Musical Me {} Gestures and Music

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Abstract

Traditionally musical instruments have always remained an art of the expert. Though music is enjoyed by nearly everyone, the required expertise and heavy commitment involved keeps many people away from this excellent art. The overall ideology of our project is to explore ways to generate music by means of gestures. The specific area we are concentrating at within that domain is a virtual drum kit aimed at drum enthusiasts, which could enable nearly anyone to play drums and feel good about it. We also try to achieve this through a natural mapping, which is very close to the way real drums are played, so that there is not a big leap when they want to play the drums for real.

Keywords

Gestures, music, drums, musical instruments, virtual, tangible, interface

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. See [3] for help using the ACM Classification system.

Introduction

Gestures

Gestures are easily learned and picked up by nearly everyone, even though there are differences in gestures between different cultures, the core concept of gesturing exist virtually everywhere. People often use gestures to communicate with each other and to express emotion. Gestures are rich in semantics and some of the normal gestures like waving the hand, stroking the hand, tapping the fingers, doesn't require years of training. Moreover, a person's reflex is very fast, as they are not interacting with any external objects.

Inspiration

When we began exploring how people used gestures that involved music, we came across several very distinct examples. We encountered the children's game Patty Cake, in which children clap hands with each other and to their own body in a rhythmic game, sometimes singing a melody that matches the clapping sounds. We found children from several different countries (United States, Japan, Mexico) interacting in this way.

Figure 1 (children playing patty cake game)

The next example of gestures that involve music is “Air Guitar” or “Air Drums”. Air Guitar or Air Drumming is a form of gesturing in which the person pretends to be playing the guitar or drums, usually while listening to or watching a famous musician perform. Persons performing air drums or air guitars typically use exaggerated gestures and body movements and become very absorbed in their performance. We also found that communicating by gestures enhanced the experience of the participants. Hence it is not only a form of communication but also has a level of gratification associated with it.

Figure 2 (air drums (left) and air guitar)

Musical Instruments and their constraints

While there is no doubting the beautiful music that can be generated from traditional instruments when in the right hands, they still come with a few constraints and necessary compromises. Though instruments are tangible, they remain untouched by the majority of people, as there is a mental barrier; many people find that learning to play an instrument is very complicated. Not only do you have to learn about the instrument, you have to learn how to read music. The cost of most instruments can be a limiting factor for people wishing to experiment with music. Another common problem with instruments is the volume of the sound they produce, people residing in apartments are particularly susceptible to this constraint. The last major hurdle that must be overcome before one can enjoy playing an instrument is the space needed to house and play the instrument. This is especially true in the case of drum sets, while other instruments are more portable, and can even be played while walking, a drummer is severely restricted in this case.

Our Design

Our initial idea is to map musical instruments sounds to specific gestures. A person performing a drumming gesture with their hands (as air drummers do) would generate drum sounds, and a person performing a guitar type of gesture (again, like air guitar), guitar sounds would be generated. Because there are gestures unique to several different types of instruments, we believe that mapping those instrument's sounds to their specific gesture will be intuitive for people to pick up.

We found that the drumming gesture is common and very intuitive and hence doesn't require any formal training to become adept. Moreover, string instruments have different forms of gesture and the sounds vary based on the manipulation of strings whereas in percussion it is mainly the speed and the rhythm in which you hit the instrument. Therefore, we decided that drums are the most appropriate instrument to focus our idea on. The drum kit has a basic setup that consists of a Bass drum, Floor Tom, Snare, Toms, Hi-hat, Crash cymbal and Ride cymbal. In our project virtual drum kit the variety of drums are virtually mapped relatively to their usual positions. But to distinguish between the instruments very clearly, different directions like left, right, front, top and bottom are mapped to different drums. The top direction is mapped to cymbals, the bottom is bass drum and similarly other instruments are mapped. The speed of

the strokes determine the volume of the instrument and the forward displacement determines the change in pitch; the user bends forward, the pitch increases, if he bends backwards, the pitch decreases. The bass drum is controlled by the user tapping their leg, similar to the movement used to play a traditional bass drum. All the other interactions like volume and pitch are similar for the bass drum.

Related Work

In recent years the area of generating music or sound with gestures has been explored in multiple directions. There has been a good deal of research done in the area of gestures, sound and music. The Hyperbow Controller [5] was an innovative way to control the sound produced from a violin. Hyperbow used the bow position, the pressure applied to the bow stick and the speed of the movement of the bow to alter the sound produced by a violin. Manipulating sound through physical interaction with a virtual world is also an area rich in research. [2] Devised a method that they called Sound Sculpting. They controlled sound effects of selected songs in real time by manipulating the shape of a virtual object.

[3] Conducted experiments between different virtual drum interfaces, their subjects felt that they might favor using a virtual drumstick so long as the latency low

DanceSpace [4] is an interactive performance space where both professional and non-professional dancers can generate music and graphics through their body movements. In DanceSpace, a user can improvise on a background theme by means of their body movement. Different instruments such as cello, vibes, drums and bells are associated with their hands and legs. In addition to the music it also generates multi colored visualizations on the screen.

