

Aligner Tones Software Improve Measurement Precision In The Process of Balinese Gamelan

Sudarma, Made¹, Ariyani, Sri², Adiputra, Nyoman³

¹Computer System and Informatics, Department of Electrical Engineering, Udayana University, Bali, Indonesia

²Applied Electronics, Department of Electrical Engineering, Udayana University, Bali, Indonesia

³Department of Physiology, Faculty of Medicine, Udayana University, Bali, Indonesia

Article Info

Article history:

Received Sep 21, 2012

Revised Nov 29, 2012

Accepted Dec 23, 2012

Keyword:

First keyword : *Software*

Second keyword: *Human tester*

Third keyword: *Measuring tones*

Fourth keyword: *Gamelan tone*

Fifth keyword

ABSTRACT

In the making process of Balinese gamelan, the tone arrangement highly depends on aligner sense and feeling which generally performed by the gamelan's craftsman himself. Each aligner has his way of aligning with different standard of tone. Tunings process is still based on the sensitivity of the ear and the feelings of the gamelan craftsmen so that the precision of tone can not be achieved. The unavailability of a standard measuring instruments tone used in the tuning process lead to the production process gamelan in Bali takes a long time. To solve these problems, a study conducted by utilizing information technology in the computer - software engineering approach. Besides, to anticipate the limitation of human resources in the field of alignment and to maintain the consistency of the gamelan's tone in the long period of time it is in need for the touch of information technology in the form of software. The software to analyze the frequency of gamelan's base tone in order to get the result of the tone in the strip of gamelan which is measurable and in accordance with the expectation. The software is intended will be able to perform the test tone as desired by the buyer. Thus the tone of the achievements obtained quickly, accurately correspond to the reference tone. It also means that the program contributed significantly to the preservation of Balinese culture can be done.

Copyright © 2013 Institute of Advanced Engineering and Science.
All rights reserved.

Corresponding Authors:

Made Sudarma

Computer System and Informatics, Department of Electrical Engineering

Faculty of Engineering, Udayana University, Bukit Jimbaran Campus, Bali, Indonesia

Tel./Fax : 62361703315, e-mail: sudarma@ee.unud.ac.id

1. INTRODUCTION

The arrangement of gamelan's tone does not have a fix and certain standard. The arrangement highly depends on the aligner's sense and feeling who generally carried out by the craftsman himself. Each of gamelan craftsman has the different way of aligning and each has the certain tone standard [2][18]. In performing his activities, the aligner has not been in the natural manner position, so that highly risk of illness because of work. The limitation of the skillful aligners also has an impact to the process of the finishing of the Bali's gamelan [11], [12].

To produce a set of Balinese gamelan needs approximately 11 months [8], [13]. This is because the process of the making or the equipment use is still traditional and the limitation of human resources in the tester field to determine the adjustment of basic tone of gamelan. Thus means the adjustment measurement tool of gamelan tone which is required is very important to prepare.

The working posture like Figure 1 will cause to raise various disorders on the musculoskeletal system [5]. The sitting position in long time with un-natural working posture or bending cause disorder on the musculoskeletal system and there is a quite much pressure on the discus intervertebralis so it can cause low back pain. This working posture in long term will cause body to bend (kiposis) [4], [10].



Figure 1. The conventional tone assessment process

From the description above it can be stated that the biggest problem happen on the adjustment process, so this process needs to have priority to be solved first. Alternative way to solve the problem in this process is by using aid tool so the adjustment that is done manually and repeatedly will no longer happen. Moreover, more than 30% of the skillful workers who still actively working as the gamelan's aligners are in the age of 60 years and older and nearly 90% of the aligners having a deaf in one or both of their ears, that is the conduction deaf and sensorineural deaf [15]. The loss of the hearing is as the result of the noise exposure which takes place repeatedly in the long period of time. This condition will have an impact to the tone accuracy outcome. Even, with the development of technology and globalization not many of the young generation nowadays who wants to involve as the gamelan craftsman especially as the aligner. This is very worrying to the continuation and sustainability of the availability of the Bali's gamelan in the future.

