Myo Beats: Gesture-based Musical Interaction in Max/MSP

Yuan CHAI
University of Paris-Sud
91400 Orsay, France
yuan.chai.doris@gmail.com

Su YANG
University of Paris-Sud
91400 Orsay, France
suyang0402@gmail.com

Yuan LYU
University of Paris-Sud
91400 Orsay, France
lvyuan0302@hotmail.com

Abstract

This paper presents a gesture-based musical interaction design named Myo Beats. It is implemented in Max/MSP environment connecting with Myo armband, a wireless motion and muscle sensing platform. Besides, volume control functions in Max/MSP is also added into the musical interaction. The paper illustrates Myo Beats with three case studies: To create bass effect based on the vector magnitude data, gyroscopes; To generate various drum beats with different Myo gestures as accompaniments while singing; To produce an applause effect by applying the volume control function in Max/MSP. The paper interprets the results of Myo Beats by introducing a real performance. In addition, the paper also concludes a few new methods for musical control and easier ways for music-making.

Keywords: Myo armband, Max/MSP, Volume Control, Musical interaction, Gesture

Introduction

There is no doubt that most musical instruments are expensive to buy and inconvenient to bring with. So we want to create music through a digital way, which costs little and is more convenient to carry and perform. This new way is called digital musical instruments [1]. Simply stated, a digital musical instrument (DMI) is tool or system for making music in which sound is synthesized digitally using a computer and the human interface is formed using some type of sensor technology.

From all the available sensors that our university labs can offer us (kinect, Myo, arduino etc.) , we decide to choose Myo---- a smart armband that let us wirelessly control technology with gesture and motion. We consider it has advantages in two aspects, one is its small volume is easy to carry and its condition of set-up is simple to reach. The other is the quality and reliability of the data it provides are good. Briefly explained, the Myo consists of eight electromyographic (EMG) sensors [2] that measure muscle tension, and an inertial measurement unit (IMU) with a 3D gyroscope, 3D accelerometer and a magnetometer. Data communication is wireless (Bluetooth, with its own dongle), and the device is easy to set up. The Myo is affordable, attractive-looking and appears to be solidly built.

Even though the device has just started shipping, there are already a few online demo videos of the Myo being used for musical applications. Most of these applications are aimed at controlling effects or musical transitions in software like Ableton Live, such as done by Liam Lacey [3]. Thalmic Labs themselves promote the use of Myo in the large-scale, interactive DJ sets of Armin van Buuren[4]. Besides, there are references about myo for Max/MSP[5] offered by Jules Francoise, and instructions of myo control on the official website[6]. So we can easily get start with these materials. After looking over all the software, we decide to use Max/MSP as the programming platform to deal with the Myo signals. The reason why using Max/MSP[13] is it has lots of useful shared libraries and easy-operated

graphical user interface. It has been described as the lingua franca for developing interactive music performance software.

As for the musical interaction we use in this project, they are 5 gestures: finger-spread, fist, wave-in, wave-out, and double-tap, and the inertial measurement unit (IMU) with a 3D gyroscope,. We suppose 3 specific situations when users want use Myo to play music, which are playing bass effect like a DJ, creating drum beats like drummers, and the applause sound interaction with the computer. These situations are all from the daily life. For example, lots of people want to play drums but give up this idea because of cost and inconvenience. Also for bass effect, people like it but don't know how to create it with things they can get to more often. The concept we design this project also partly comes from the article A Sustainable Identity [7], which gives an good explanation of everyday designer. Based on its concept, we drive into the musical area that everyone could become a musician. The new way of playing music with Myo creates an excellent chance for people who are not musicians and don't have many instruments to play music. This chance is significant due to the low-cost and diversity, which means they can try various of instruments with one digital equipment.

Related Work

There have been many designs of Digital Musical Instruments (DMI). DMI allow users to create new types of musical control, which may be not possible for traditional musical instrument. Moreover, some creation of DMIs also make it much easier for users to engage in live music-making [1].

Rasmussen has defined three main basic types of musical interaction. According to Rasmussen's model [8], they are skill-, rule-, or model-based. Skill-based is a continuous responses to a continuous signal, rule-based is a response to a stored procedures, while model-based is more abstract. Myo Beats contains mainly the skill-based musical control by using Myo armband sensor to detect the gestures and rotations.

