Jurnal Sains dan Teknologi
Volume 11 Number 2, Tahun 2022, pp. 229-237
P-ISSN: 2303-3142 E-ISSN: 2548-8570
Open Access: https://doi.org/10.23887/jstundiksha.v11i2.53176

Gamelan Data Repository: The Implementation of Information and Communication Technology Preserving the Balinese Traditional Musical Orchestra

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ARTICLE INFO

Article history:
Received May 22, 2022
Revised May 29, 2022
Accepted Agustus 14, 2022
Available online October 25, 2022

Kata Kunci:
Penyimpanan Data, Orkestra Bali, Digitalisasi Nada Standar

Keywords:
Data Repository, Balinese Orchestra, Digitalization Of Standard Tones

ABSTRAK

Pengetahuan untuk membangun orkes Bali diturunkan dari generasi ke generasi dalam klan, orkestra di seluruh pembuat dan di seluruh wilayah di Bali menunjukkan perbedaan nada yang halus namun khas, yang dapat diubah ketika pengetahuan diturunkan secara manual. Penelitian yang bertujuan untuk mendigitalkan perbedaan perbedaan kreasi Orkestra Bali lintas marga pengrajin di Bali ini dilakukan sebagai upaya untuk melestarikan perbedaan unik yang dihasilkan oleh masing-masing marga melalui pengembangan prototipe sistem dan database untuk menyimpan nada dalam orkestra. set. Langkah-langkah perancangan untuk mencapai tujuan tersebut terdiri dari (1) menganalisis kebutuhan pelestarian Orkes Bali dan memetakan permasalahan yang dihadapi oleh perajin tradisional dalam mempertahankan nada baku; (2) merancang sistem pencatatan nada baku antar pengrajin di Bali, yaitu pengambilan sampel dua kelompok pengrajin terbanyak dari dua kabupaten yang diakui memiliki nada paling khas di Bali, yaitu Bali Selatan dan Bali Utara; (3) mengembangkan prototipe; dan (4) mengembangkan database Orkes Bali. Ketika database sudah siap, itu akan memberikan referensi bagi para pengrajin untuk membakukan set mereka sesuai dengan tradisi yang dimaksud sambil membuka kemungkinan luas penggunaan mulai dari evaluasi hingga penciptaan komposisi musik kolaboratif di seluruh media, sementara pada saat yang sama melestarikan standar. nada dalam penyimpanan digital.

ABSTRACT

As the knowledge to build Balinese orchestra are passed down from generation to another within the clan, the orchestras across makers and across areas in Bali show subtle but distinctive differences in their tones, which may be altered when the knowledge is passed down manually. Research aimed at digitalizing these distinct differences in the creations of the Balinese Orchestra across craftsmen clans in Bali is conducted as an effort for preserving the unique differences produced by the respective clans through the development of a system prototype and database for storing the tones in the orchestra sets. The steps design to attain these purposes comprised of (1) analyzing the needs of preserving the Balinese Orchestra and mapping the problems faced by traditional craftsmen in maintaining standard tones; (2) designing a system to record the standard tones among craftsmen in Bali, i.e. sampling two most two groups of craftsmen from two regencies recognized as having the most distinctive tones in Bali, namely South of Bali and North of Bali; (3) developing the prototype; and (4) developing the database of Balinese Orchestra. When the database is ready, it will provide a reference for craftsmen to standardize their sets according to the intended tradition while opening a wide possibility of uses ranging from evaluation to the creation of collaborative musical compositions across media, while at the same time preserving the standardized tone in digitalized storage.