To anticipate the limitation of the human resources in the field of aligning and to maintain the consistency of the gamelan tone in the long period of time it is deemed necessary for the touch of information technology in the form of software. The software is designed as the software for analyzing the basic tone frequency of gamelan with the function as the gamelan strip tone measurement with reference to the fix reference tone.

Figure 2 shows the work process of software tester, starting from the data source (input) continued to the computer and information is processed by software and next the result (output) in the form of information needed by the user [14]. Ergonomic intervention on the small industries by using ergonomic chair and table will decrease working load and subjective complaint, and also increase working productivity significantly [1],[17]. As ergonomic implementation on the small industries, it is also done the betterment of work station in this research so the working posture of the tester is become more natural.



Figure 2. Assessment of the tone by using the software

Based on the problem mentioned above, to achieve the expected result then software is designed to measure the tone as the substitution of the aligning sense of hearing in assessing the strip tone which leads to the change of work attitude. The objective of the research is to find out the increasing performance of Bali's gamelan tone alignment after using the software design.

2. RESEARCH METHOD

The research is the experimental research by using the same subject design which can be seen at Figure 3.

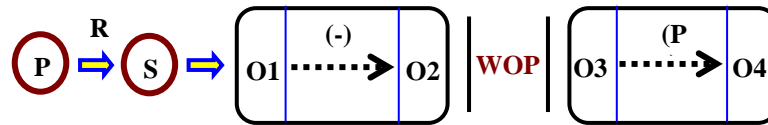


Figure 3. The Research Design [3]

Description:

- P : Population (the aligners who are included in the inclusion criteria).
- R : Random Sampling with simple random method.
- S : Sample (who are chosen to be the research sample after random sampling).
- O1 : Sample observation prior to work at first period.
- O2 : Sample observation after work at first period to the time for aligning, accuracy, satisfaction, and work productivity.
- (-) : Without software design samples are working with work condition available to date.
- (P) : With software design and workstation redesign. Samples are working with the software. Measurement conducted 3 days consecutively.
- WOP : Washing Out Period to clear up residual effect given for 3 days period, where the work process between (-) and (P) is the same, that is in the morning, so that psychologically the work environment will be similar between the first period and the second period. The selection of 3 days WOP is based on the consideration to give enough adaption time in addition to clear up residual effect.
- O3 : Sample observation prior to work at second period.
- O4 : Sample observation after work at second period to the work time for aligning, accuracy, satisfaction, and work productivity.

The research protocol with the procedure is as follows: Stage 1 – aligning process prior to use software. The aligner works with the conventional manner and determine the tone accuracy with the hearing sense with the process as follows: (a) fill in the initial measurement; (b) conduct the tone assessment on the gamelan's strip which will be aligned using the hearing sense and conventional work manner; (c) to conduct the tone and time recording every assessment stage until the aligner getting the tone he wishes; (d) to conduct the recording of frequency attainment each stage of the tone assessment to find out the level of tone accuracy that assessed with the ear sensitivity; (e) fill in the questionnaire form aligner's satisfaction questionnaire. Washing Out Period is provided for one week period including the time for equipment usage adaptation, software. In this period it is provided with assistant in the process of tool's operation. Stage 2 – aligning process with software and the tone accuracy measured by software, with the prose performed as follows: (a) fill in the initial measurement form; (b) to conduct the tone assessment on the gamelan's strip that will be aligned using software; (c) to conduct the tone and time recording every level of assessment until the aligner getting the desired tone; (d) to conduct the recording of frequency attainment every stage of tone assessment to find out the level of tone accuracy that assessed by software; (e) fill in the level of questionnaire form and the aligner's satisfaction questionnaire.

3. RESULTS AND ANALYSIS

Computer software is the program used to match the gamelan's instrument tone used as the tested tone with gamelan's instrument tone that used as the basic reference. The program consists of several functions packed in several modules to get the matching outcome. The data analysis conducted by the way as follows: (a) descriptive analysis; (b) normality test by using Shapiro-Wilk test; (c) accuracy, productivity, satisfaction were analyzed using t-paired test. Data is processed using SPSS for Windows version 16.0 program.

