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# Using Game Mechanics to Facilitate Networked Musical Collaboration

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**Abstract**

In this paper, we investigate methods for improving networked musical collaboration by introducing game mechanics to musical performance. We present a novel audiovisual performance system, where multiple users contribute to an over-the-network performance that is mediated by a variety of game-like rules. User evaluations and audience feedback collected in both private performance and public concert contexts indicate the potential of game-like music environments for improving musical interaction and listener attention in networked computer music performances.

**Author Keywords**

Networked music performance; game mechanics; audiovisual performance systems.

**ACM Classification Keywords**

H.5.5 [Information interfaces and presentation (e.g., HCI)]: Sound and Music Computing

**Introduction**

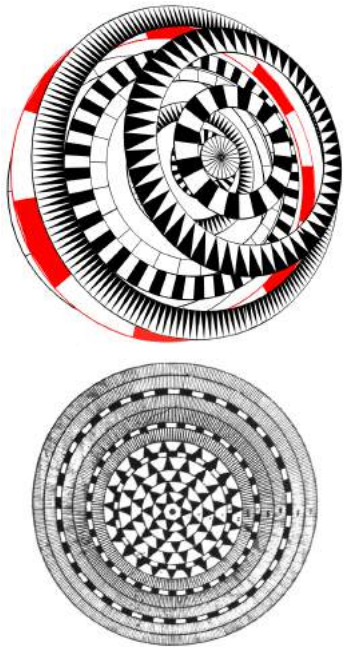
Musical collaboration over computer networks pose various challenges to musicians. The sense of togetherness in traditional settings is altered in this medium due to remote participation, time delays and data losses. In this paper, we propose that the incorporation of game mechanics in a networked musical performance can promote effective

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collaboration between players and improve the audience's engagement with a performance.

Over the past two decades, multiplayer computer gaming has proven to be a highly successful medium for shared, collaborative experiences in virtual, networked environments [2, 3]. Lundgren and Bjork characterize the *mechanics* of a computer game as the rule system that defines how players interact with the environment and other players [5]. Jarvinen explains that a limitation of possibilities through game mechanics leads players toward a desired behavior [4]. He also states that game mechanics can be described with a small set of actions, such as “shoot” or “take cover”. According to Sicart, a game's mechanics are shared by all human players as well as AI agents [8].

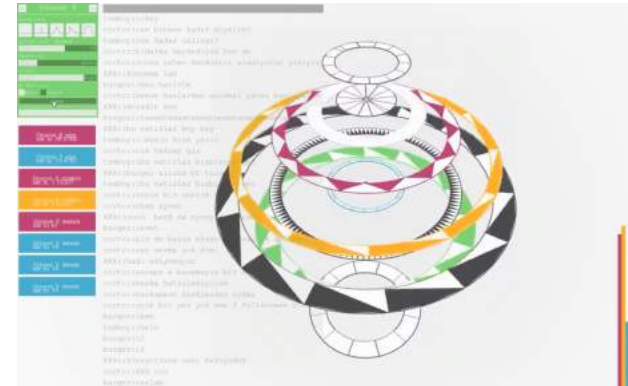


**Figure 1:** Graphical sound objects in *Monad* (top) resemble early 20th century optical disc designs (bottom)[9].

### The *Monad* Application

Similar to multiplayer games, a collaborative musical performance is an inherently shared experience between multiple agents. We have designed a novel networked music software called *Monad* that explores the use of game mechanics as a fundamental element of musical improvisation. Furthermore, we use *Monad* to study the relationship between performers and audiences in networked performances. The software interface primarily consists of rotating graphical objects inspired by Evgeny Sholpo's optical disc designs for his *Variaphone* instrument series from the 1930s [9], as seen in Fig. 1. All players are able to add and subtract objects, and manipulate their parameters to improvise electronic music. The system offers control over the timbre, dynamics, filtering, and pulse characteristics of each graphical sound object. Fig. 2 shows a screenshot of the *Monad* interface.

*Monad* uses a client-server architecture to transmit information between the players about the game state. Ev-



**Figure 2:** A screencast from a performance with *Monad* v0.1 [6], which utilized a client-driven rewarding mechanism.

ery player is a client and the server acts as a “shared object” that all clients interact with. After receiving the latest state from the server, sounds are synthesized within each client's node. In addition to maintaining the system state, the *Monad* server also stores each player's IP address, color label, remaining assets, and nickname.

The interactions between performers, and the audience's attentiveness to these interactions are an important part of a musical experience. In an environment where participants are unable to use bodily gestures to communicate, such as networked performances, text-based communication offers a medium of self expression, while extending the time spent on bidirectional communication. In *Monad*, an embedded chat system is used to facilitate conversations amongst players, and therefore to allow them to cooperate with or challenge each other. *Monad* takes advantage of its virtual setting by giving each player the opportunity to interact with all of the visible objects in a given state. Although it is more common for musicians to play their own instruments within a traditional music performance, *Monad* offers

an intra-active system [7] where a player can contribute to or override another player's actions. This is intended to motivate both collaboration *and* competition, in a way that facilitates interaction in a networked music performance.

