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Experiments on the Quality of the Output Tone on the Electric Sasando Produced by Edon and Oebelo With A Variety of Wire Materials

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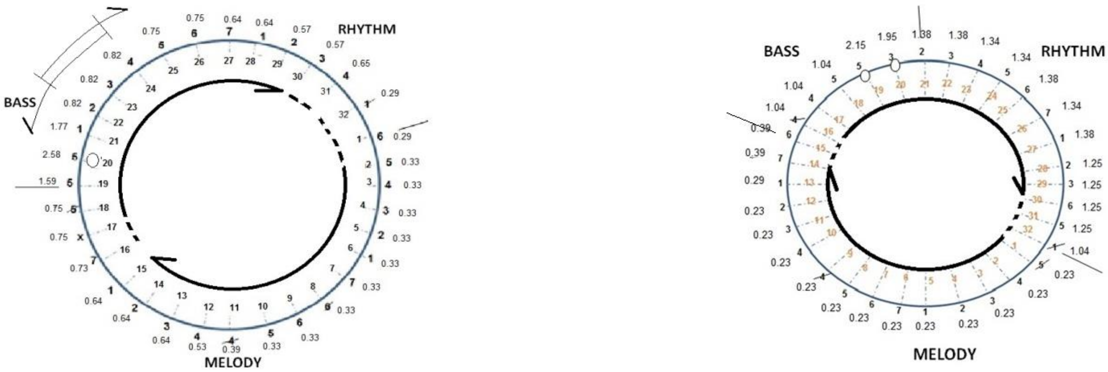
ABSTRACT
This study aims to identify and improve the quality of the output tone of the Sasando musical instrument from Rote, East Nusa Tenggara by varying the 32 types of wire used. The type of Sasando used in this study was the electric Sasando made by craftsmen Oebelo and craftsmen from Edon Kolhua. The results showed that the two types of Sasando are physically different, but have the same frequency pattern on 32 strings, according to the functional melody, bass and rhythm of the strings. The Edon electric Sasando has a frequency range of 75 to 1.015 Hz and an intensity of -15 to -77 dB, which is slightly lower than the Oebelo electric Sasando, which is 86 to 1.314 Hz and -37.32 to -74.91 dB. Both Sasandos prefer to use melodic strings with a diameter of over 0.36 mm.
Keywords: *electric sasando, frequency, intensity, tone.*

1. INTRODUCTION

Sasando is a traditional musical instrument originating from Rote, East Nusa Tenggara (NTT). Sasando is not only famous in Indonesia but is often enjoyed by the world community such as Australia and Europe. Proven in 2011, this instrument was registered by UNESCO as a world cultural heritage from Indonesia, such as batik and angklung instruments that had previously registered [1,7].
There are 2 types of Sasando such as traditional Sasando and electric Sasando. Traditional Sasando naturally utilizes the palm leaf midrib as a resonant space, but it has begun to decrease its use due to its limited output of tone because depends on environmental factors such as distance, temperature, humidity, and the size of palm leaves [2,8]. While, the electric Sasando is a musical instrument innovation with analogue sound signal convert to an electric format, by adding transducers in the form of sensitive microphones or placing electric spools. For wire can use guitar wire or others.
The famous Sasando craftsmen locations in NTT are Oebelo and Edon Kolhua, who produce electric sasando of violins types with different configurations **Fig. 1**. This type of Sasando can be combined with other musical instruments in the sound system.



(a) (b)

Figure 1. 32 strings configuration with the diameter in mm of Sasando electric for (a) Edon, (b) Oebelo

There has been done a lot of research to simulate a variety of traditional music instrument into the Android version in order to attract the interest of young people to use it because it feels easy. This method is considered effective in preserving national culture, especially in traditional music instrument. [3] Who use Multimedia Development Life Cycle (MDLC) to simulate based on android to *angklung (saung)*. They found that after the application was successful and tested on young people, over 88% liked it and were easier to play. Then, [4] do the same thing with angklung too but using Adobe Flash CS6. They have advantages when used application with 3 octaves tone and has a tone transpose facility to recording while being played.

