Experimental Study of Cymatics

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***Abstract*—Cymatics is the study of the visualization of sounds. Cymatics analyzes sounds by applying basic principles of wave mechanics. Since sound is a type of wave, it can be displayed through visual media. Inspired by the idea that Cymatics visualizes sound, this study researches the previous studies about Cymatics, especially Ernest Chladni's Cymatics pattern which is the most achieving. By conducting experiments, this study estimates the accuracy of the Chladni patterns and suggests that different Cymatics forms can be found when experiments are conducted in different circumstances. Verifying Chaldni patterns and studying Cymatics is important to systemize the visualization of sound for useful application. If sound can be systematically visualized, it would expand the opportunity for people with impaired hearing to communicate and appreciate art.**

***Index Terms*—Cymatics, chladni pattern, aurally-challenged.**

I. Introduction

As the number of MP3 players increases throughout the world, modern people can listen to music everywhere, any time. These days, people with earphones, enjoying music, can be seen everywhere. Some of the unfortunate people, however, must live in complete silence. They have limitations in sympathizing with other ordinary people who can listen to music and watch movies. They have limitations in sympathizing with other ordinary people about ordinary activities, such as listening to music or watching movies. In movies, background music flows out from the speakers for various scenes. Music that fits to the scene flows through the speaker every moment. It helps people focus on the movie and to be more moved and touched; however, this function is of no use to those who are auditorily challenged. Also, when singers dance along the music, the dance is merely gestures to people who cannot hear. We are willing to afford these people the chance to appreciate the value of music with something other than auditory senses.

Song is a form of art that is created when lyrics and melodies come together. People are touched by music when these two blend properly. However, if people

cannot hear, even though they can read the lyrics, they cannot listen to the melody. What if we can visualize melody just like lyrics? We thought that people who are aurally challenged can enjoy music by sight, replacing auditory senses.

The key of visualizing sound is Cymatics. Cymatics is the study of visualized sound and vibration. Unlike other fields of studies, Cymatics was not studied and researched thoroughly, resulting in the lack of information and data about Cymatics. As we researched the topic we found out a standardized pattern of visualized sound, the Chladni pattern. The purpose of this paper is to prove the validity of the Chladni pattern by studying Cymatics thoroughly and examine the possible contribution of the pattern to the aurally challenged

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II. Experimental Study

A. Hypothesis

We establish two hypotheses about the change of shapes of visualized sound.

$$v = \sqrt{\frac{\beta}{\rho}} \ (v = \text{wave velocity}, \rho = \text{density}, \beta = \text{bulk modulus}) \quad (1)$$

$$v = \lambda f \ (v = \text{wave velocity}, \lambda = \text{wave length}, f = \text{frquency}) \quad (2)$$

Hypothesis 1: Relation between the type of board and the shape on the board

According to (1), sounds that have same frequency have different velocities because of the bulk modulus of their media. If the velocity varies, according to (2), the wave length would change. This change indicates that the distance between two consecutive nodes would differ according to its material. The lines are formed by particles on the node, so the change of location of nodes would result in the change of the shape.

Hypothesis 2: Relationship between the frequency and the shape on the board

According to (2), the change of sound frequency would result in the change of wave length. Because the change of wave length results the change of location of node, the shape displayed on the board will vary.

B. Experiment

To confirm the validity of the Chladni pattern and our hypotheses, we conduct experiment.

Tools: Function generator, audio amplifier, speaker, oscilloscope, various boards(paper, polystyrene)

Variable: Type of the board, frequency of sound

Procedure

First, connect the speaker to an amplifier and a function generator. Then, glue the board to the speaker and scatter particles on the board. Generate a frequency by frequency generator. Then, observe and record the shape on the board. Change frequency by 10Hz and record different shapes on the board. See Fig. 1.

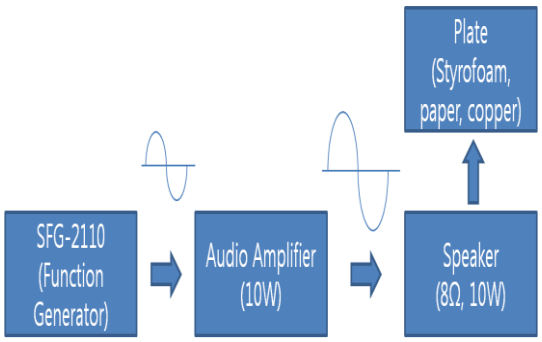
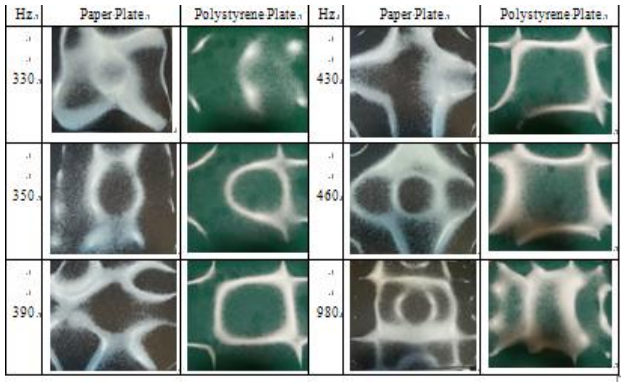


Fig. 1. Block diagram of experimental device.