For all of the DMI, mapping, which is the connection between gesture and sound, is of vital importance. Even though there isn't a systematic study for mapping strategies applied in DMI, three basic strategies includes *one-to-one*, *one-to-many*, and *many-to-one*. [9] An interesting study from A. Hunt and R. Kirk shows that the complex mapping strategies used multi-parametric instrument have better performance than simpler mappings for complex tasks. [10]

Myo armband controller designed by Thalmic Labs, is regarded as a promising interface for musical expression [2]. Myo consist of eight electromyographic (EMG) sensors that measure muscle tension, as well as an inertial measurement unit (IMU) with a 3D gyroscope, 3D accelerometer and a magnetometer. One of its most compelling feature for the NIME (New Interfaces for Musical Expression) application is the combination tracking of both motion and muscle activity.

A few works have been down with Myo for music-making, such as the large-scale, interactive DJ sets of Armin van Buuren by Thalmic Labs [11]. The performance of using the Myo as a MIDI controller from Music Tech Fest London 2014.

Max/MSP is a widely used graphical environment for making computer music and multimedia works[12]. It allows users to match various multimedia by adding lines with drag and drop, which make it easier to manipulate various multimedia simultaneously.

Case Study

1. Gyroscope Data and Bass Effect

There is no doubt that every music fan wants a subwoofer (Bass Audio) at home, however, most devices are expensive for them. And also a pair of professional bass is hard to move around when you need an outside performance. Then what about having an electrical bass with gesture on your computer? Make it like bass sound and easy to take with.

Since the Myo help document which helps people use Myo on Max/MSP platform has already completed enough, especially on data stream instructions about accelerated speed, gyroscopes and orientation, we decided to build bass audio with Max/MSP. At beginning, we found a very simple and typical rhythm sound, and would like to use the orientation to control the volume to make it like bass effect, and also like to use the accelerated speed of Myo to change the bass speed. But after we got these two values and did some tests, we found that they all can only make changes between very small range (both are -1 to 1). We cannot get value like this to change the volume of the sound. Therefore, we tested again with the gyroscopes, it can make changes between larger range like number more than one hundred, these values were making sense for changing volume. So we used this typical rhythm sound within the Myo gesture- rest, and controlled its volume by using gyroscopes' value of the Myo. When the users turn around their arm, the gyroscopes' value of myo will change accordingly, based on this typical rhythm sound, it will create a basic bass effect with Myo finally. We make full use of these simple gestures, including its orientation to create bass effect, which is definitely full of fun for music fans.

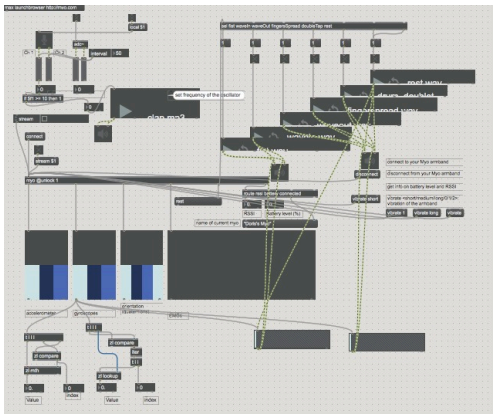

Figure 1: Max file screenshot

2. Myo Gestures and Drum Beats

The normal music accompaniments are usually toneless and always in the same way, what should we do if we want to sing with accompany more fun or make it in our own way? Since Myo can recognize different gestures, we want to generate various drum beats with different Myo gestures as accompaniments of singing. Myo has 5 gestures recognition: there are fist, wave-in, wave-out, finger-spread and double-tap. We designed 5 sound effects with these gestures respectively. For the fist gesture, we added the gong sound effect. For the wave-in and wave-out, we designed a pair of drum beats. For the finger-spread, we designed a shorter sound effect. For the double-tap gesture, we added the longer sound effect instead to make it more abundant. In total, we designed two pairs of sound effects with comparison style, one last is single. Every sound effect is easy to recognize therefore user can know clearly which gesture are they doing and whether if they did right or not. Combining all of these sounds, users can easily create a piece of wonderful drum beats that belong to their own style.