1. INTRODUCTION

Gamelan has many kinds, such as Javanese gamelan and Balinese gamelan which are very different in character and sound of music (Gunawan et al., 2022; Widara & Muryana, 2022). Each gamelan also has various types of musical instruments, such as gongs, kempul, balungan, kenong, kendang, bonang (Gayatri et al., 2021; Permadi, 2021). During this time there are also differences in gamelan sound notation caused by several factors, including: (1) there is a difference in the way it is made, (2) testing the quality of gamelan sound notation using the ear of the maker himself. The factors above indicate the absence of standard standards in each note (Suprapto et al., 2019). Gamelan is made to have no standards in resonance, sound color, amplitude or frequency because gamelan is made manually by hand (Malau & Suyanto, 2020; Sa'adah et al., 2019). Gamelan makers set the tone of the instrument with their own feelings based on experience. So that the basic frequency of the gamelan becomes nonstandard (Ardana, 2021; Janurangga & Putra, 2022).

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Gong Kebyar is one of the Balinese Gamelan which includes Gamelan Anyar (Yoga, 2022). In Bali, there are two main forms of equipment and styles of gamelan gong kebyar, namely gamelan gong kebyar North Bali and gambelan gong kebyar South Bali (Santi et al., 2022; Sukadana et al., 2021). The two gamelan gong kebyar difference lies in the stature of the gangsa, where North Bali is in the form of a "penjain" blade and is pressed (Ardana, 2021; Gayatri et al., 2021), while South Bali uses the shape of the "kalorusuk" blade and is hung. In addition, North Bali Gambelan sounds louder than the sound of South Bali gambelan, although in the same line (Ardana, 2021; Suprapto et al., 2019). If you see the current conditions, gamelan is designed manually by the makers with their own feelings based on experience. The human sense of hearing can distinguish highs and lows of notes but cannot know for certain what kind of tone is heard by it. This is very important for a musician to know whether his musical instrument has produced the right notes.

However, today the alignment of gamelan is usually done by experts, that is only by using their intuition. Each gamelan produced has a difference in each tuner. Based on the problems mentioned above, the development of a database and prototype system to standardize gamelan (especially Gong Kebyar) is a very critical thing to do. Therefore, the problem raised in the first year (2019) of this research is "How is the Database Design and Development System and Prototype in the framework of Standardizing Balinese Gamelan?". The purpose of this research is to preserve one of the Balinese cultural heritages. The tone possessed in a set of Balinese gamelan will not change from time to time, although the creators keep changing..

2. METHOD

This research basically aims to design, develop, and evaluate software used to standardize Balinese gamelan. This system is expected to be one of the tools that can maintain Balinese gamelan as a cultural heritage. If this standardization process is not carried out, it is feared that there will be a shift in the tone of the Balinese gamelan from time to time. This is because, at present the creator or craftsman of gamelan in Bali only relies on his feelings or intuitions in creating gamelan products. To produce products and technology transfer in accordance with the objectives of this research proposal, this research is planned to consist of three phases, namely: (1) Planning and Development of Database and Prototype System for Balinese Gamelan Standardization, will be carried out in the first year (2019); (2) Implementation Phase, Institutionalization to establish the Balinese Gamelan Standardization Agency, and Policy Formulation to support the operational products produced, will be carried out in year II (2020); and (3) Product Evaluation and Improvement Phase will be carried out in year III (2021).