3.1. Tones Accuracy

The assessment accuracy of gamelan's tone aligner is the level of result proximity achieved to the tones which the quality is assessed or counted. Thus the output from the aligner is compatible with the degree of truth that expected. Based on the result of the study it is found out that the average of accuracy level at first period is $94.60 \pm 0.83\%$ and the average at second period is $97.93 \pm 0.96\%$. The meaning analysis with t-paired test shows that both groups after treatment, the average of the tone accuracy level differs significantly ($p < 0.05$). Table 1 bellow is shows the result comparisons between accuracy, work productivity, and satisfaction.

The increasing of the accuracy level by 4.26% after using computer software is due to when in the process of reference tone alignment the frequency is already known, so that easily to bring closer the aligned strip frequency with reference tone frequency.

Table 1. The Comparison of the Accuracy, Work Productivity and Satisfaction Between First Period and Second Period

Variabel	Period		p
	Period I	Period II	
The accuracy (%)	$94,60 \pm 0,83$	$97,93 \pm 0,96$	0,001
Work productivity (bars / beats)	$0,382 \pm 0,034$	$0,543 \pm 0,052$	0,001
Satisfaction (score)	$16,87 \pm 1,06$	$23,40 \pm 0,91$	0,001

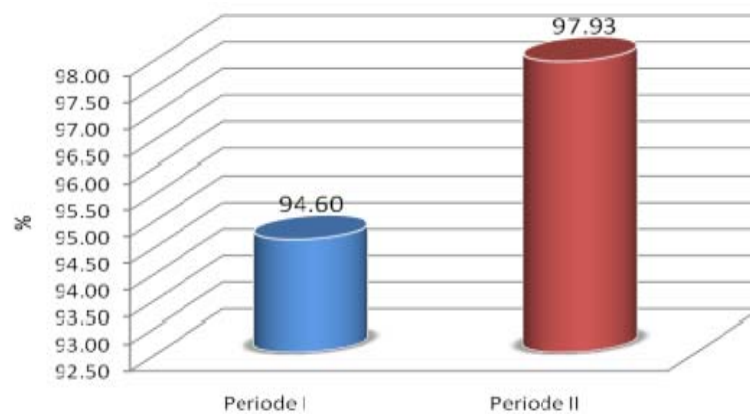


Figure 4. The Accuracy between First Period and Second Period

3.2. Work Productivity

The productivity basically is the outcome from all the activity components. In this research the productivity is counted based on the amount of strips that can be aligned in one working hour divided by working pulses multiplied by 1 working hour. Based on this study it is found out that the average of working productivity at first period is 0.382 ± 0.034 strip/ pulse and the average at second period is 0.543 ± 0.052 strip/pulse. The meaning analysis with t-paired test shows that both groups after treatment, the average of the productivity differs significantly ($p < 0.05$). Further it is found out that there is the increasing of productivity by 29.63%. The increasing of worker's productivity and suppressing the high cost is one of the advance steps to win the global competition such as to make use of the human resources and suppress all kind of costs but increase the optimal production output. Suppress the cost as small as possible such as the cost required to pay the health benefits and sickness rehabilitation due to working, accident and injury. This can be done by developing the working condition and environment that is healthy, safe, and comfortable. In other words is that by implementing work effectiveness such as selecting and transferring the technology which is highly efficient.