C. Result



D. Analysis

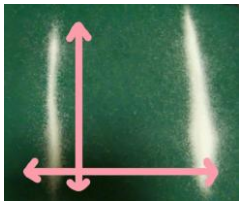


Fig. 2. 110Hz on Polystyrene.

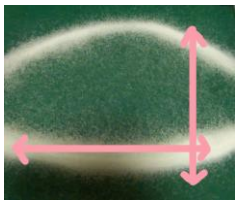


Fig. 3. 160Hz on Polystyrene.

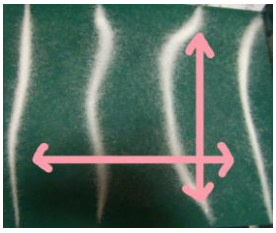


Fig. 4. 600Hz on polystyrene.

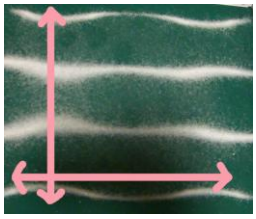


Fig. 5. 780Hz on polystyrene.

In Fig. 2, the pattern of 110Hz is two vertical lines. As figure shows there is only the horizontal standing wave. Vertical standing wave does not exist at 110Hz. In Fig 3, there are two horizontal lines which show that there is only vertical standing wave at frequency 160Hz. In Fig 4, even though lines are bent, there are four vertical lines which mean that there are only horizontal lines. Also in Fig 5, there are bent horizontal four lines. There is no horizontal standing wave

After observing all the patterns in the chart we can conclude that:

Patterns become more complicated as frequency becomes higher. If frequency becomes higher, there are more nodes and antinodes.

Patterns on the paper board and patterns on the polystyrene board are different. Since every subst ance has different resonance frequency, every plate creates different patterns

Fig. 6. Chladni pattern.

Fig. 7. 130Hz on polystrene.

Fig. 8. Chladni pattern

Fig. 9. 450Hz on paper

Fig. 10. Chladni pattern

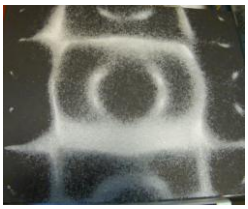


Fig. 11. 980Hz on paper

As shown in the Fig. 6 to 11, some of the results showed similar result with Chaldni pattern. Chladni experimented with violin bow, which he could not specify frequency. We can know the range of frequency is quite scattered, because he used violin bow to produce sound. On the contrary, our frequency generator created sound from 110Hz to 1200Hz. Even though all the results are not identical, overall patterns are similar since the basic principles lying on the experiments are same.

III. Conclusion

A. Practical Value of Cymatics

When Braille was designed, it was an innovative method to involve visually impaired people into world of letters and literatures. By transforming visual language into tactile language, visually disabled people were able to expand their domain of communication. Although they can listen to what others say, sound does not provide them the same accessibility to language as sight: they could not enjoy literature, which is an art piece made up with words. However, Braille enabled them to read and appreciate the art itself.

We believe that Cymatics would facilitate conversion of sound to visual language. If the sound is visualizes, as Braille expanded chance of communication, visualization will lead people to appreciate auditory art such as music

B. Further Application

- Cymatic Therapy

Cymatherapy is a computerized form of combined sound and magnetic therapy applied directly to the body. It uses subtle audible sounds that simultaneously work on an energetic and physical level. Cymatherapy supports the body's natural ability to heal itself by providing precise

combinations of frequencies that are associated with healthy tissue and organ systems. Cymatherapy assists your body to provide itself with effective and gentle relief for stress, injury, chronic pain and many other conditions. This therapy is also highly effective when combined with many of the other available therapies offered by Natural Holistics, such as massage, chiropractic or nutritional medicine. [1]

- Autism

Various discussions are ongoing with autistic research and support centers. Extensive discussions have taken place on the benefits of integrating interactive technologies with cymatics to allow total sensory immersion and control. A commission for Aldeburgh music saw seeper.com and flat-e.com (the creators of this site) design, develop and build an interactive cymatic installation in cooperation with school children. Discussions with a key autism center in the UK have lead to ongoing development of interactive cymatics in this context. Various discussions are ongoing with autistic research and support centers. [2]

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REFERENCES

[1] "Cymatherapy." Web log post. Cymatics. Ed. Evan Grant. Web. [Online]. Available: http://www.cymatics.co.uk/

[2] "Autism." Web log post. Cymatics. Ed. Evan Grant. Web. [Online]. Available: http://www.cymatics.co.uk/