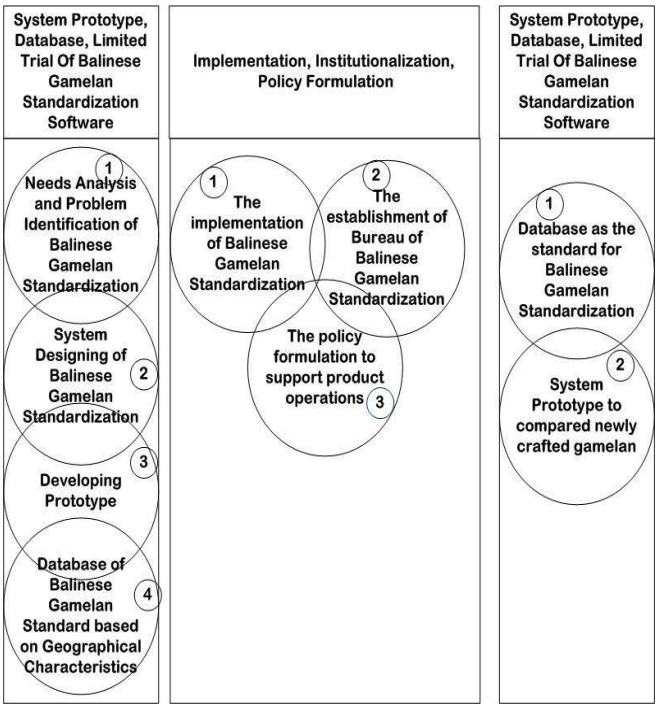

Figure 1. Stage of Research.

3. RESULT AND DISCUSSION

Result

Data Acquisition

The data uses a dataset from personal records consisting of 12 instruments of gamelan kebyar gong consisting of: *(1) ugal pengumbang, (2) ugal pengisep, (3) gangsa pengumbang, (4) gangsa pengisep, (5) kantil pengumbang, (6) kantil pengisep, (7) penyacah pengumbang, (8) penyacah pengisep, (9) jublag pengumbang, (10) jublag pengisep, (11) jegog pengumbang, and (12) jegog pengisep*. Recording is done with the OLYMPUS DIGITAL VOICE RECORDER VN-8600PC recorder with the recording location in a music studio to avoid outside noise.

Pre-processing Music Files

Pre-processing the music file, begins with a recording file that is edited using the Adobe Audition application that changes the appearance of the file into an audio spectrum, then takes a piece of music clip that is done manually by listening to a music file repeatedly then taking part of the song contained from "dong" up to "ding" or 10 tones. Furthermore, with the help of the Adobe Audition application to select each of these tones. Parts of each note are taken manually by utilizing the selection tools found in the Adobe Audition application, and the duration of clips for each note in the gamelan is determined on average from 6-10 seconds. The results of the music file clips are saved in .wav format with mono audio channel.

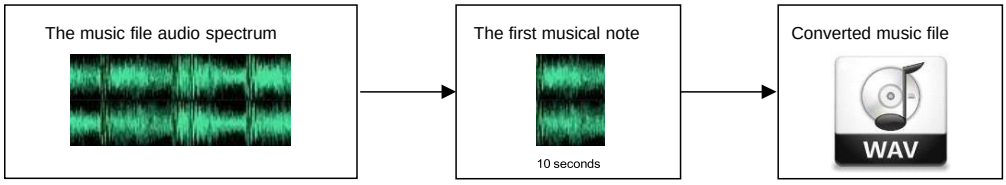

Figure 2. Preprocessing stages of music files

This mono audio channel format is used as input to the FFT process, because the FFT process in the system can only process one signal channel in mono format. Besides this mono format is a decrease in the number of channels / audio channels from the stereo format which has 2 channels, namely right and left, to take the average audio signal into one / mono channel. The dataset of each of the gong kebyar gamelan instruments is different in number depending on the number of blades or tones found in each gamelan instrument. Next is displayed the amount of data in each gamelan instrument gong kebyar.

Table 1. Scales Number of Blades of Each Gamelan Gong Kebyar

No	Instrument Name	Number of Strip	Tone	File Name
1	Ugal Pengumbang	10	*dong*	UU_01
			deng	UU_02
			dung	UU_03
			dang	UU_04
			ding	UU_05
			dong (tinggi)	UU_06
			deng (tinggi)	UU_07
			dung (tinggi)	UU_08
			dang (tinggi)	UU_09
			ding (tinggi)	UU_10
2	Ugal Pengisep	10	*dong*	UI_01
			deng	UI_02
			dung	UI_03
			dang	UI_04

