

JAVANESE MUSIC GAMELAN IDENTIFICATION BASED ON GRAY LEVEL COOCURRENCES MATRIX (GLCM) FEATURES EXTRACTION OF SPECTOGRAM IMAGE

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JAVANESE MUSIC GAMELAN IDENTIFICATION BASED ON GRAY LEVEL COOCURRENCES MATRIX (GLCM) FEATURES EXTRACTION OF SPECTOGRAM IMAGE

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Certificate

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as a Presenter

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Nancy E. Chapman, Ph.D



Semarang, 30 October 2019

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Program Book

*International Conference on
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Opportunities and Challenges in Southeast Asia*



*Soegijapranata
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October 29 - 30, 2019*

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GROUP	NAME, AFFILIATION, EMAIL	PRESENTATION TITLE
	Mr. Putu Chris Susanto Dhyana Pura University, Indonesia <i>chris.susanto@undhirabali.ac.id</i>	Enhancing Classroom Interaction through Self-Disclosing Social Media Posts
	Ms. Monica Ella Harendita (First Author), Mega Wulandari, and Vittalis Ayu Sanata Dharma University, Indonesia <i>meharendita@usd.ac.id</i>	Are we ready yet to flip our classes? Analysis on students' and lecturers' use of technology
Group 11	Mr. Vinno Christmantara Widya Karya Catholic University, Indonesia <i>vinno@widyakarya.ac.id</i>	Javanese Music Gamelan Identification Based on Gray Level Cooccurrences Matrix (GLCM) Features Extraction of Spectrogram Images
	Ms. Tri Pujiani Harapan Bangsa University, Indonesia <i>tripujiani@uhb.ac.id</i>	E-learning for Industry 4.0 and Its Effectiveness in Improving Students' Learning Motivation

Time	Activity
	<ul style="list-style-type: none"> • <i>Enhancing Classroom Interaction through Self-Disclosing Social Media Posts</i>, Mr. Putu Chris Susanto, Dhyana Pura University • <i>Are we ready yet to flip our classes? Analysis on students' and lecturers' use of technology</i>, Ms. Monica Ella Harendita, Ms. Mega Wulandari, and Ms. Vittalis Ayu, Sanata Dharma University
	<p>Room Three - Panel Chair: Dr. Natalia Paranoan [RK 3, 4th Floor, Thomas Aquinas Building]</p> <p>Online, Distance, Virtual, and Augmented Reality Learning (3)</p> <ul style="list-style-type: none"> • <i>Javanese Music Gamelan Identification Based on Gray Level Cooccurrences Matrix (Glcm) Features Extraction of Spectrogram Images</i>, Mr. Vinno Christmantara, Widya Karya Catholic University • <i>E-learning for Industry 4.0 and Its Effectiveness in Improving Students' Learning Motivation</i>, Ms. Tri Pujiani, Universitas Harapan Bangsa • <i>Developing and creating Board Game as a Media to Lear English Vocabulary for Senior High Student</i>, Mr. Kevin Christopher Vhong, Soegijapranata Catholic University

INTERNATIONAL CONFERENCE PROPOSAL

RESEARCH DOMAIN: DIGITALIZATION OF LOCAL WISDOM AND KNOWLEDGE

RESEARCHER

VINNO CHRISTMANTARA

Title of the Proposal

JAVANESE MUSIC GAMELAN IDENTIFICATION BASED ON GRAY LEVEL COOCURRENCES MATRIX (GLCM)
FEATURES EXTRACTION OF SPECTOGRAM IMAGES

A concise summary of the project and its goals and objectives (maximum 300 words)

The project will discuss an another approach of Javanese Music Gamelan identification, which is using image features processing rather than audio or signal processing of Gamelan audio. The project goal is to identify the right class of Gamelan Music within a collection of random audios. The collection consists of two class audio files in fair numbers: 1) Gamelan music audio and 2) Non-Gamelan music audio. A testing dataset will be generated from .mp3 audio sample collection that downloaded from various source on internet. Each audio sample will be converted to .wav format so it can be processed using a Windows audio library. This process will generate 10 seconds of splitted audio file from the sample. The 10-seconds of splitted audio will be treated as an image processing object research. A spectrogram image will be generated from those 10-seconds audio file. All of these steps called as pre-processing phase. Once collection of spectrogram images has been created, the next steps would be done in image processing domain.

The images will be converted to grayscale image so they can be processed using Gray Level Co-Occurrence Matrix. The 14 Haralick features will be implemented on each GLCM matrix to make the features more compact and sharper. The reason using Haralick features is because to compare GLCM matrices directly will results a bad computing performance due to its size. The k-Nearest Neighbors (kNN) will calculate the distance between test features versus dataset features. The evaluation result score of identification using kNN classifier of data testing to be expected on 60% or above.

A brief description of how your project is relevant to the college, university, or educational context from which you come (maximum 300 words)

Javanese Music Gamelan is one of famous Indonesian cultural heritage that also proven by UNESCO as a world cultural heritage. Gamelan using 4 ways of unique notation that is *sléndro*, *pélog*, *degung* (most played on East Java), and *madenda* (called as diatonic – similar to minor notation that played on European music). The features in Javanese Music Gamelan is interesting to be inspected due to it's unique sound. As Widiya Karya Catholic University located in Malang, East Java – we had responsibility to conserve the Gamelan Music too, since there is fact that this Music also had been played outside Indonesia. There is a Gamelan music group named “Gamelan Wellington” (www.gamelan.org.nz) in Wellington, New Zealand. MIT also have a group that playing this music initiated by Evan Ziporyn and Kenan Sahin, named “Galaktika” (www.galaktika.org). The music information retrieval of Gamelan Music has been initiated by past researches using Audio Signal Processing. This project will use another approach of Music Genre classification and identification, especially on Gamelan Music, using an Image Processing method.

