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Realization of Pratuokng (Bamboo Tube Zither) Repertoire among the Bidayuh of Annah Rais through Frequency Modulation Synthesis Sound Modeling

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ABSTRACT

Gongs are heard during Gawai celebration on first and second of June every year as an indication of appreciation for the harvest obtained. Gongs are a symbol of prosperity for the Bidayuh (Horsbourgh, 1858). Gong players gather and perform and are frequently joined by the traditional Bidayuh dance at an open space, 'awah' of the longhouse known as 'Kupuo'. There are three levels of tone attribute derivative from the gongs, namely 'canang', 'satu' and 'tawak'. In the community of Annah Rais, Padawan, Sarawak, there are tube zithers known as *pratuokng*, which contain a similar tone structure as the Bidayuh gong set and offer comparative collections. Seen from the point of view of sound preservation, the Audiovisual Research Collection for Performing Arts (ARCPA) located at the Music Department of Faculty of Human Ecology, UPM is stepping forward in developing elusive learning for a scholarly group to get to far-reaching database collections. In this respect, an exploratory examination concerning *pratuokng* collection is directed by means of sound simulation via Frequency-Modulation Synthesis (FM Synthesis), draws nearer as a model. The 'Audio Modulation' method, especially by means of frequency modulation, empowers summing sine wave to be a structure at different amplitudes. Subsequently, creating a non-consonant partials of frequencies sidebands will build up a metallic timbre, empowering the acknowledgment of the *pratuokng* music back in the traditional Bidayuh gong ensemble.

Keywords: Audio archiving, audio modulation, bidayuh, Frequency-Modulation Synthesis, *pratuokng*, tube zither

INTRODUCTION

Present State of Audio Preservation

An archive is a deposit of files that keep records of an organization or individual for legal purposes. Archiving audio-visual documents is vital in order to not only keep records but to define present value sets that is key in decision making on what is important to human life. Philosophically, the significant recollection of the past is as important as conceiving the future possibility (Musib, 2015). Edmondson (2004) elaborated on these thoughts as follows:

> The accumulation and transmission of memory from one generation to another is a sustaining motivation of human society. It is the 20th century that has been characterized by a new, technological form of memory – the sound recording and the moving image. Now its preservation and accessibility depend on a new discipline synthesized from these three traditions. The philosophy and principles of audio-visual archiving, of guarding and sustaining that new kind of memory stands on their foundations. The philosophy in audio-visual archiving – what is done and not done, and why – is the consequence of these foundational principles and value (p. 5).

In the context of Memory of the World, preservation is the sum total of the steps necessary to ensure the permanent accessibility – forever – of documentary heritage. It includes conservation, which is defined as those actions, involving technical intervention, required to prevent further deterioration of original materials (p.6).

In line with the objective of the national cultural policy, which is to strengthen the unity of the nation through culture, ARCPA is taking another step in constructing a new approach to archiving. Aside from collecting, authorizing, managing, publicizing and accessing the collection of individual cultural expressions materials, abated by the code of ethics, this new approach known as architectural archiving is looking at other possibilities in archiving historical materials.

Currently, research on exploring other possibilities of collecting and documenting archived materials is scarce. To name a few, an article written by Jähnichen for the Sarawak Museum, 'Sound Environmental Accounts about Borneo's Land Dayaks and their Echoes in Contemporary Performing Arts of the Bidayuh in Padawan,' focuses on collecting tube zither music *pratuokng* played in Bidayuh gong context. Musib wrote an article titled 'Back to reality complex-preservation methods of sound production and its environment in the digital era' in a publication for University of Malaya in 2012. Umashankar's (2012) article, "Survival of Traditional Performance under Different Acoustic Conditions" was presented at the 43rd International Association of Sound and Audiovisual Archives (IASA) Conference in New Delhi, India. His research was on documenting and archiving acoustic properties of an old temple used as a theatre with the aid of 'impulse response'. Lastly, a doctoral

dissertation by Musib (2015) introduced the methods of recording and the possible outcomes for studies of sound perception and identity issues based on various sound experiences, known as the "Contextual Sound Preservation for Local String Instruments." A rich set of Bidayuh tube zithers recordings that allows for a choice of listening conditions mainly include the distance to the musicians and the position within the village environment.

