MALLO MARCH: A LIVE SONIFIED PERFORMANCE WITH USER INTERACTION

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ABSTRACT

In this extended abstract we present a new performance piece titled *MalLo March* that uses MalLo, a predictive percussion instrument, to allow for real-time sonification of live performers. The piece consists of two movements where in the first movement audience members will use a web application and headphones to listen to a sonification of MalLo instruments as they are played live on stage. During the second movement each audience member will use an interface in the web app to design their own sonification of the instruments to create a personalized version of the performance. We present an overview of the hardware and interaction design, highlighting various listening modes that provide audience members with different levels of control in designing the sonification of the live performers.

1. INTRODUCTION

In a classical concert performance, the audience plays a passive role by sitting and listening to live performers as they play acoustic instruments. With the advance of technology, new areas of musical performance have been developed that utilize the additional computational power to create live digital musical instruments. These instruments can be played by live performers, using various digital sensors (as in the EyeHarp, an eye-controlled instrument [1]), or by using live data streams as the "player" such that changes in the data trigger changes in the sound (as in *Leech*, a sonification of Bit-Torrent traffic [2]). In both contexts, the information provided by the performer or the data is sonified to produce a live real-time performance. When the information is provided by a live performer (rather than by data), the timing of the sonification is important as audience members expect the visual cues of the performer to synchronize with the sonified audio.

This synchronization is challenging because it takes time for information to be transmitted and for audio to be synthesized. This is particularly true in cases where the information needs to be transmitted long distances (i.e. around the world via the Internet), or when the audio synthesis is complex. Researchers have overcome these issues by making local audio processing as fast as possible and minimizing network transmission times [3]. However, there is a limit to the time that can be gained through these methods. A digital instrument called MalLo [4] was developed to overcome the challenges of performing over long distances by predicting the strike of a percussion instrument before it occurs. The prediction is sent over the network so that the strike will be sonified at both the sending and receiving locations simultaneously. Rather than using MalLo to overcome long distances, in this work we propose to use MalLo as a way to overcome long processing times associated with complex audio synthesis between performers and a local audience.

Our piece *MalLo March* features multiple MalLo instruments played live on stage. During the performance, audience members use their own network-capable computing devices (laptops, smart phones, tablets, etc.) and headphones to design and listen to the live sonified performance. We intend to distribute in-hear headphones and headphone jack splitters so that everyone has the chance to participate, even if they do not have a device. The performance opens with *Movement 1* where audience members are asked to navigate to a URL using their web browser. Once the performers begin playing the MalLo instruments, audience members will be able to hear synthesized audio of the predicted strikes via their headphones and the web app hosted at the URL. During the first movement audience members will no have control over the design of the sonification. However, once *Movement 2* begins they will be able to interact with a user interface on the web app to change the sonification in various ways and manipulate the sounds of the MalLo instruments. By opening up the sonification design process to audience members they be able to explore the sonic possibilities of the performance.

In this extended abstract, we briefly describe the technical design of the performance by outlining the way the hardware of MalLo works and the types of interactions that will be available to audience members via the user interface. We also include a brief discussion on what we hope to gain from the performance.

2. HARDWARE DESIGN

In order to gain time with which to execute computational processes we use a predictive instrument called MalLo [4]. As shown in Figure 1, MalLo predicts note times and note velocities before they are played by capitalizing on the long distance traveled by percussion mallets. First, we track the head of a percussion mallet. Next, we fit a quadratic regression to the mallet's path (taking advantage of the fact that its path is very predictable [5]). We compute the time at which the mallet will strike the surface, and we send this information to the receiver. The receiver takes in a continuous stream of predictions, each one more accurate than the previous. The receiver waits until the predicted time reaches a specified accuracy threshold and sonifies the note. During the period
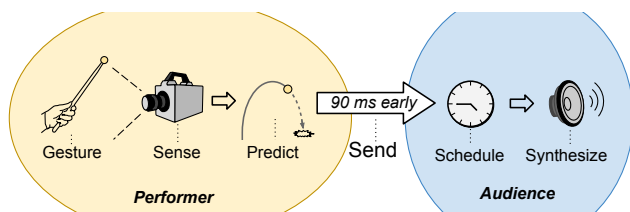
Figure 1: Our musical instrument tracks the head of a percussion mallet and predicts what time it will strike. This allows up to 90 ms of anticipation time which can compensate for time spent transmitting note information or processing of advanced synthesis algorithms.

between receiving the predictions and the final sonification, the receiver can be performing a variety of computations (e.g. complex audio synthesis algorithms).

