

Play-A-Grill: Music to Your Teeth

Aisen Caro Chacin

Design and Technology Department
6 E 16th St. Parsons The New School for Design
New York, NY 10003 USA
aisenc@gmail.com

ABSTRACT

This paper is an in depth exploration of the fashion object and device, the Play-A-Grill. It details inspirations, socio-cultural implications, technical function and operation, and potential applications for the Play-A-Grill system.

Keywords

Digital Music Players, Hip Hop, Rap, Music Fashion, Grills, Mouth Jewelry, Mouth Controllers, and Bone Conduction Hearing.

1. INTRODUCTION

Play-A-Grill, (see Figure 1) combines a digital music player with the mouth piece jewelry known as a grill, which is usually associated with hip hop and rap music genres. Grills are almost always made of precious metal, most notably gold or platinum. They are completely removable, and worn as a retainer. This piece of jewelry presents a perfect opportunity to merge an arbitrary music fashion object and reintroduce it as the music player itself. Because the grill is worn over the teeth, sound can be transmitted using bone conduction hearing instead of outside speakers or headphones.



Figure 1. Play-A-Grill

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2. ORIGIN

2.1 Experiments and Inspiration

This concept was inspired by an interactive installation at the Exploratorium Museum in San Francisco called Sound Bite that displayed bone vibration hearing through a rod [8]. A user could slide a straw over a rod, and through biting it and closing her ears, could hear any four different types of music. The clearest sound came from a hip hop music sample. This experience spun an ongoing conversation in my mind about bone conduction and its applications.

2.2 Hearing Through Teeth

Bone conduction hearing has been used since the 1880's in commercial products to aid hearing loss, except in patients suffering from damage to their auditory nerves. Rhode's Audiophone (see Figure 2), also known as the acoustic fan, was a popular instrument in the United States [5]. It looked like a fan with a retractable convex shape made of vulcanite, a rare copper. This fan, acting as an eardrum, would gather the sound vibrations in the air of its surroundings and vibrate at their frequencies. While users bit the end of the fan, these vibrations passed to the teeth, which then vibrated the cochlea and became audible frequencies once again.

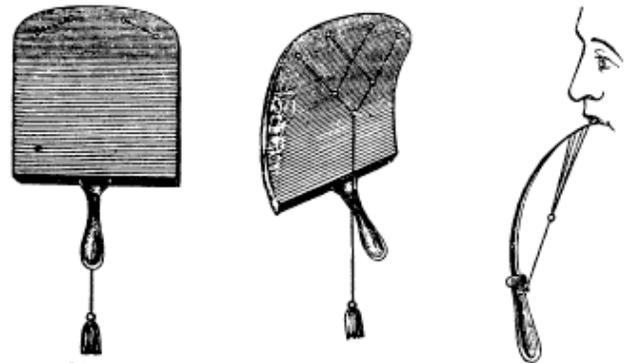


Figure 2. Functionality Illustration of Rhode's Audiophone

Since the 1880's, hearing aids utilizing bone conduction have changed and improved substantially. Cochlear is the company that in 1977 created the Baha a surgically implanted hearing aid. The Baha works with an audio processor that transmits the audio to the cochlea via bone conduction through a small stainless steel screw that is implanted into the skull bone, behind the ear. It was approved by the FDA in 1996 as a system for conductive and mixed hearing losses [2]. Although this system may be more effective to bone conduction because it is implanted directly into the skull, other less invasive methods and systems have recently emerged in the market, such as the new SoundBite by Sonitus Medical. The SoundBite microphone

is placed inside the user's ear and transmits wirelessly to a unit inside the user's mouth, around the posterior molars (see Figure 3), where it translates the wireless signal back into vibrations on the teeth. This device is fairly new; it was recently approved by the FDA, and the earliest reviews are from 2010 [9]. Like the Baha, SoundBite aids single-sided and conductive hearing loss.



Figure 3. Functionality of SoundBite Hearing System

Most of the examples I describe above use bone conduction to aid deafness. However, artists have also been exploring the idea of using this method for alternate applications. James Auger and Jimmy Loizeau together conceived the idea of Audio Tooth implant in late 2000. Their concept is to replace the cell-phone and any long-range receiver with a false tooth that contains a receiver. They see it as a form of telepathy that resonates directly in the subject's consciousness [1].

All of these devices work the same way: they replace the speaker output of an audio system with a vibration motor. The frequency of sound is translated to motor vibrations and it is transmitted directly through bone conduction, instead of using a speaker membrane to pulsate sound vibrations through the air.