Objective

The main objective of this research is to contribute to the sound experience of gong music through simulation of sound synthesis. The realization of gong sound via audio modulation creates an experience to the listener of what was once heard by the community of the Bidayuh. Currently, the gongs were substituted by the tube zither known as *pratuokng*. Archiving the sound culture of gong-like timbre in the form of plug-ins known as VSTi (Virtual Studio Technology Instruments) can potentially provide an individual community identity, namely the gongs of the Bidayuh Biata in Annah Rais. Each gong has its own timbre characteristic, and one is different from the other. With the aid of VSTi, a sound synthesis is able to simulate at a microscopic level, on each 'synthesized gong'. This includes audio modulation techniques that require a modulator. Sound preservation that includes a variety of receptive perspectives will be of increasing interest in research projects among social scientists, technicians, and decision makers in Malaysian communities through a growing awareness of intangible attributes of cultures (Musib, 2015).

MATERIALS AND METHODS

Research Design

The way this research was conducted was through describing the sound of *pratuokng* and its relation with the gongs of the Bidayuh (see Figure 1). It was done through frequency analysis deriving from the actual sound recording from gongs of the Bidayuh in Annah Rais. The gongs were digitally recorded using a large diaphragm condenser microphone at a 48 kHz sampling rate. The design of the sound simulation was structure based on similar harmonic content of the actual gongs, through a V.S.T.I (Virtual Studio Technology Instruments) plug-ins model design. Each of these sound modelling represents the sound radiators of both *pratuokng* and the gongs. Later, each of these sound generators was assembled (orchestrated) via MIDI protocol, hence the musical pieces of the *pratuokng* are able to be generated and record through a MIDI keyboard controller.

RESULTS AND DISCUSSIONS

Social Setting of the Bidayuh

Annah Rais is a settlement with over 500 years of unwritten history. There are about ten to forty families living in a single kupuo. Each kupuo comes with a different size and name. The kupuos of Annah Rais (see Figure 2) are named and categorized based on the number of apartment units built in each kupuo and the kupuo size (Musib, 2015) (see Table 1).
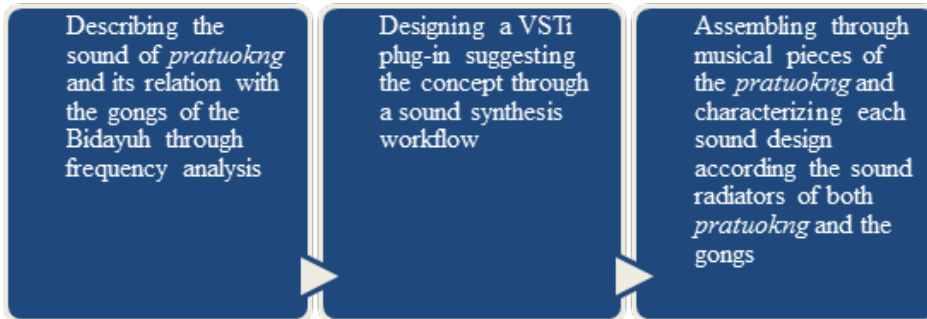
Describing the sound of *pratuokng* and its relation with the gongs of the Bidayuh through frequency analysis	Designing a VSTi plug-in suggesting the concept through a sound synthesis workflow	Assembling through musical pieces of the *pratuokng* and characterizing each sound design according the sound radiators of both *pratuokng* and the gongs

Figure 1. Realization of Pratuokng (Bamboo Tube Zither) repertoire through Frequency Modulation Synthesis Sound Modelling workflow

Figure 2. Kupuo Saba, Annah Rais, Padawan, Sarawak

Table 1

The measurement of each 'kupuo'

Name of the longhouse	No. of apartment	Kupuo size
Kupuo Saba 1	10 apartments	54.30m x 33.20m
Kupuo Saba 2	7 apartments	36.30m x 21.00m
Kupuo Terakan	11 apartments	56.62m x 30.10m
Kupuo Sijo 1 (Sau-u)	12 apartments	45.66m x 22.74m
Kupuo Sijo 2 (Sibudat)	6 apartments	32.40m x 20.10m

