Shall I Dance?

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CNM 290: Theory and Practice of Tangible User Interfaces

Abstract
In this paper we describe the objective, operation, and possible use cases of an audio amplification and transformation device, "Shall I Dance?".

Keywords
Audio, accessibility, amplification, Arduino

ACM Classification Keywords
B.4.1 Input/output and data communications: devices.

K.4.2 Computers and society: Social issues.

Introduction
"Shall I Dance?" is a device that extends the natural vibration of sound into direct vibrate pulses on the body. A microphone analyzes sound and translates it to pulses, sent across six small vibrate motors. This is neither an instructional nor corrective device. Its central purpose is reinforcing the connection between music and the body. Freedom for the user comes in determining the nature of both the body and the music. It has no controls and requires no instruction. The user simply plugs it in and decides where to place the microphone and the vibrate motors.

Audience
The hearing-impaired are clear benefactors of technology that delivers sound to alternate senses, but

they are not alone in this need. Dancing is a human-cultural universal. It is a way to connect all the senses at once and to connect socially with both friends and strangers. One of the only hinderances to dancing is self-consciousness. For it to be an enjoyable activity, the dancer must feel comfortable with the social atmosphere, and confident in their attachment to the music. Amplifying the natural vibrations that sound already produces is a way to cement this bodily connection. All music venues— dance clubs, concert halls— take advantage of the sensation of sound waves. That additional attachment to the music makes dancing much easier. Unfortunately, the only real means of achieving it is playing the music at ear-damaging volume levels.

Context

There are several related fields of research here, the main two being body-engaging rhythm video games, and alternative hearing devices for the hearing-impaired. The main drawback of the predominant research in these fields is that they rely on the eyes. This of course leaves the sight-impaired without solution. Even for sighted-people, dancing is about watching others dance, not looking at a screen for cues. Shall I Dance? does not try to shift sonic information to another sense the way video games do, or replicate hearing the way a cochlear implant does, but rather amplify the natural behavior of sound itself.

Games like Dance Dance Revolution and Guitar Hero are novel and important in their use of alternative and intuitive interfaces. These games are limiting in many ways though: there is only a small, pre-determined selection of songs, the motions are scripted and directive, there is very little room for improvisation and creativity. Save for a few exceptions, creativity and improvisation is critical to dancing. Confidence as a dancer does not come from memorizing choreography, but from a well-honed understanding of how the sound of a song translates to a beat, and a body trained to move in a rhythm attached to that beat. It is not about moving a particular body part mechanistically at every drum stroke, but moving fluidly on and between the beats, and changing the patterns of motion at regular intervals.

Devices like hearing aids and cochlear implants allows the ears of the hearing-impaired to function as it is meant to, and this is an extraordinarily beneficial technology. However, the sound produced is very far from the sound a fully-functional ear hears. It is tinny and coarse, and that is only the best approximation of the generated sounds. There is no way to determine how it actually sounds to a deaf ear. The implants are controversial on social level as well. In a National Public Radio broadcast on the topic of cochlear implants, Neal Conan stated (about the related film, "Sound and Fury"), "Some ... see the device as at least a partial cure for a handicap, but others argue that it denies a child access to her own rich language, ASL, American Sign Language, and to another birthright: an intimate connection to the thriving and robust world of deaf culture" [1]. Along this line of thought, it seems more beneficial to nurture an ability the deaf have innately— feeling sound through vibration— rather than impose some requirement of "normalcy" and force them to listen through their ears.

There is a surprising amount of research done specifically in the field of deaf dancing. The famous Gallaudet University's Dance Company for example, offers specialized dance classes for the hearing-impaired. Their front page reminds that, "many people

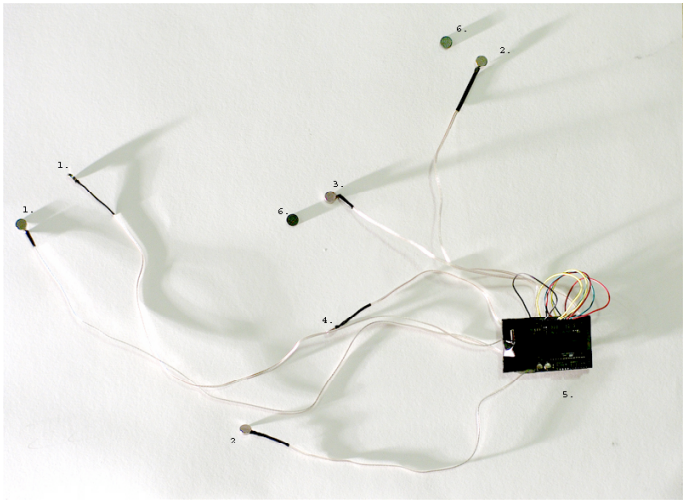

figure 1. The device with six vibrate nodes, varied length wire, magnets, controller and circuitry. See below for the description of parts, corresponding to the numbers on the figure.

have the misconception that deaf people 'hear' by feeling vibrations through the floor. How is this possible, especially if the person is moving and jumping so that they do not keep in continuous contact with the floor?" [2]. The school focuses on a method combining counting with sign language. This is clearly successful, but again, centered on memorizing choreographed dances to specific songs, and relying heavily on sight. And though vibrations cannot be felt through the floor while the dancer is in motion, it still is the mode of listening to music that most deaf people rely on. The Hubei Disabled People's Association in China offers a similar program. One student, Tai Lihua (now 29 and leading her dance troupe), recalls first entering the school at age 7 and experiencing the feeling of a drum: "I was thrilled with joy when the rhythmic vibration passed over my body from under my feet" [3]. The positive affect of this feeling is undeniable. Music and dance, such ancient cultural keystones, should not preclude anyone.