3. Volume Control and Applause Effect

Nowadays, more and more people like to go to karaoke, partly because they could have better performance and gain good feeling of themselves when they are in Karaoke. The atmosphere there is quite hot, loud cheers and applauses rang out continuously. Which makes people really enjoyable. So the atmosphere of playing music is quite important to the people who like music. However, if it is possible to create this atmosphere with our computers at home? Even when you are alone with no audience, computer can interact with you.

So we design a way to make hot atmosphere for playing music. When users play aloud music, computer will send a piece of applause sound to make users feel good and passionate. During the software study of our project. We find Max/MSP can get the audio input signal. So we plan to leverage this function to create some sounds according to level of volume. The interactive way we think is if users create the sound that has peak of volume more than level 10 (around 80 db), the gate of the applause sound will be triggered. We did some experiments and finally decided to choose the level 10. In Max/MSP, the volume of audio is defined by output value level. The sounds created by Myo are always among the 0-5 level. These sounds will not trigger the applause. If you want to trigger the applause, you need to do gestures like clapping hands. Which distinguishes the control of applause with other sounds. For the structure in Max/MSP, it needs a audio input, and a peak value output, connected with play sound file. Between the peak value output and the input value of sound file, we write an if sentence that is $f1>=10, then 1. In this way, if the peak value is more than 10, the max will keep this value always equal to 1. Then the input value of the sound file becomes to 1, so the applause could be triggered.

This example is quite simple, but it explores a way of leveraging the output value. Researchers can use the if sentences to select the value they want. They can also make full use of the output parameters from Myo like orientation, accelerometer, and gyroscopes. That would be a significant work.

User Test

At first, all the participants are taught how to play the instrument and create effect. Then, they are asked to choose a song from library and give a whole performance. They start from the bass effect, then accompany to the music by Myo gesture and finish the whole performance by adding the applause effect. Most of them have good performance with Myo, several people' gestures can not be recognized by Myo at the first try, but after creating a new portfolio and gesture training it will be better. However, there are still one or two people' gestures can not be recognized totally. From our observation, they are all extremely thin.

Figure 2: User Test

Discussion

From the user test mentioned above, the general performance is good. Most of the participants

enjoy the performance and gave good feedback later. Among the three cases study, the applause and bass effects receive better feedback than Myo gesture accompaniment. From the user test, we find out that the gestural recognition isn't very stable. Since the mechanism of Myo is to measure the muscle tension, we try to minimise the differences by creating profile for each participants. However, the results still vary among different users. The gesture recognitions are not accurate for some participants who are slim in arm.

From the comparison with MuMYO[2], we also consist of a combination of continuous tones with sound-producing action and impulsive sound (drum beats). The combination not only add timbre to bass effect, but also generate rhythm for original drum beats. Besides, the application of volume function from Max/MSP software also create more possibilities in musical interactions.

As any musical instrument, the performance for DMI also need practice and rehearsal. Thus, the stability for DMI is of vital importance. From the process of implement, we found out that IMU data for Myo armband is more stable than Myo gesture. For later design of gesture-based musical control with Myo armband, the IMU data is more recommended.

This project is a good glance at the digital musical interaction domain, but still exists some problems. The critical reflections we conclude from the feedbacks of users and ourselves are listed below: Firstly, the possibility of using Myo to create music is just exposed a little compared with the complex functions that Max/MSP provide. Secondly, the other two IMU data orientation and accelerometer are not fully used in our project, because of the time limitation we only explore the use of gyroscopes. At last, what we have done are based on the mature software Max/MSP. Besides this software, there are similar software that can handle digital music or researchers can write codes by themselves using API of Myo, to create more functions and interactions.

Conclusion and Future Work

Myo Beats offers a novel approach for live music-making by using Myo armband and Max/MSP software. Our vision is to allow users create special musical effect from velocity data, so that they can make bass effect by simply shaking their arms in rhythm; to generate various sound from different gesture, so that they can practice drum at home by doing different Myo gestures; to produce a sound from voice volume, so that they can add more applause from one claps. Zbigniew said, "Where language ends, music begins". The goal of Myo Beats design is to create your own music by using the most simple instrument, which are your arms.

The future work contains three directions. Firstly, concerning the gesture recognition problem, we are working on adding music effects controlled by IMU data. Secondly, to make Myo Beats suitable for more music genres, we are considering developing different Max files with same control mechanism. Finally, a visual metronomic attached would help user for better practice and rehearsal.

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