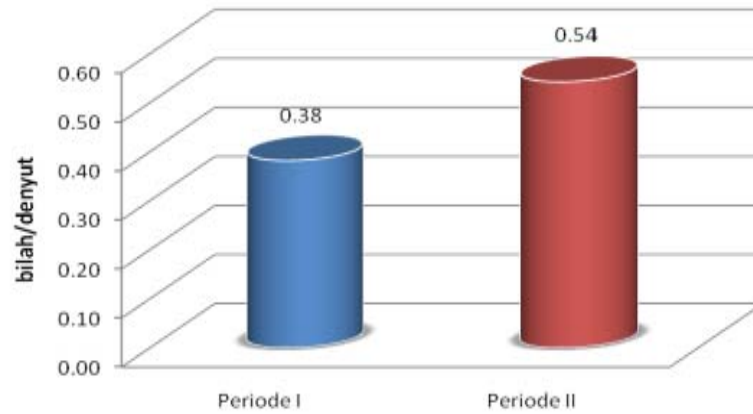


Figure 5. The work productivity between First Period and Second Period

Technology advancement is one of the factors that determine work productivity since it will simplify the workers in making the proper goods or services. The result of the study is in line with the result who stated that the usage of the chair and working table that compatible with the workers' anthropometry can increase the work productivity by 16.87% ($p < 0.05$) for the Palimanan's rock rooster sculptures at Mahkota corporation Bali [16]. So is the research also stated that the development of chair dimension and the height of suitable working space with the anthropometry of brick makers can increase the work productivity of the brick makers by 167.25% [7].

3.3. Satisfaction

The increase of satisfaction score by 27.91% due to the time needed is shorter than previous working time, the level of accuracy also increasing, so is the work effectiveness also improve the satisfaction for the aligners. Basically the assessment satisfaction is the individual thing. But in this case the software is built based on the rules or criteria in the Bali's gamelan tones. The degree of satisfaction towards the assessment of a gamelan aligning is not individual by nature anymore but already in the frame of reference in the gamelan's tones pitch.

This research is supported by the result of study who stated that there was an information system quality impact to the satisfaction of the accounting software end users significantly [19]. Differ from the result of study by who stated that the organization commitment, interaction and motivation together with professional commitment interaction and motivation individually or collectively did not have the impact significantly with the work satisfaction at the Office of Jakarta Audit Internal Education Foundation [20].

Satisfaction is also affecting the persistence of aligners in doing their activities. The aligners with high satisfaction tend to work with high spirit. The quality of work and the outcome that can be achieved by the satisfied people with their working outcomes will create the satisfaction also to the user of the product, in this case is Bali's gamelan set. Work satisfaction is the wish of everybody. Someone who satisfied will cause better health compared to the disappointed people [9]. Satisfaction also related with the feeling of safety and comfort.

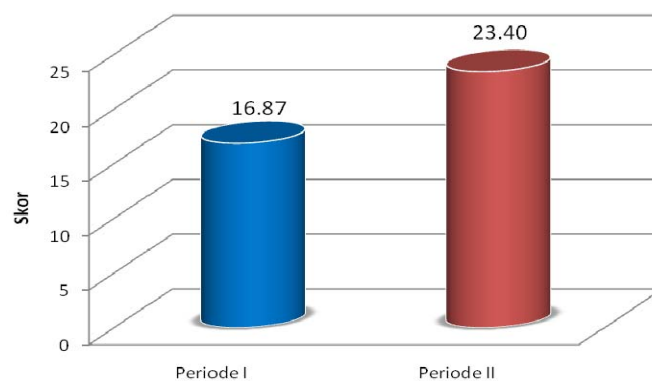


Figure 6. The satisfacton between First Period and Second Period

4. CONCLUSION

Based on the result and discussion mentioned above, so it can be concluded that aligner tones software measurement precision in the alignment tones process through: the improvement of assessment accuracy of Bali's gamelan aligners; the improvement of work productivity of Bali's gamelan aligners; and the improvement of assessment satisfaction of Bali's gamelan aligners

ACKNOWLEDGEMENTS

A great appreciation goes to promoter, co-promotor and everybody who has made valuable contributions in this study and their critical comments on this manuscript.

