DIAGNOSTIC SINGING BOWLS

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ABSTRACT

The Hypertension singing bowl is a CAD object shaped by a year of blood pressure data, 3D printed in steel so it resonates when stuck or rung. But can blood pressure really be diagnosed by listening to singing bowls shaped by blood pressure datasets ? This paper presents work in progress to answer this question.

1. INTRODUCTION

Data physicalization maps a dataset onto the shape of a physical 3D object that can be explored by touch as well as vision. Data physicalizations have been considered as artworks or educational props, but a recent evaluation has shown improved effectiveness for 3D tasks involving 3D datasets [1]. Shape and material physically affect the acoustic vibrations produced from interactions with an object. The possibility that data physicalizations could be designed to produce sounds was explored in an experiment with bells shaped by an HRTF dataset and 3D printed in stainless steel [2]. The modulation of the shape of a bell by a dataset produced audible differences when it was rung, that could also be observed in the acoustic spectrum. This led to the proposal of the hypothesis that Acoustic Sonifications could allow users to hear useful information about a dataset mapped onto the shape of a resonant object. This hypothesis was explored further by modulating the shape of a tibetan singing bowl with a year of blood pressure readings, which altered the pitch and timbre of the sound that was produced [3]. These results raise the further question of whether it is possible to diagnose blood pressure by listening to Acoustic Sonifications in the form of Singing Bowls?

2. DIAGNOSTIC CATEGORIES

Blood pressure readings are classified into five major diagnostic categories of risk, shown in Table 1. A blood pressure reading of 110/70 is classified as “Normal” and does not require treatment. A lower reading is called Hypotension, which has symptoms such as dizziness and fainting. Higher readings are classified into 3 levels of Hypertension, where the increased pressure on arteries and organs has increasingly serious consequences for longterm health.

Diagnosis	Systolic	Diastolic
Hypotension	85	55
Normal	110	70
Pre-Hypertension	130	85
Stage 1 Hypertension	150	95
Stage 2 Hypertension	160	100

Table 1: Blood pressure risk categories

3. DIAGNOSTIC SINGING BOWLS

The simple shape of a singing bowl makes it straight forward to model a CAD template that can then be digitally modulated by a dataset, using graphics progamming software such as Processing [4]. Five Diagnostic Singing bowls were computationally generated from the average Systolic and Diastolic readings for each category of risk, as shown in Figure 1.

The Systolic pressure of 110 maps onto the radius of the rim, and the Diastolic pressure of 70 maps onto the radius of the base. The spokes smoothly join the rim and base to create the simplest shape, which should also have the simplest acoustics.

Figure 1a: Normal

The spokes are slightly larger in radius than the rim and base, causing the bowl to resonate at a lower frequency. The Systolic pressure of 85 increases the upper spoke radius to 36mm compared to the rim of 35mm. The Diastolic pressure of 55 increases the lower radius in the same way.

Figure 1b:Hypotension

The Systolic pressure of 130 maps to a radius that is smaller than the rim, and the Diastolic pressure of 85 maps to a radius that is smaller than the base. The smaller radius should cause the bowl to resonate at a higher frequency than the Normal bowl. The discontinuous joins between the spokes, rim and base may add acoustic complexity.	 Figure 1c: Pre-hypertension
The reading of 150/95 further reduces the spoke radius, causing the.bowl to resonate at a higher frequency than the Pre-hypertension Diagnostic Bowl.	 Figure 1d: Stage 1
The reading of 160/100 further reduces the spoke radius, causing the bowl to resonate at a higher frequency than the Stage 1-Hypertension Diagnostic Bowl.	 Figure 1e: Stage 2

Figure 1: Diagnostic Blood Pressure Singing Bowls

4. PATIENT BOWLS

The Patient dataset, labelled SB, shown in Figure 2a, has 100 readings with an average of 147/95 which is in the Stage 1 Hypertension category. A second Patient dataset labelled MK, shown in Figure 2a, have an average of 124/81, which is in the Normal category. However these readings are more erratic, with a standard deviation of 14/10.

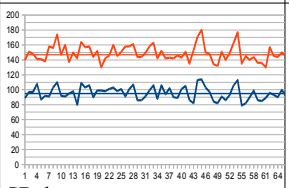
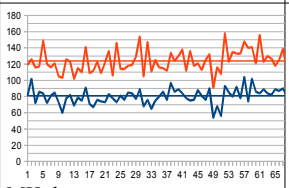
Patient Dataset	CAD Bowl
 SB dataset Ave=147/95, Stdev=10/8	Figure 2a:SB Bowl 
 MK dataset Ave=124/81, Stdev=14/10	 Figure 2b: MK Bowl

Figure 2: Patient datasets and CAD Bowls

5. EXPERIMENT

The experiment will test whether Patient bowls can be correctly diagnosed by comparing the sounds with the Diagnostic bowls. Preliminary results will be presented.

6. REFERENCES

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[4] Reas, C. and Fry, B. (2010), Getting Started with Processing (1st ed.), Make, p. 208, ISBN 1-4493-7980-X