BodyMusic [1] is a cyber instrument that enables people at all levels to control the tone and melody of the music through body movements. Here the control of pitch, volume etc are controlled by natural movements such as motion of the hand, flexing of the fingers, wrist movement. But Bodymusic has to be evaluated in a sense of how interactive the experience would be for the users.

Though there has been interesting work on generating music with natural body gestures, none of them effectively address the problem of creating proper instrumental music by common people. Our work primarily aimed at addressing that concern.

Implementation

Current Prototype

Due to technical limitations, we demonstrated our idea of generating music from gestures with two different prototypes. The first method we devised requires users to hold an object in each hand. These objects (we used the Nintendo Wii-mote) contain accelerometers that are used to track the motion and speed of the gesture. The Wii-mote sends MIDI Continuous Controller Events (CC

Events) to a computer via Bluetooth. A midi instrument, such as Apple's GarageBand, interprets these MIDI CC Events and sound is produced. The framework used is based off of the DarwinRemote open source project. While this demonstration was well received during our two-day exhibition, it still requires that the user hold physical objects to track their gestures.

Figure 3 (Wii-mote implementation)

The second method for generating music from gestures we prototyped did not have such a constraint. This method used a web camera to track the movements of the user's hand, and based on the motion, we would then generate a musical instrument's note. We used computer vision techniques to track the movement of hands through a web camera and mapped the gestures to different instruments by means of MIDI mapping. In this implementation the possible gestures are limited to the users waving the hand up, down, left and to the right. Although this is the direction we had the most hope for, because the user was not required to hold anything, we found that limitations of our equipment dampened the effectiveness of this method. In its current state users are limited to slow, sweeping gestures, or the web camera would not be able to accurately track movement. But we believe that this is primarily due to the technology limitation and it could be possible to accurately track movement with a tiny accelerometer that can communicate wireless via Bluetooth.

Figure 4 (motion tracking implementation)

Use Case

The drum enthusiast

It is not unusual to see people with headphones on, listening to music as they commute to and from school or work. Moreover, people often can be seen tapping their feet or hands to a song they are particularly engrossed in. Drum enthusiasts are a group of people who want to play and enjoy drum music, but are not interested in professional training. These enthusiasts face the above-mentioned constraints posed by music instruments and in addition, there are other problems

in terms of portability and intrusiveness to others in the living space. These problems are especially more pronounced in the case of drums than any other instruments. Even if a person was interested in becoming a better drummer, they cannot bring their drums with them like people with guitars can. But it is sometimes common to see drum enthusiasts carrying drumsticks and occasionally 'drumming' away in the air as if they were actually playing.

With a virtual drum kit available to them whenever and wherever they desired, these drum enthusiasts could be free to experiment with new songs or beats just about anywhere, even without their drum set and drumsticks. Our design will allow drum enthusiasts to go beyond the limits of traditional instruments that we discussed in section 1.3. Drum enthusiasts would no longer have to worry about space requirements because they only need the free space around them, and the virtual drums do not take up space permanently. Similarly, having the output of the virtual drums sent to headphones would eliminate the noise limitations of a traditional drum set. Thus our concept would enable these drum enthusiasts to explore and enjoy the art of music without any worries about the constraints associated with traditional instruments.

Findings

The prototypes that we developed were demonstrated in a two-day poster session. From observing the participants we could infer that people are really comfortable in generating music with hand gestures. We also learned that if the mapping is natural there is no need of explanation and it is intuitive for people to experiment with generating music on their own.

In our implementation using the Wii-mote, people started playing the music immediately with very minimal explanation. After we observed several people experimenting with this method, we found that this Wii-mote mapping (where users are holding an object in both hands) is quite intuitive for drums and other percussion instruments. However, the mapping did not work quite as well with other instruments such as the guitar, or other string and wind instruments.

In our second implementation, the motion capturing setup via web camera, we observed that people were comfortable with the idea that their hand movements generated sounds normally heard from musical instruments. But when we switched the system to generate random notes, the interaction of the participants decreased. We expected this, as it is natural for people to want to hear soothing musical notes rather than random sounds. Some of the participants liked the visual feedback of the motion capturing system, which led us to conclude that a naturally mapped visualization is a useful add-on to a natural gesture based system. Ultimately, we were not able to completely and accurately judge the performance of our design as it was not fully implemented and we only had two distinct prototypes with which to demonstrate our idea.

Conclusion

We hope that it's just the beginning of our work as there is a lot of potential research left in this direction. Conducting deep research on how musical instruments are learned and played would help deepen our understanding in this area. One possible avenue to explore is to extend the work to multiple types of instruments. Currently the users enjoyed playing the drums, but our implementation doesn't demonstrate such a natural mapping for other instruments. We would also like to develop a natural mode of switching between instruments. Augmenting the current work with natural and meaningful visualizations would enhance the user experience.

Thus, it is becoming clear that music generation by means of body movement is a natural mode of interaction, but it still has its own advantages and disadvantages. It cannot be compared directly with music created by playing traditional instruments, as the objective and motivation is different in this case. Music generation with gestures, which may seem like a strange mapping initially, can become a common mode of interaction in future.

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