Implementation

The device is a physical network of six DC vibrate motors and a microcontroller. It is tethered to a computer for data analysis, though a wireless version is possible. The code that controls the device is written in two open-source programming environments: Processing and Arduino. Processing is a Java-based language, and the Processing code analyzes live sound through a microphone. The code is based on the Beat Detect library. It divides the sound into three frequency ranges and performs beat analysis. The C-based Arduino code, which runs on the Arduino microcontroller [figure 1.5], takes instructions from Processing on which motor to pulse, and send commands through six digital output lines. Two of the motors pulse at peaks in the high frequency range [figure 1.1], two motors pulse at peaks in the middle frequency range [figure 1.2], one pulses for the lower frequencies [figure 1.3], and one pulses to the beat of the music [figure 1.4]. The motor tied to the beat gives an exaggerated pulse at the first beat of every measure (i.e. every 4th beat). There is only one motor designated to the lower frequency range, because those vibrations tend to be the ones felt naturally, without augmentation. The measures are emphasized to encourage shifts in body motion at those times, as is practiced in formal dancing. The motors are small and can be attached to clothing magnetically [figure 1.6] without damage.

User determination

As the name suggests, Shall I Dance? is a device intended to connect bodies to music, but those are terms we leave open to the user. A body may be a torso, just a hand, a dish of water, a pot of flowers—anything mutable or sensible. The device is aesthetically rendered to stand alone as well, dancing in its own body. The music may be from speakers, performed live, or may just be the ambient noise of a street or a room. The beat analysis is option and can be turned off for more ambient sound display.

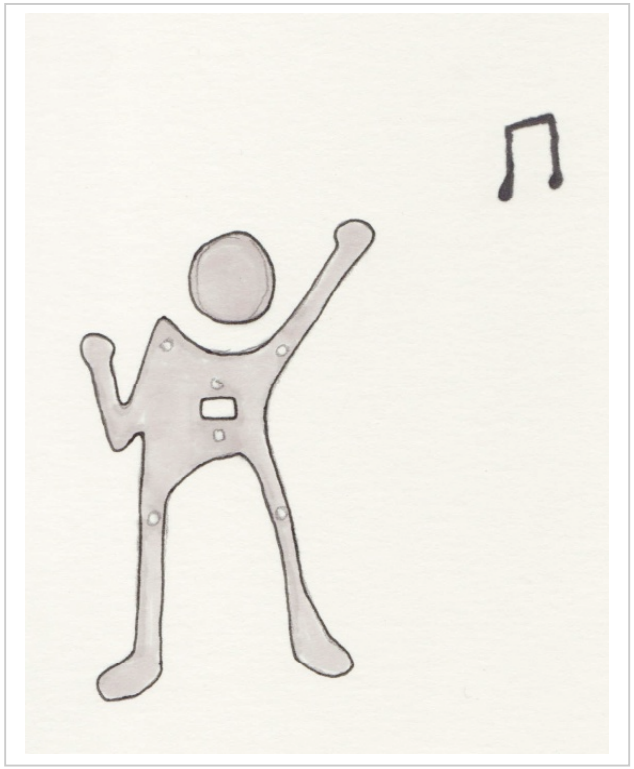

figure 2. An example orientation of the nodes across the body.

The microphone can be placed locally (tethered to the device) or remotely. A microphone placed remotely might serve as a social device, for sharing the sounds of someone else's day, for having a wordless conversation, or for monitoring behavior in physically distant rooms and spaces.

The hope of this project is that users will define new ways of using this device. It is purposefully small, lightweight, adjustable, unobtrusive, and designed with a minimal aesthetic. It can be worn on the body in any orientation, hidden or revealed, worn indoors or outdoors. It may be used socially or privately. The bond between people and technology is always strengthened by a sense of ownership, and that coincides with a feeling of control over how, when, and why the technology is used.

Conclusion

Shall I Dance? aims to improve the relationship between sound and bodies. It establishes a feedback loop between human action, digital interpretation, and electronic pulses. It functions uniquely for every user based on their decisions on what input to give the device, and what body receives the output. We hope to engage the hearing-impaired and rhythmically-challenged, and give them a new confidence in the therapeutic and socially significant practice of dance. We hope to protect the ears by providing an alternative mode of listening. Finally, we hope to encourage the exploration of bodies and the physics of sound in new ways.

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Citations

[1] China Daily, March 06, 2005. http://www.chinadaily.com.cn/english/doc/2005 03/06/content_422197.htm.
[2] The Gallaudet Dance Company. http://depts.gallaudet.edu/dance/techniques.html.
[3] NPR's Talk of the Nation, October 12, 2006. http://www.npr.org/templates/story/story.php?storyID =6189253.