challenge users to become active participants, and to create the kind of engaging and accessible musical experience which is unfortunately rare in our world today.

5. ACKNOWLEDGMENTS

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