There is only one experimental study to test wire quality by comparing with ANSI 304 type steel wire [5], but it focuses on experimental tests and numerical analysis aimed at determining the chemical composition of the wire and the mechanical ability of the two string materials based on the tensile test. But, the study of the quality tone output based on frequency and tone intensity parameters of the Sasando electric based on variation the types of wire used has not been done.

2. METHOD

The experiment was started by mapping the position and diameter of the original Sasando wire, then the tones were recorded. Then, it was varied with 4 different types of wire which had almost the same diameter. Each note was recorded and tabulated. The alternative wire tested is found in **Figure. 2**.

Wire Number (mm)	Wire Test and diameters (mm)			
	Vd1	Vd2	Vd3	Vd4
1–12 0.33	JXI2 0.29	D'Addario1 0.30	Fender2 0.36	Neo2 0.33
13–19 0.53-1.59	D'Addario3 0.64	D'Addario4 0.86	Fender3 0.56	Neo3 0.43
20 2.56	FenderBass4 2.67	Orphee4 2.54	FenderBass 3 2.03	Orphee3 2.03
21 1.77	Magic4 1.80	Pyramid4 1.79	Magic3 1.61	FenderBass2 1.65
22–29 0.82-0.57	D'Addario3 0.64	D'Addario4 0.86	Fender3 0.56	Neo3 0.43
30 0.57	Fender2 0.36	JXI2 0.29	Neo2 0.33	D'Addario 2 0.41
31 0.65	D'Addario3 0.64	D'Addario4 0.86	Fender3 0.56	Fender4 0.76
32 0.29	D'Addario1 0.30	Fender2 0.36	JXI2 0.29	Neo2 0.33

(a)

Wire Number (mm)	Wire Test and diameters (mm)			
	Vd1	Vd2	Vd3	Vd4
1–15 0.23-00.39	JXI2 0.29	Neo1 0.25	Neo2 0.33	Fender1 0.25
16–18 1.04	Pyramid1 1.15	Neo6 1.17	Fender1 0.25	Magic1 1.17
19–20 1.95-2.15	Orphe2 1.65	Magic4 1.80	FenderBass3 2.03	Pyramid4 1.79
21–27 1.24-1.38	Magic2 1.49	JXI5 \1.27	JXI6 1.49	D'Addario6 1.37
28–31 1.25	Fender6 1.22	Neo6 1.17	JXI5 1.27	D'Addario5 1.12
32 1.04	Pyramid1 1.15	Neo6 1.17	Fender1 0.25	Magic1 1.17

(b)

Figure 2. Wire tested on (a) Edon Sasando, (b) Oebelo Sasando

Experimental stage (**Figure 3**), starting with the acquisition, data retrieval, and identified in a tone.

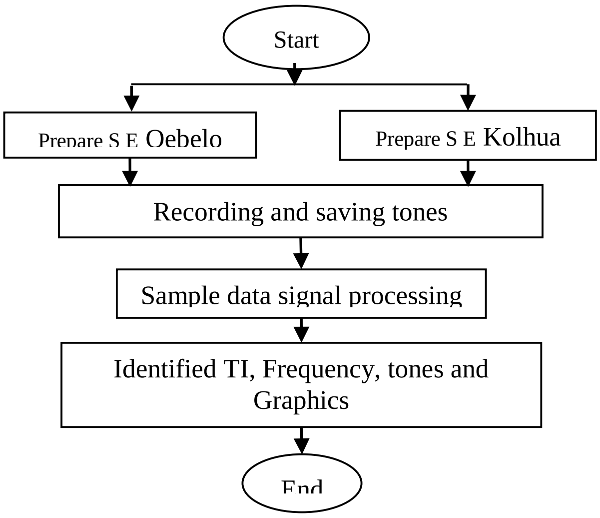
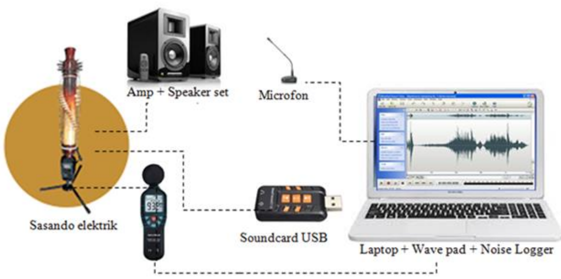