(Recorded by Ahmad Faudzi Musib and Chow Ow Wei)

There are around ten to forty families living in one longhouse or kupuo. Sarawak's inhabitants encompass more than twenty distinctive ethnic groups (Musib, 2015). They are frequently alluded to as Dayak. The term Dayak has uninhibitedly alluded to the indigenous Iban and Bidayuh. The Bidayuh consist of five minor sub-groups (see Figure 3). Most of the Bidayuh and their sub-ethnic groups live in the southern part of Sarawak. They comprise the Bidayuh Selakau-Lara or Selako in the Lundu area, Bidayuh Jagoi in the Bau district, Bidayuh Biatah in a small region of Padawan, Bidayuh Bukar-Sadong in Serian, and also the Bidayuh Baru or Modern Bidayuh in the central regions of Padawan and Bau (Musib, 2015).

Pratuokng of Annah Rais

Situated on a highland and encompassed by a tropical rainforest that is rich with different sorts of bamboo, Annah Rais utilizes this characteristic asset primarily to build and restore the kupuos. The entire construction of the kupuo is made of bamboo. It was a custom in the past that the tube zithers were made in the drying yard for development and repair. The *pratuokng* or *aguokng tarikng* (bamboo gong) used to be made a toy out of these remains which had now turned into an all-around regarded melodic instrument of the Bidayuh Biata. The *pratuokng* is sorted as an idiochord tube zither and is built utilizing a giant bamboo known as patukng or betung. Investigations of the audio signal in the form of frequency spectrum were completed so as to decide the distinctions and likenesses of a tube zither and the gongs. The aftereffect of the audio signal in the form of frequency spectrum analysis between the gongs of Kupuo Saba and the principle *pratuokng* (see Table 2) connotes both shared comparative resources of sounds, in particular, canang, satu, and tawak. Strikingly the *pratuokng* sounds one octave higher than the gong set, for instance, the canang, and the tawak and a variety of the satu-named strings of the *pratuokng*. It appears to be conceivable that these outcomes are because of the material of metal that reverberate more as a contrast with the resounding of the bamboo which is limited by the size of the bamboo nodes, in addition to the thickness of the strings of the *pratuokng*.
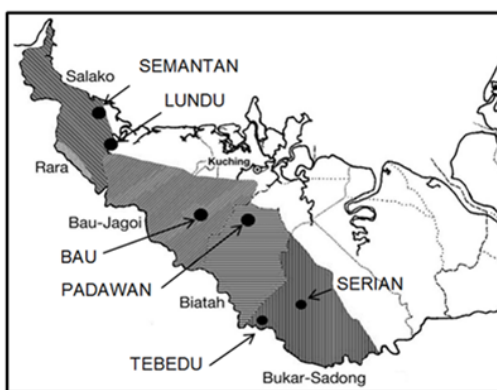

Figure 3. Map defined by language varieties of the Bidayuh and their sub-ethnic groups mostly inhabits the southern part of Sarawak (Rensch et al., 2006)

Table 2

The recorded gong set and a single pratuokng voices

Gong voices	Pitches	Frequencies	Pratuokng voice	Pitches	Frequencies
canang 1	G3+6 cents	196.69Hz	*canang* 1	G#4	422.24Hz
canang 2	F3-1 cents	174.50Hz	*canang* 2	F#4	368.09Hz
canang 3	A#4-39 cents	455.76Hz	*canang* 3	D#4	315.51Hz
satuk 1	D3+8 cents	146.13Hz	*satu* 1	C#4	283.79Hz
satuk 2	A#2 +36 cents	119.05Hz	*satu* 2	C4	255.43Hz
satuk 3	G2 +48 cents	100.77Hz	*satu* 3	-	-
tawak 2	A2 -1 cents	109.89Hz	*tawak* 2	G#3	207.72Hz
tawak 1	A2 -19 cents	108.76Hz	*tawak* 1 (DRUM TOUNGE)	G#3	207.72Hz

Pratuokng as Substitution for the Gongs of the Bidayuh

A meeting was set up with Arthur Borman, age 52, a *pratuokng* musician in early February 2017 (see Figure 4) concerning this issue. Arthur affirmed that the *pratuokng* will be utilized as a substitution, particularly if there was a demise or newborn in the group of the kupuo. Playing the gong will also bring misfortune, he added. Other fascinating realities that Arthur said was,

"If there are insufficient players to play the gong set, the *pratuokng* will be an option" (see Figure 5).