REFERENCES

- [1] Adiputra, N.; Sutjana, D.P.; Suyasning, H.I.; Tirtayasa, K. (2001). "Gangguan Muskuloskeletal Karyawan Beberapa Perusahaan Kecil di Bali". *Jurnal Ergonomi Indonesia*. Vol.1 No.1 Juni: 6-9.
- [2] Arifin I. 2000. Perangkat Pengklasifikasi Sumber bunyi Berbantuan Spectrum Analyzer Dan Jaringan Syaraf Tiruan, *Proceeding Komputer dan Sistem Intelijen (KOMMIT2000)*, Jakarta 23-24 Agustus 2000, [cited 2012 May 10]. Available from: https://docs.google.com/viewer?a=v&q=cache:q7XFEjBsnoIJ:repository.gunadarma.ac.id:8000/1377/1/Kommit2000_komunikasi_005.pdf
- [3] Colton, T. 1985. *Statistika Kedokteran*. Diterjemahkan oleh Rossi Sanusi. Yogyakarta: Gadjah Mada University Press.
- [4] Grandjean, E. 2000. *Fitting The Task To The Man. A textbook of occupational Ergonomics* 4th ed. London: Taylor & Francis.
- [5] Manuaba, A. 2000. Beban Tugas untuk Prajurit Dikaitkan dengan Norma Ergonomi di Indonesia. *Seminar Nasional Ergonomi di Lingkungan ABRI*. Jakarta: 20 Pebruari.
- [6] Manuaba, A., 2006, *Ergonomics is a Must to Face Global Competition in Hotel Business*. Taiwan: Pan Pacific Conference on Occupational ergonomics.
- [7] Nuada, I W. 2005. Perbaikan Dimensi Tempat Duduk dan Ketinggian Bidang Kerja Dapat Mengurangi Keluhan Muskuloskeletal dan Meningkatkan Produktivitas Kerja Pembuat Batako di Desa Mengwi Kabupaten Badung (Tesis). Denpasar: Program Pascasarjana Universitas Udayana.
- [8] Pager, I Wayan. 2009. Transkripsi wawancara dengan perajin gamelan Bali. Gianyar: Blahbatuh, 3 September 2009.
- [9] Parasuraman, A. Zeithaml, V. A. & Berry, L.L. 1988. Servqual : A Multi-item Scale for Measuring Consumer Perceptions of Service Quality. *Journal of Retailing*. 64 (1), p. 12-40.
- [10] Pheasant, S. 1991. *Ergonomic Work and Health*. London: MacMillan Academic Profesional Ltd.
- [11] Rai, 2001. Ngumbang Ngisep Pada Sistem Pelarasan Gamelan. ISI Denpasar: Mudra pp. 5-7
- [12] Rembang, I Nyoman. 1985, Hasil Pendokumentasian Notasi Gending-Gending Lelambatan Klasik Pegongan Daerah Bali. Denpasar: Departemen Pendidikan dan Kebudayaan. pp.8-9
- [13] Suandiyasa, G. 2012. Transkripsi wawancara dengan penyelaras gamelan Gong Yuda, Desa Tihingan, Klungkung. 21 Pebruari 2012.
- [14] Sudarma, M., 2010. *Kecerdasan Buatan*, Udayana Press, ISBN: 978-979-8286-71-1
- [15] Sudarma, M., 2011. Penelitian pendahuluan perajin gamelan, *unpublish*
- [16] Suputra, I G.N.B. 2003. Pemakaian Tempat Duduk dan Meja Kerja Mengurangi Keluhan Muskuloskeletal dan Meningkatkan Produktivitas Kerja Pemahat Roster Batu Padas Palimanan di Perusahaan Mahkota Bali (Tesis). Denpasar: Program Pascasarjana Universitas Udayana.
- [17] Titin, I. O. 2010. "Intervensi Ergonomi pada Proses Stamping Part Body Component Meningkatkan Kualitas dan Kepuasan Kerja Serta Efisiensi Waktu di Divisi Stamping Plant PT. ADM Jakarta" (Disertasi). Denpasar: Program Pascasarjana Universitas Udayana.
- [18] Wibowo A. 2007. Pengaruh Tegangan Sisa terhadap Frekuensi Nada Dasar Perunggu. *Seminar Nasional Teknologi 2007 (SNT 2007) ISSN : 1978 – 9777*
- [19] Wijanto dan Istingsih. 2011. *Pengaruh Sistem Informasi terhadap Kepuasan Pengguna Akhir Software Akuntansi*, [cited 2012 January 26]. Available from: <http://www.freejournalresearch.com/2011/11/pengaruh-kualitas-sistem-informasi.html>
- [20] Wijayanti, D. 2011. Pengaruh Komitmen terhadap Kepuasan Kerja Auditor Internal, [cited 2012 March 25]. Available from: <http://www.freejournalresearch.com/2011/10/pengaruh-komitmen-terhadap-kepuasan.html>