No	Instrument Name	Number of Strip	Tone	File Name
			ding	UI_05
			dong (tinggi)	UI_06
			deng (tinggi)	UI_07
			dung (tinggi)	UI_08
			dang (tinggi)	UI_09
			ding (tinggi)	UI_10
3	Gangsa Pengumbang	10	*dong*	GU_01
			deng	GU_02
			dung	GU_03
			dang	GU_04
			ding	GU_05
			dong (tinggi)	GU_06
			deng (tinggi)	GU_07
			dung (tinggi)	GU_08
			dang (tinggi)	GU_09
			ding (tinggi)	GU_10
4	Gangsa Pengisep	10	*dong*	GI_01
			deng	GI_02
			dung	GI_03
			dang	GI_04
			ding	GI_05
			dong (tinggi)	GI_06
			deng (tinggi)	GI_07
			dung (tinggi)	GI_08
			dang (tinggi)	GI_09
			ding (tinggi)	GI_10
5	Kantil Pengumbang	10	*dong*	KU_01
			deng	KU_02
			dung	KU_03
			dang	KU_04
			ding	KU_05
			dong (tinggi)	KU_06
			deng (tinggi)	KU_07
			dung (tinggi)	KU_08
			dang (tinggi)	KU_09

No	Instrument Name	Number of Strip	Tone	File Name
			ding (tinggi)	KU_10
6	Kantil Pengisep	10	*dong*	KI_01
			deng	KI_02
			dung	KI_03
			dang	KI_04
			ding	KI_05
			dong (tinggi)	KI_06
			deng (tinggi)	KI_07
			dung (tinggi)	KI_08
			dang (tinggi)	KI_09
			ding (tinggi)	KI_10
7	Penyacah Pengumbang	7	*dung*	PU_01
			dang	PU_02
			ding	PU_03
			dong	PU_04
			deng	PU_05
			dung (tinggi)	PU_06
			dang (tinggi)	PU_07
8	Kantil Pengisep	7	*dung*	PI_01
			dang	PI_02
			ding	PI_03
			dong	PI_04
			deng	PI_05
			dung (tinggi)	PI_06
			dang (tinggi)	PI_07
9	Jublag Pengumbang	5	*ding*	JUU_01
			dong	JUU_02
			deng	JUU_03
			dung	JUU_04
			dang	JUU_05
10	Jublag Pengisep	5	*ding*	JUI_01
			dong	JUI_02
			deng	JUI_03
			dung	JUI_04
			dang	JUI_05
11	Jegog Pengumbang	5	*ding*	JEU_01
			dong	JEU_02

No	Instrument Name	Number of Strip	Tone	File Name
			deng	JEU_03
			dung	JEU_04
			dang	JEU_05
12	Jegog Pengisep	5	*ding*	JUI_01
			dong	JUI_02
			deng	JUI_03
			dung	JUI_04
			dang	JUI_05

Testing Result

The testing results for the standardization of Balinese gamelan use Adobe Audition application to determine the overall frequency (Hz) and also the musical notes of each bar in the Balinese gamelan device. From the comparative results of some Balinese gamelan instruments, the following is the result of Balinese gamelan standardization. The next stage that will be carried out is a focus group discussion (FGD) by inviting several experts / practitioners to clarify the sounds produced from each of the Balinese gamelan instruments.

Table 2. Testing Result For The Standardization of Balinese Gamelan Using Adobe Audition

No	Instrument Name	Number of Strip	Tone	File Name	Trial With Adobe Audition	
					Overall Frequency (Hz)	Musical Note
1	Ugal Pengumbang	10	*dong*	UU_01	194.35	G3-14cents
			deng	UU_02	54.47	A1-16cents
			dung	UU_03	152.79	D#3-31cents
			dang	UU_04	192.59	G3-30cents
			ding	UU_05	64.97	C2-11cents
			dong (tinggi)	UU_06	146.16	D3-7cents
			deng (tinggi)	UU_07	51.92	G#1+0cents
			dung (tinggi)	UU_08	54.18	A1-26cents
			dang (tinggi)	UU_09	136.37	C#3-27cents
			ding (tinggi)	UU_10	67.31	C2+49cents
2	Ugal Pengisep	10	*dong*	UI_01	60.93	B1-22cents
			deng	UI_02	63.89	C2-40cents
			dung	UI_03	58.67	A#1+11cents
			dang	UI_04	55.09	A1+2cents
			ding	UI_05	157.27	D#3+18cents
			dong (tinggi)	UI_06	107.59	A2-38cents
			deng (tinggi)	UI_07	187.89	F#3+26cents
			dung (tinggi)	UI_08	55.25	A1+7cents
			dang (tinggi)	UI_09	149.01	D3+25cents