Figure 3. Experimental Flowchart

The experimental stages start from the taking 640 data audio file in .wav format as input values in the form of intensity and frequency recorded using the Behringen's Mic2USB microphone and soundcard USB (**Fig. 4.**). Then, processed using wavepad software to reduce an eliminating noise from environment and using FFT method for obtaining infographic parameters of frequency (Hz), tone and gain intensity (dB), see **Figure. 5**.



(a)

(b)

Figure 4. (a) The Configuration of 640 sample data acquisition in Sasando tones. (b) Oebelo Sasando (left), Edon Kolhua Sasando (right)

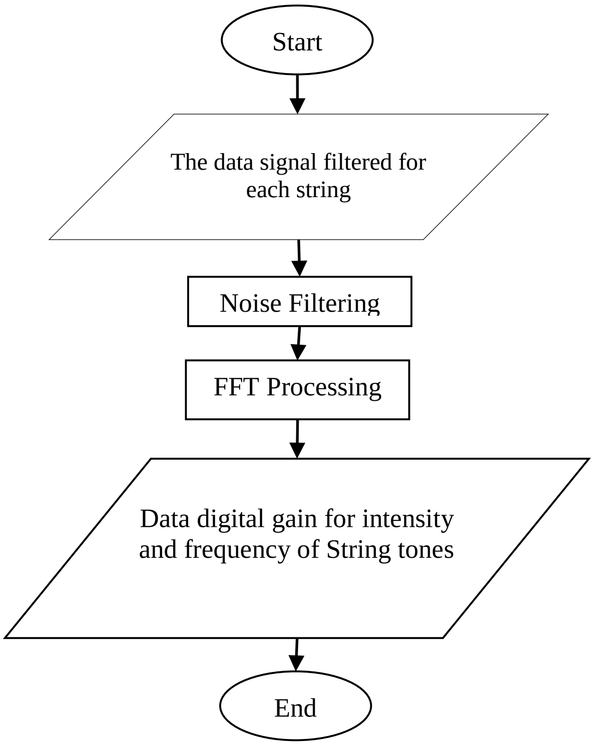
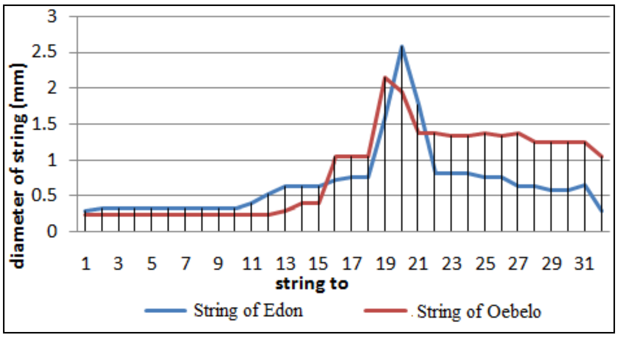


Figure 5. Flowchart of processing data intensity, frequency and tones.

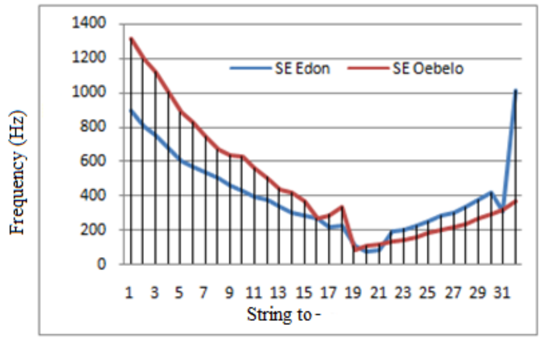
3. RESULT AND DISSCUSION

The results of a comparison of the diameter and frequency measurements of 32 strings on the Edon and Oebelo electric Sasando are shown in **Figure 6**.