From the point of view of the social setting of the Bidayuh Biatah in Annah Rais, the substitution of the gong set a clear path for the *pratuokng* to be acknowledged and valued by the younger generation, as opposed to towards a regularizing framework that is utilized and educates by the more seasoned age of the Bidayuh

Figure 4. Arthur Borman on *pratuokng* accompanied by *gaduak,* a single headed drum played by Pola at the awah of Kupuo Saba, Annah Rais, Padawan, Sarawak (Photo by Ahmad Faudzi Musib)

Figure 5. Arthur Borman (right) leading the *pratuokng* ensemble namely Madeeh (Photo by Ahmad Faudzi Musib)

in Annah Rais (see Figure 6). The list of musical repertoire title of the *pratuokng* pieces that offer a comparative collection of the gong music are *Pingadap, Ti-tiek nunuo', Simangi Binua, Kangkuk, Tak taki' taup daka, Sinayietng, and Bua' jug.*

Developing a Concept of Reconstructing the *Pratuokng* Pieces through Frequency Modulation Sound Synthesis

In reconstructing a *pratuokng* piece back to the gong context, the 'Kangkuk' musical piece for *pratuokng* was chosen to simulate the experiment. Through the realization of gong-like timbre via synthesizer audio modulation techniques called Frequency Modulation, the musical piece for *pratuokng* will be transformed back to the gong sets. Promotion of acoustic or ethnic instruments through sound synthesis is an ongoing process. Starting from the RCA modular synthesizer invented by Harry Olsen and Hebert Belar, electronic engineers and employee of RCA's Princeton Laboratories, that was able to generate and manipulate

Figure 6. Historical photo of the gong played by three people (Ethnology Department, Sarawak Museum).

multiple geometric waveforms in the 1950s, to the current digital synthesizer that is able to generate presets of three ethnic races of Malaysia, namely Malay, Chinese and Indian. The sole intention of the current study is to develop a concept of reconstructing the *pratuokng* pieces through a frequency modulation sound synthesis able to experience a simulation of the *pratuokng* piece in a gong-like timbre. Carrying out the approach of 'perspectivism' in sound naturalness and the exploration of acoustical sound experience and replicate through synthesis parameter controls through technical tools and methods as a concept, the design yields effective sound experience within acoustic properties such summing sine wave at odd order harmonics. During re-examination of the tube zither music, the tunes and additionally cadenced examples played on each sound radiator (strings) of the *pratuokng* were extricated. The melodic parts from the extraction are appointed to every melodic piece of the 'gong set'. These 'gongs' are then played through a plan of 'metal-like' timbre produced by means of modulating frequency via Audio Modulation techniques. On a fundamental level, this step will create sidebands or non-harmonic partials. Regulating a source oscillator's frequency with a sound modulator will likewise deliver a timbre change (see Figure 6).

Two oscillators are involved, where there is the modulator that controls the frequency of another oscillator known as the carrier; subsequently, through these configurations sidebands are created. This
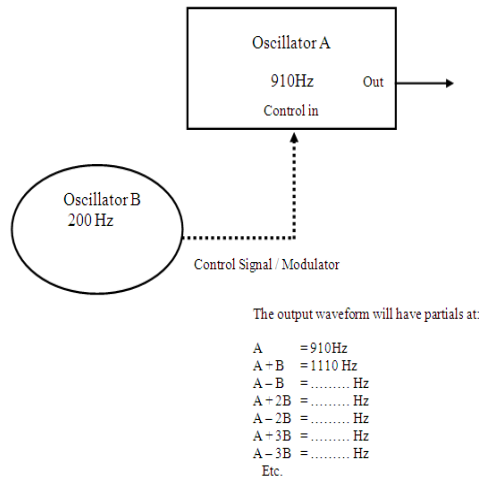
Figure 7. Block diagram defining two oscillators in audio modulation technique which were able to yield gong-like timbre (Block diagram by Ahmad Faudzi Musib)