No	Instrument Name	Number of Strip	Tone	File Name	Trial With Adobe Audition	
					Overall Frequency (Hz)	Musical Note
			ding (tinggi)	UI_10	104.71	G#2+14cents
3	Gangsa Pengumbang	10	*dong*	GU_01	148.66	D3+21cents
			deng	GU_02	54.82	A1-5cents
			dung	GU_03	52.24	G#1+10cents
			dang	GU_04	110.5	A2+7cents
			ding	GU_05	137.99	C#3-7cents
			dong (tinggi)	GU_06	149.95	D3-34cents
			deng (tinggi)	GU_07	104.13	G#2+5cents
			dung (tinggi)	GU_08	59.28	A#1+29cents
			dang (tinggi)	GU_09	138.68	C#3+1cents
			ding (tinggi)	GU_10	66.05	C2+17cents

Discussion

The first stage carried out in this study was to record the type of Balinese gamelan (Gong Kebyar) in accordance with its characteristics. This recorded data will be used in a Focus Group Discussion (FGD) involving practitioners, craftsmen, academics, local governments, and other related parties to determine the tone reference that will be used in the gamelan standardization\process. in the analysis of the next stage. One method used to determine the frequency of a signal is to use the Fourier Transformation Method (FFT) (Rakisheva & Mukanova, 2021; Setiawan, 2022). Fourier transforms aims to convert time-time sound signals into the frequency domain (Apoorva, 2021; Zhang & Ma, 2022). The result of a Fourier transformation is the frequency spectrum. This frequency spectrum states the composition of the frequency structure of a signal which will then become a frequency table (Dona et al., 2022; Kusuma, 2021). Making a frequency table using the FFT process for all possible tones. The basic frequency table is used as a reference in the analysis process.

By knowing the frequency of a note, you can tell which tone it came from. Adaptive filter Least Mean Square (LMS) is a digital filter that is able to adjust the filter parameters to the given signal using the least mean square adaptive algorithm (Eweda et al., 2021; Xu et al., 2021). So that this filter can be used to detect the frequency of various gamelan device signals. The adaptive digital filter system & MSE consists of several stages (Maghrabi et al., 2022; Riabukha et al., 2022). The first stage generates a reference signal. Then the filtering process is carried out between the blind signal and the reference signal. Blind signal is an input signal in the form of a gamelan device's sound signal used. From the filter results, we can calculate the MSE signal value. Mean Square Error (MSE) is one method of calculating the error value or error of a system (Aisah et al., 2022; Sa'adah et al., 2019). The process of adaptive digital filter system & MSE can be seen in Figure 3. Database that will be used as a reference in standardizing Balinese gamelan. Simultaneously a prototype system will be developed which will be used for the standardization process, which is a digital tone matching process between new gamelan produced by artisans and the Balinese gamelan standardization database. Furthermore, the MSE value of the signal is analyzed and compared to the frequency table, an approximate tone and device will be generated.

The availability of technology, both hardware and software in this study shows the harmony between technology and research activities that will be carried out. Therefore, to be able to carry out this research properly, the research team worked closely with the Bali Provincial Culture Office and practitioners who are Balinese gamelan craftsmen. The seriousness of the local government regarding the standardization of Balinese gamelan shows the importance and usefulness of the products to be produced

4. CONCLUSION

The analysis shows that there was a difference between the recorded Balinese gamelan tone with the standard gamelan tone stored in the repository. The tones being compared were specified for gamelan in southern Bali. It is worth mentioning that the difference may be affected by noise or preprocessing audio. Hence, an additional dataset is necessary for a better data repository. Besides, sound recording should be conducted in a soundproof room as well as improving the audio quality by conducting preprocessing audio.