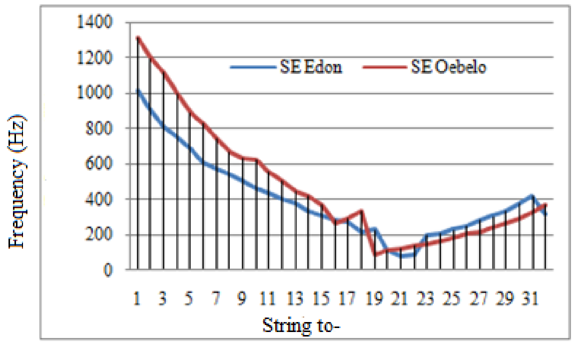
Figure 6 (a) shows that the string of Oebelo's Sasando is thicker than bass and rhytm (above 1 mm), whereas melody strings are thinner than the diameter of Edon's Sasando. We choose the dimeter of Edon's sasando tends to below 1 mm, except for 3 bass string were the one thicker than another bass in Oebelo's sasando. Why we chose it? Because the dimeter selection of sasando strings has technical consideration related to the sound output produced based on the characteristic of the sasando set made**.**



(a)



(b)

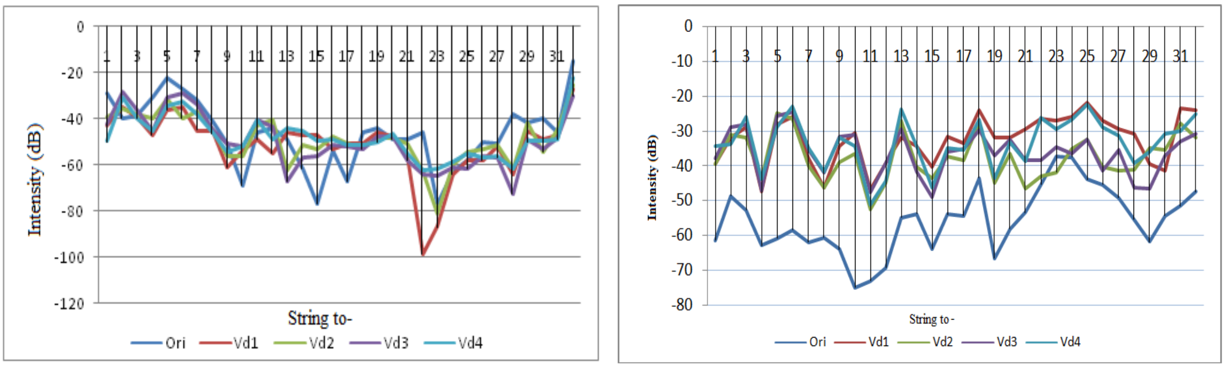


(c)

Figure 6. The Comparison of Sasando Electric from Edon Kolbano and Oebelo for determine: (a) 32 strings diameter; (b) Standart Frequency; (c) if shifted 1 string

Figure 6 (b) and (c) shows that when the sasando's stingr is shifted one string of the standart from 32 (rhythm 1015 Hz) have a little difference in chromatic tones (middle tone, kres #). In normally, it has high frequency melody, but low bass and middle rhythm. From the result to shows that the frequency of Oebelo's sasando higher than Edon's sasando. But it has lower rhythm and it affects to intensity of the sound produced.

The result of the sound intensity from Edon's Sasando and Oebelo's sasando showed in **Figure 7**.