### Game Mechanics in *Monad*

A group improvisation with *Monad* relies on an internal economy built around intangible resources [1]. Every action that has a sonic outcome costs a certain amount of resources determined by the game server. To promote a well-balanced economy in *Monad*, we implemented different types of game mechanics. Specifically, we experimented with two different reward systems in order to see how it affected players' behavior during an improvisation.

For *Monad* v0.1, we developed a *client-driven* reward system that relies on players to give each other points if they "like" another player's actions. Remote players' most recent actions are displayed as a stream of buttons on the user's screen; clicking on an event rewards points to the corresponding player. In this system, the clients' decision-making becomes critical to the internal economy. In Jarvinen's terms, the principal game mechanic here is the "approve" action.

For *Monad* v0.2, we developed a *server-driven* reward system that functions independently of the individual players' explicit approval. Here, the server keeps track of all players' actions and assigns points to players who make changes that are analogous to other players' moves. This model is inspired by the call-and-response motifs often used in musical improvisations. In the current implementation, similar actions are rewarded when they are performed within a limited time span (i.e. 10 seconds). As a result, users are encouraged to pay attention to other performers, and to promptly respond in order to retain resources. Using Jarvi-

nen's terminology, the principal game mechanic underlying this model is the "imitate" action.

### User Evaluations & Audience Feedback

Different versions of the system were tested one-on-one with 10 participants with varying experience in music and video games. Each participant connecting from a remote location was given brief instructions on the UI and the mechanics of the *Monad* environment. A subsequent performance exercise was followed by a survey, which gathered information about the participant's musical and gaming experience, their reactions to the game mechanics, their impressions of the communication system, and their overall experience on a Likert scale. The results showed that all participants felt they improved as they played, enjoyed the musical product, and was willing to play again. Interestingly, the amount of competitive behavior was surprisingly low amongst the participants. This manifested as a collaborative attitude throughout each performance. Furthermore, providing each player with unique color labels and nicknames of their choice reportedly increased their sense of agency in the environment.

The client-driven rewarding mechanism worked less efficiently as the number of participants and user actions in a performance increased. Testing *Monad* v0.1 with multiple participants produced relatively more cacophonous musical outputs as observed in the audio recordings; the increased level of disorder in the environment prevented purposeful collaboration between players. In *Monad* v0.2, an effective collaboration was determined by players' imitation of each other rather than their explicit approval of each others' actions. The musical outcome in this case was less chaotic. Participants indicated that the automated reward system worked much less obtrusively and motivated them to be more attentive to other players' actions in order to "survive".

```
K//Grv7//mute:on
K//Grv9//mute:on
hepDamar//reset all
hepDamar//reset all
hepDamar//Grv4//size:83.7
K//Grv3//rotation:-10
tom//Grv8//rotation:-4
hepDamar//Grv4//density:7
tom//Grv8//rotation:-5
tom//Grv8//rotation:-5.3
hepDamar//Grv4//size:36.8
tom//Grv8//rotation:-6.1
*K +3 points!*
*hepDamar +3 points!*
hepDamar//Grv4//density:12
hepDamar//Grv4//rotation:7.
tom//Grv8//mute:off
tom//Grv8//mute:on
tom//Grv8//mute:off
hepDamar//Grv4//density:20
*K +3 points!*
*hepDamar +3 points!*
K//Grv2//size:89.1
tom//Grv8//mute:on
tom//Grv8//mute:off
tom//Grv8//mute:on
*K +3 points!*
*tom +3 points!*
K//Grv2//density:3
```

**Figure 3:** The list of most recent events and update notifications during a *Monad* v0.2 performance.

The two versions of *Monad* were used in two different electronic music events. On a Likert-type scale, the audience members overall reported having experience with electronic music and networked performances, but indicated that they lacked experience in gaming. As seen in Figs. 4 and 5, the audience members were able to view a projection of one of the local performers' screen. The performances were successful at capturing the audience's undivided attention; answers to the survey revealed that the majority of listeners enjoyed the performance and were interested in experiencing it again. In both settings, very little information about the system were disclosed to the audience in advance. While about half the survey-takers had no awareness of the underlying game mechanics throughout the performance, the rest stated it became noticeable as the performance developed. The latter group also declared what they saw and what they heard were more coherent, and they were more musically satisfied.



**Figure 4:** *Monad* v0.1 performed on 24 May 2015 in Kadıköy, Istanbul.



**Figure 5:** *Monad* v0.2 performed on 26 December 2015 in Beyoğlu, Istanbul.

## Conclusion

Networked musical collaborations offer unique challenges and opportunities. In this preliminary study, we observed that imposing game mechanics upon a networked performance directly affected the nature of the musical collaboration. Specifically, we found that game mechanics that emphasized imitation over approval increased the amount of active collaboration between performers. Additionally, we observed that using *non-musical* elements, such as an embedded chat system and a visible economy of the performance, also improved the audience's attentiveness to a computer-based performance. We plan to explore the effects of implementing other game mechanics in our system, such as turn-based actions and levelled designs. We believe that the application of game mechanics to musical collaboration presents new and interesting possibilities. Moreover, we believe that new characterizations of mean-

ingful musical collaboration could be used to design more effective game mechanics and to improve game play.

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