5. ACKNOWLEDGE

This work was supported by the Indonesian Ministry of Education, Culture, Research, and Technology through the multi-years Applied Research Grant

6. REFERENCES

Aisah, S. S. N., Abdullatif, F., & Hartono, H. (2022). Identifikasi frekuensi bunyi gambang laras slendro gamelan Jawa menggunakan jaringan syaraf tiruan pada Matlab. *Jurnal Teras Fisika: Teori, Modeling, Dan Aplikasi Fisika*, *5*(1), 273–282. https://doi.org/10.20884/1.jtf.2022.5.1.5816.

Apoorva, K. S. (2021). Design and Analysis of Synthesizable RTL Verilog For Discrete Fourier Transformation Using FFT. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(12), 2372–2379. https://www.turcomat.org/index.php/turkbilmat/article/view/7828.

Ardana, I. K. (2021). Re-Actualization Balinese Gamelan Harmony for Renewal Knowlegde of the Balinese Music. *International Journal of Creative and Arts Studies*, *8*(1), 51–69. https://doi.org/10.24821/ijcas.v8i1.5514.

Dona, K., Liu, J., Kurinsky, N., Miller, D., Barry, P., Chang, C., & Sonnenschein, A. (2022). Design and performance of a terahertz Fourier transform spectrometer for axion dark matter experiments. *Journal of Instrumentation*, *17*(6). https://doi.org/10.1088/1748-0221/17/06/P06014.

Eweda, E., Bershad, N. J., & Bermudez, J. C. (2021). Stochastic analysis of the diffusion least mean square and normalized least mean square algorithms for cyclostationary white Gaussian and non-Gaussian inputs. *International Journal of Adaptive Control and Signal Processing*, *35*(12), 2466–2486. https://doi.org/10.1002/acs.3334.

Gayatri, A. A. A., Dewi, A. A. S. L., & Suryani, L. P. (2021). Perlindungan Hukum Atas Hak Kekayaan Intelektual Karya Seni Musik Gamelan Bali. *Jurnal Preferensi Hukum*, *2*(2), 371–376. https://doi.org/10.22225/jph.2.2.3340.371-376.

Gunawan, I., Milyartini, R., & Masunah, J. (2022). The Use of Laras in Contemporary Gamelan Music. *Harmonia: Journal of Arts Research and Education*, *22*(1), 161–173. https://doi.org/10.15294/harmonia.v22i1.35483.

Janurangga, I. K., & Putra, I. W. D. (2022). Gamelan dan Energi" Karya Musik Baru Untuk Gamelan dan Perangkat Elektronik. *Jurnal Riset Dan Pengabdian Masyarakat*, *2*(1), 73–90. https://journal.ar-raniry.ac.id/index.php/jrpm/article/view/1257.

Kusuma, D. T. (2021). Fast Fourier Transform (FFT) Dalam Transformasi Sinyal Frekuensi Suara Sebagai Upaya Perolehan Average Energy (AE) Musik. *PETIR*, *14*(1), 28–35. https://stt-pln.e-journal.id/petir/article/download/1022/749.

Maghrabi, M. M., Bakr, M. H., & Kumar, S. (2022). Adaptive digital back propagation exploiting adjoint-based optimization for fiber-optic communications. *Optics Express*, *30*(10), 16264–16288. https://doi.org/10.1364/OE.453640.

Malau, P. J. A., & Suyanto, Y. (2020). Sintesis Taganing Adaptif Menggunakan Metode Pitch Shifting by Delay-Line Based untuk Standardisasi Gondang Batak Toba. *IJEIS (Indonesian Journal of Electronics and Instrumentation Systems)*, *10*(2), 131–142. https://doi.org/10.22146/ijeis.37659.