Figure 8. 'Kangkuk,' a musical piece for *pratuokng* (Transcribed by Gisa Jähnichen, 2012)

makes it conceivable to 'recreate' the gong in light of the proportion of the modulator and the carrier. The sonic qualities are precisely broken down and outlined with the outcome that takes into consideration the re-enactment of gong music that used to be a *pratuokng* piece. In an excerpt of 'Kangkuk,' a musical piece for *pratuokng* (see Figure 8), transcribed by Jähnichen, it indicates that the *pratuokng* is replicating its performance in the gong context.

Marks show the distribution of rhythmic accents. The crosses indicate the possibility to use drum tongue or the tawak 1 of the *pratuokng* (Jähnichen, 2012). Jähnichen added, "After listening to this pattern for a while, the rhythmic structure turns into another shape by identifying the tawak sound as an emphasized beat. The tawak is played by gently smacking or slapping the drum tongue with the performer's left hand. The way to play both *pratuokng* seems to be clearly derived from the way to play a gong set accompanied by drum" (Jähnichen, 2012).

Taken together, these results suggest that the sound design via realization of FM synthesis of a tawak-like timbre should
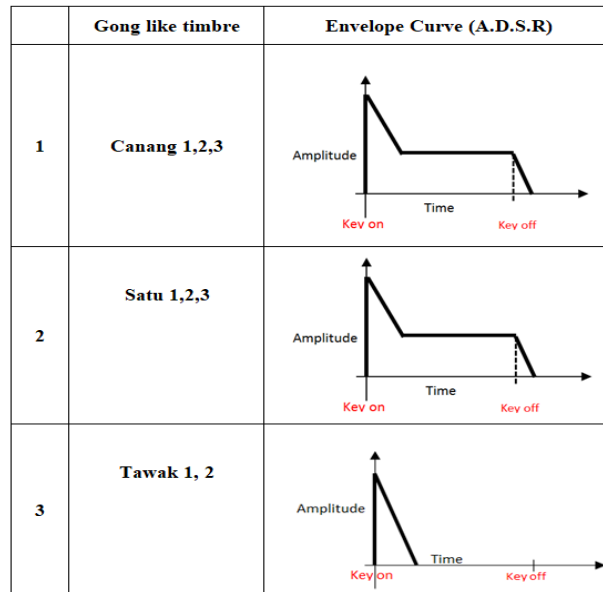
	Gong like timbre	Envelope Curve (A.D.S.R)
1	Canang 1,2,3	
2	Satu 1,2,3	
3	Tawak 1, 2	

Figure 9. The proposed envelope curve setting for the gong-like timbre set.

include a modifier (envelope generator) into the design. This enables the output to be replicated to a 'short sounding' drum-like shape. Manipulating the ADSR (Attack, Decay, Sustain, and Release) parameters will enable a user to shape the canang, satu and tawak-like timbre output accordingly (see Figure 9).

CONCLUSION

The substitution in instrumentations as shown in the case of the gong set with the aguokng tarikng (bamboo gong) was based on culturally substantiated similarities of sound radiators. Creating the gong sound played back by *pratuokng* and making it audible through another sound engine can contribute to the sound experience of gong music through simulation of sound synthesis. The realization of gong sound via audio modulation creates an experience to future generation listeners of the Bidayuh Biatah in Annah Rais of what was once heard by their community in the past. These processes are not much different from the historical example of substituting an acoustic piano by an integrated synthesizer that plays the piano sound patches without having the hassle of tuning it, moving it around, and placing it accordingly. Using the above scenario, the present sound patches such as the Japanese wind instrument, shakuhachi and its musical phrase in the form of sound samples have been used by many hardware or software synthesizers. This practice has been slowly and sonically accepted in cultures without piano or the shakuhachi tradition. Though the advances in electronic instrumentations are able to overcome undesirable attributes of traditional instruments, perhaps this can

be an approach in collecting and preserving the sound as well as the musical pattern or phrase played by the Bidayuh as a form of preserving and promoting documentary heritage.

ACKNOWLEDGEMENT

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