3. MUSIC AND FASHION

Music and fashion are the most cyclical of all art and culture based Industries. Ideas and aesthetics are constantly recycled, reappearing decades later. Both of these cultural expressions are seamlessly embedded in our daily lives, and they are venues to our personal identity [7].

Walking down most high school hallways one can see teenagers embracing different subcultures in an attempt to find their personal identities. Punks, metal heads, hommies, hippies, ravers, hipsters, goths, etc. are among the many subcultures that represent the differing aesthetics of popular music genres through a dress code. There are other subcultures that arose from poverty and struggle, such as gangsters and skinheads, which are more related to socio-economic issues than cultural identity. These subcultures' dress codes are more prominent and radical in the youth population. Class struggle is a pinnacle of hip hop causing its style to center on the display of wealth.

3.1 Hip Hop

Hip hop is a flexible and powerful tool for communication, given its rebellious spirit, materialistic values and aggression. Because of its adaptability in communication it has become a perfect capitalistic tool in fashion. From the late 70's to mid 1980's hip hop style was about promoting self-identity. Hip hop always glorified display of wealth, but it was not until the 90's when brand names became fashionable. For example, men began to wear the Gucci frames without the lenses, for pure style [3].

Regardless of brand names, flashy expensive jewelry has always been the preferred hip hop fashion statement. Referred to as "bling-bling," gold chains, diamond watches, and especially mouth jewelry pieces are hip hop's crown jewels and an explicit display of wealth and power. The grill, also known as a "front," is the most iconic bling. Removable grills were made fashionable in the 1980's by Eddie Plein, owner of Eddie's Gold Teeth in New York City, when he fitted famous Flava Flav. Twenty years later, Dirty South rappers spun the fashion back into a national epidemic of diamond teeth [6]. In hip hop slang, diamonds are referred to as ice. Rap star Nelly dedicated an entire song to grills and their fashion sense, in collaboration with other rap artists, Gipp, Ali, and Paul Wall the owner of a business that manufactures grills worth \$20-\$30,000 in value. Some of the verses of their song, "Grillz" say [4]:

"Got 30 down at the bottom, 30 mo at the top
All invisible set in little ice cube blocks
If I could call it a drink, call it a smile on da rocks..."-Nelly.
"I got my mouth lookin somethin like a disco ball
I got da diamonds and da ice all hand set
I might cause a cold front if I take a deep breath
My teeth gleaming like I'm chewin on aluminum foil...
Piece simply symbolize success
I got da wrist wear and neck wear dats captivatn
But it's my smile dats got these on-lookers spectatin
My mouth piece simply certified a total package
Open up my mouth and you see mo carrots than a salad
My teeth are mind blowin givin everybody chillz
Call me George Foreman cuz I'm sellin everybody grillz." -Paul Wall.



Figure 5. Bejeweled Ancient Teeth from Chiapas Mexico.

In the history of the civilization, teeth decoration goes deep into our histories. The oldest record of embellishing teeth is a skull found in Mesoamerica from 2500 years ago (see Figure 5). The skull had gems set on the teeth by carefully drilling holes that

did not penetrate the tooth pulp, showing the high skills of ancient dentists [11].

4. INTEGRATION

The Play-A-Grill required several steps and methods beyond researching the social and technical aspects that surround the concept. These included:

- Making a prototype for hearing via bone conduction to make sure that this was a viable concept.
- Making a mold of my mouth with alginate and casting it in plaster to be used as a guide.
- Carving a wax model of the grill fitted to the posterior top teeth.
- Casting the wax model into silver.
- Hacking an existing digital music player with a tactile interface. It was crucial that the interface not require visual cues so that the tongue could control it.



Figure 6. First Prototype Motor Output for Digital Player.

4.1 Bone Conduction Prototype

In order to test bone conduction I used a small vibration motor and connected the leads to a headphone jack cable. I then plugged it into an mp3 player, and I received positive results (see Figure 6). Prototyping subject #1 was able to hear the sound through his teeth. Naturally, the greater the amplification the audio device has, the louder one can hear music from one's teeth. If the music is loud enough the concave shape of the palate make the vibrations of bone conduction resonate, resulting in a mouth speaker. This way people can hear the music coming from the mouth of the subject whose teeth are

vibrating. The idea of vibrating teeth sound dangerous, and as with grills, it is not recommended to wear the Play-A-Grill for extended periods of time. Also, it is better to use less sound amplification, and instead covering the ears to better hear the sound from bone conduction, making it a more personal and private experience. Usually one cannot feel the vibrations that are coming through the motor, other than perceiving their audibility.