Permadi, I. B. H. Y. (2021). Adaptasi Pengembangan Pola Kotekan Gamelan Bali dalam Permainan Gitar Klasik. *Journal of Music Science, Technology, and Industry*, *4*(2), 293–305. https://jurnal.isi-dps.ac.id/index.php/jomsti/article/view/1799.

Rakisheva, D. S., & Mukanova, B. G. (2021). Fourier Transformation method for solving integral equation in the 2.5 D problem of electric sounding. *Journal of Physics: Conference Series*, *2092*(1). https://doi.org/10.1088/1742-6596/2092/1/012018.

Riabukha, V. P., Semeniaka, A. V., Katiushyn, Y. V., & Atamanskiy, D. V. (2022). Protection of Coherent Pulse Radars against Combined Interferences. 3. ALF-Based Digital Adaptive System of Sequential Protection of Programmed Surveillance Radars against Combined Interference. *Radioelectronics and Communications Systems*, *65*(2), 72–80. https://doi.org/10.3103/S0735272722020029.

Sa'adah, M., Wulandari, D. P., & Suprapto, Y. K. (2019). Identical Instruments Detection using Least Mean

Square Based Adaptive Filter. *Journal of Physics: Conference Series*, *1201*(1), 012013.

Santi, N. P. I. K., Indrawan, I. N., Dewi, I. A. A. C. S., Danggur, M. D. S. D. A., & Adipurwa, A. A. T. A. (2022). Penerapan Metode Fonik dan Biblioterapi untuk Meningkatkan Kemampuan Peserta Didik dalam Menabuh Gamelan di Sanggar Seni Shanti Werdhi Gita. *Abdi Widya: Jurnal Pengabdian Masyarakat*, *1*(1), 1–9. https://jurnal2.isi-dps.ac.id/index.php/abdiwidya/article/view/886.

Setiawan, A. (2022). Estimation of Sound Source Direction Using Fourier Transformation Method with Arduino. *JTECS: Jurnal Sistem Telekomunikasi Elektronika Sistem Kontrol Power Sistem Dan Komputer*, *2*(2), 111–122. https://doi.org/10.32503/jtecs.v2i2.2771.

Sukadana, I. W., Juniarta, I. K. A., & Winyana, I. N. (2021). Metode Pembelajaran Gamelan Selonding Pada Sekaa Gong Sabha Winangun, Dalam Siatuasi Pandemi Covid-19. *WIDYANATYA*, *3*(2). https://doi.org/10.32795/widyanatya.v3i2.2120.

Suprapto, Y., Yuniarno, E. M., & Fithri, K. (2019). Gamelan Notation Generating Using Band Pass Filter for Saron Instrument. *2019 International Conference on Computer Engineering, Network, and Intelligent Multimedia (CENIM)*, 1–6.

Widara, A., & Muryana, I. K. (2022). Pelegongan Music Composition "Kasmaran| Komposisi Gamelan Pelegongan "Kasmaran." *GHURNITA: Jurnal Seni Karawitan*, *2*(3), 165–172. https://jurnal2.isi-dps.ac.id/index.php/ghurnita/article/view/458.

Xu, L., Ding, F., & Zhu, Q. (2021). Decomposition strategy-based hierarchical least mean square algorithm for control systems from the impulse responses. *International Journal of Systems Science*, *52*(9), 1806–1821. https://doi.org/10.1080/00207721.2020.1871107.

Yoga, A. A. P. (2022). New Creation Music Jaladi Merta Ayu| Tabuh Kreasi Baru Jaladi Merta Ayu. *GHURNITA: Jurnal Seni Karawitan*, *2*(2), 134–141. https://jurnal2.isi-dps.ac.id/index.php/ghurnita/article/view/466.

Zhang, C., & Ma, W. (2022). Fast Fourier Transformation Computation of Modal Transfer Function for Rotating Source Localization. *AIAA Journal*, *60*(5), 3352–3356. https://doi.org/10.2514/1.J061179.