Our system sends its timing predictions as absolute time messages, in Unix time (time since January 1, 1970). This allows for nearly unlimited scaling. The system clocks of the sender and receiver must be synchronized to a high degree. In previous work MalLo relied on GPS satellite signals to allow for time synchronization over long distances. However, for this performance we will use a variant of Precision Time Protocol (PTP) for time synchronization [6]. Also, because we will not have access to the system clock of every audience machine, we will implement it in our web app, on the client side.

Each audience listener will be required to listen via a web app that they access on a personal computing device. As shown in Figure 2, MalLo prediction messages are sent to each device where they are scheduled, and the audio is synthesized.

3. INTERACTION DESIGN

Audience members will navigate to the web app URL at the start of the piece. Using their own personal networked device and headphones, they will listen to the sonification of the predicted MalLo notes that are being sent over the Internet. During *Movement 2*, the audience members will see a user interface designed to give them control over the sonification of the performance. We imagine three types of interaction modes that allow for various levels of control of the sonification. In each of these modes, the incoming data to the sonification will be the live performance data sent from MalLo (note timing information and velocity), and the output will be the sound from the sonification algorithm chosen via the particular interaction mode.

Interaction Mode 1: Change the Channel In this mode, users are allowed to switch between preset sonifications similar to changing the channel on the radio and hearing the same song performed by different combinations of instruments. For each channel, the live data from the performers will be input into a different sonification to create a unique sonic performance.

Interaction Mode 2: Change the Instruments To give users slightly more control, in this mode users are able to choose a different preset sonification for each of the MalLo instruments. By doing so users are able to "Change the Channel" for each instrument.
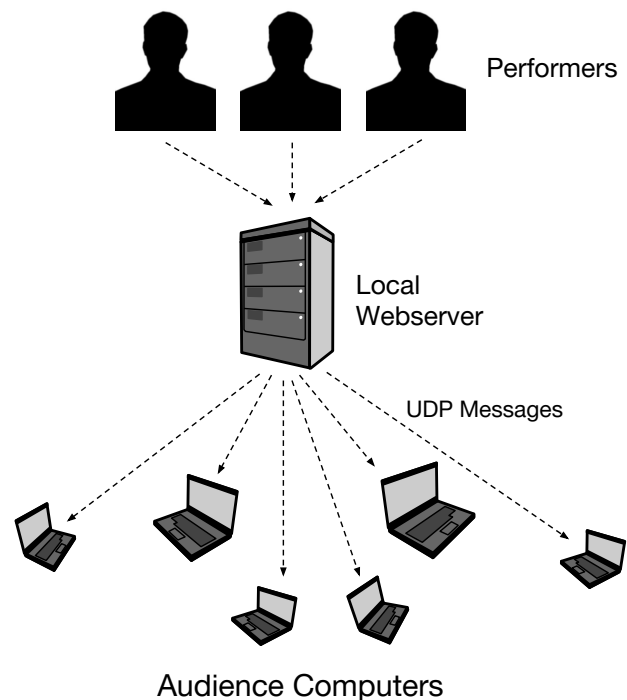

Figure 2: Note information is sent from a local webserver to each audience member's web browser where. There the notes are scheduled and synthesized according to the parameters of the sonification.

Interaction Mode 3 - Create the Instruments At the lowest level of control, users are able to directly modify the synthesis parameters for each instrument. In particular they can alter pitch, duration, waveshape, samples etc.

4. DISCUSSION

MalLo March is a piece intended to combine live sonification of performers with end-user design of sonifications. With permission from each audience member, we hope to log information about how they used the interface during the performance and do a short survey at the end. In particular we are interested in observing how people interact with the various interaction modes, how successful they felt they were in creating sonifications, and what was gained or lost by adding the interaction in the second movement. Our composition is intended to be enjoyable for the audience as well as give us insight into the design of sonifications.

5. ACKNOWLEDGMENT

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