(a) (b)

Figure 7. The standard intensity for 4 variant of sasando strings from (a) Edon and (b) Oebelo

The intensity values of standard string from Edon's sasando about (-15 to -77) dB, all of Variant Vd1 (- 27 to -99) dB, Vd2 (-25.25 to 81.04) dB, Vd3 (-30 to -72.68) dB and Vd4 (-22.47 to -62.77) dB. In general, the value of sound intensity doesn't significantly different from the standard. But, the are some inconsistent data related to the diameter, for example in the 22nd string (standard dim = 0.82 mm) replaced by the first variant string (D'Addario3 0.64 mm) which change the significant intensity to -99 dB from -46 dB, but not linearly. This is caused by the audio intensity of sasando influenced by many factors, and one of the factors is how much the muscle force when we picking a sasando's string.

The distribution of variant intensity patters around the standard intensity justifies that the configuration standard string of Edon's sasando is good. For various string variant of quality, Edon's sasando can still produce a stable tone. But, physically the 12 strings of 18 melodies with a diameter of 0.33 mm, that breaking easily when we calibrated tone/stem, especially for for the basic tone C. Therfore it's recommended to be replaced with a slightly larger diameter, so it has better density. For example, using second Fender's string with diameter = 0.356 mm, μ=0.008 g/cm, and 〉=8.0412 kg/m^3.

The characteristic of Oebelo's sasando strings as all use small diameter, and the 15 melody strings (0.23 to 0.29 mm) having a dominant diameter of 0.23 (for 13 strings), and 3 string have diameter respectively 0.29 mm (for 1 string) and 0.39 mm (for 2 strings). This is the main weakness of the Oebelos's sasando strings. The smallest strings of Oebelo's sasando equivalent to the number 2 string of the guitar, so that it's easily broken when we used. The intensity of standard string of Oebelo's sasando at the intervals (-37.32 to-74.91) dB, Vd1 (- 21.82 to -47.47) dB, Vd2 (-24.47 to - 52.55) dB, Vd3 (-24.47 to -49.00) dB, and Vd4 (-22.55 to -51.25) dB.

Figure 7 shows that the significant difference between the standard intensity (about -50 to -60 dB) with the variant intensity at -30 to -40 dB. This result proves that the standard strings sold on the market cannot replace Oebelo's sasando strings (Warsito, 2018). He observed about intensity and frequency of traditional music sasando and found that the gain intensity of sound and frequency wave in sasando string respectively about 20.2 dB (for 130.8 Hz) and -37.4 dB (for 349.2 Hz). This is a reason why even though Oebelo's sasando string easily to breaking up, but they have a good quality tone output. Oebelo's sasando has a unique construction when it still has a good modification as a resonance chamber. So it can be played traditionally without electricity, it just opens the "haik". If we used electrical, you can open or reduce this "haik".

The 32-string sasando electric is complicated to play by anyone who has never experienced or never practised or studied. Even more difficult ia how to place the fingers to be able to put the combination of melody, bass and rhythm. Moreover, the electric sasando is not just diatonic tone but it has reached a chromatic tone. Of course, it is very appropriate to compare or to be parallel with the modern musical instrument. The main challenge is the concern of millennials interest of traditional music instrument as a uniqe culture of NTT.

4. CONCLUSION

Based on the result of research about Edon's and Oebelo's sasando electric, it show that physically and dimensionally different such as type of configuration; strings; electrical completeness; intensity level and frequency of the sound output. But, have similar frequency pattern in 32 strings, according to the functional melody strings, bass and rhythm. However, Edon's sasando has a lower frequency and intensity than Oebelo's sasndo, but the type is full electric which is equipped with a tested pickup and pre-amp to support the quality of the output tones. While the Oebelo's sasando is more characterized by traditional and electrical combination.

Tone quality is determined by wire quality and diameter. The smaller the diameter, the higher the sound intensity, but the weakness is prone to breaking. Recommendations are replaced by wire with a slightly larger diameter, better density. For example using Fender 2 strings with specifications (dim = 0.356 mm, μ = 0.008 g/cm and ρ= 8.0412 kg/m^3). Physically stronger, but the disadvantage is that it requires less force in picking it.

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