4.2 Mold Making and Wax Casting

I made an impression of my mouth using alginate, the material used by dentists use to make bite molds. The material sets very quickly, and because it is made of algae it also dries very fast, which means that the plaster casting needs to be poured immediately. Once the plaster cast had set overnight it was ready to be used as a guide for the grill model. To create the grill model, I used metal casting grade wax. I wrapped the wax around the 4 posterior top teeth and attached letters spelling ICEN over the wrap. I chose ICEN because "ice" is the slang term for diamonds in hip hop culture, and because ICEN is a phonetic play on my name, which further adds my own brand to my "bling-bling" as a reference to the early years of hip hop, when promoting one's own name was more important than sporting brand names. Once the wax model was finished, Quality Mold Making in New York City cast it to silver. When I picked up the cast, I immediately put it in my mouth to see how it fit. The jeweler yelled, "No! Don't do that! I clean it in cyanide after it is cast." I am very glad I did this in front of him and not on my way back home on the train.

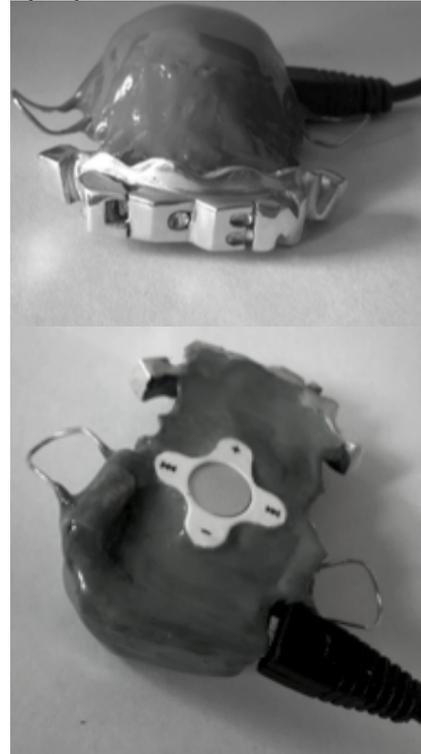


Figure 7. Top and Bottom Detail of Play-A-Grill Device

4.3 Hacking the Player

Finding the right music player was crucial for this project. There were many qualities that were imperative for the prototype to function well. First it needed to be small enough to fit in the

mouth of a user. Second, it needed controls that were simple for a tongue to navigate. And third it had to be inexpensive, since it would be subject to dissection, and I would most likely use more than one. Indeed, I used two. The digital mp3 player I used was an off-brand mimicking an old version of the iPod Shuffle. This was a perfect device because it met the tactile controls for the tongue, the size requirements, and since it was an off-brand, it was inexpensive. The first step to hacking the player was to break the enclosure, detach the headphone input, and connect a motor. This was an easy hack and there was not much to it, until I found that the quality of the sound was too faint. To solve this problem I added an op amp break out board to amplify the vibrations of the motor. I connected the two motor leads to the amp and to the output of the device. During this operation, I soldered off the power connections on the circuit board and had to start fresh with a new mp3 player. Once the operation was repeated and successfully completed, I organized all the components and the grill together on the mouth mold and set them with a combination of silicones (see Figure 7).



Figure 8. Functionality of Play-A-Grill.

5. CONCLUSION

The Play-A-Grill device merges the arbitrary music fashion object and empowers its function by making it the music player itself. Would hip hop fans wear this device? Most of the responses have been positive. The grill is the perfect music related jewelry piece to serve this function because it allows for alternate technologies to emerge, such as bone conduction hearing. The idea of a digital sound player in the mouth has potential of embodying different forms. For example audio players that can also be recorders and serve a short memory function, allowing the user to record their conversations.

Another application can be to apply receivers and transmitters such as the Audio Tooth Implant concept, but instead using radio transmission, so the devices can operate as walkie-talkies [1].

Transferring sound directly through bones provides physiological advantages to the user by relieving stress on the eardrum, while still transmitting sound to a single user. Regarding the first iteration of this device, the improvements for future iterations need to take the size of the controller, as it is too big and uncomfortable for wearing during long periods of time. Another important lesson was to create a new type of interface that is designed specifically for a tongue to control. This "shuffle" type controller model is useful and intuitive, without requiring sight, but the buttons are made for fingers and too hard to be pressed by the tongue. There is a lot more exploration to be done for mouth controllers, for example incorporating systems used in assistive technologies for people with limited mobility or dexterity such as the sip-and-puff controller that allows the user to direct a wheelchair based on the sequence of air blown. Most other music interaction controllers use the aid of an external computer to interpret action and perform sound, such as the Mouthesizer of Michael Lyons. The Play-A-Grill also attempts to provide a display that challenges our perception of listening, altering the body's natural sound output and relocating as an input.

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