In what ways will your project address ethics or whole person education? (maximum 300 words)

The project will be address in local knowledge and wisdom digitation domain. The Gamelan Music identification will lead to another exploration of local knowledge mining such as frequency or energy correlation with the pattern of the sound itself. The gamelan sound should contain some certain frequency that affect human brain. In the future time, this research will opened the possibility of research collaboration with Cultural Institute or School.

Integritas, Peduli, Tangguh, Etika, Kompeten



JAVANESE MUSIC GAMELAN IDENTIFICATION BASED ON IMAGE PROCESSING TO DIGITIZE AND TO EXPLORE THE LOCAL WISDOM

Vinno Christmantara, Yosi Kristian

United Board International Conference

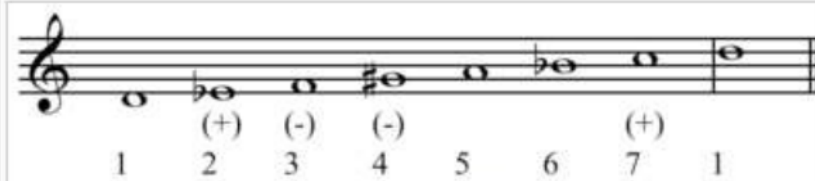
October 28 – 30, 2019 – Soegijapranata Catholic University - Semarang



Why Gamelan?

- Gamelan Music is a Javanese Local Wisdom
- Unique chord composition and beat
- Energy, sacre, and majestic
- Approved by UNESCO as one of world cultural heritage
- It is a rare to do a research on this topic based on image processing rather than signal processing

Gamelan Notation



Pelog approximated in Western notation.^[1] [Play \(help·info\)](#)

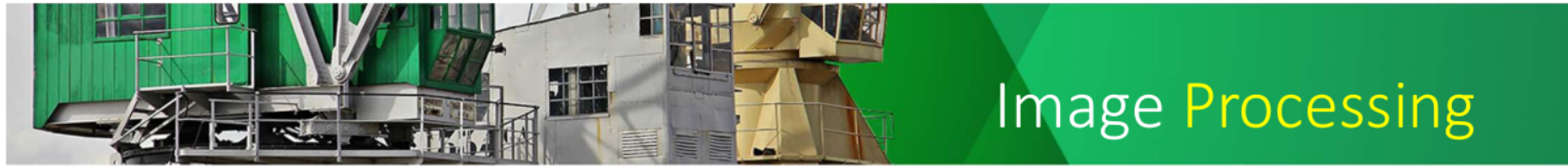


Slendro approximated in Western notation.^[1] [Play \(help·info\)](#)



Background

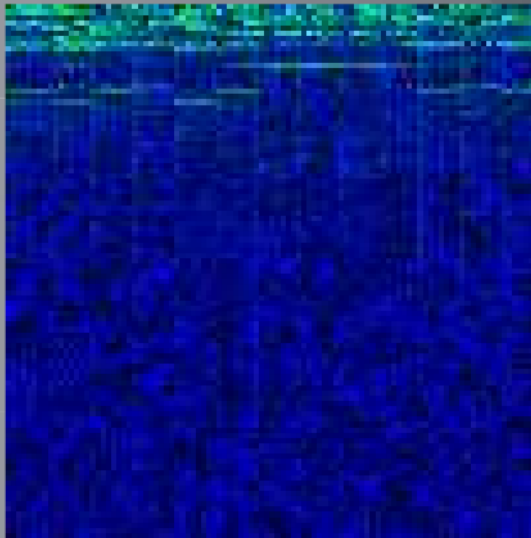
- Classification and Identification become an interesting challenge due to a big data field, especially Musical Information Retrieval
- Listening to each audio file cost time and effort
- Comparing audio signal requires large computing resource



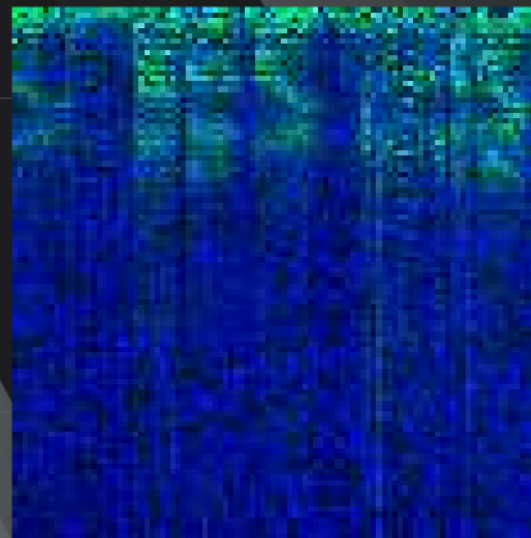
This research will utilize the audio files becoming spectrograms image, as a representation of the frequency, time, and amplitude of an audio signal.



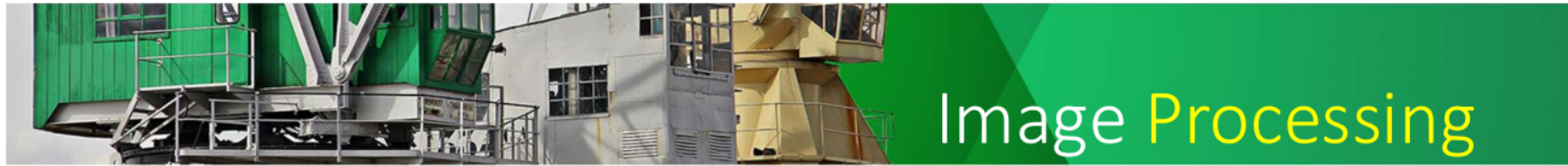
Spectrogram



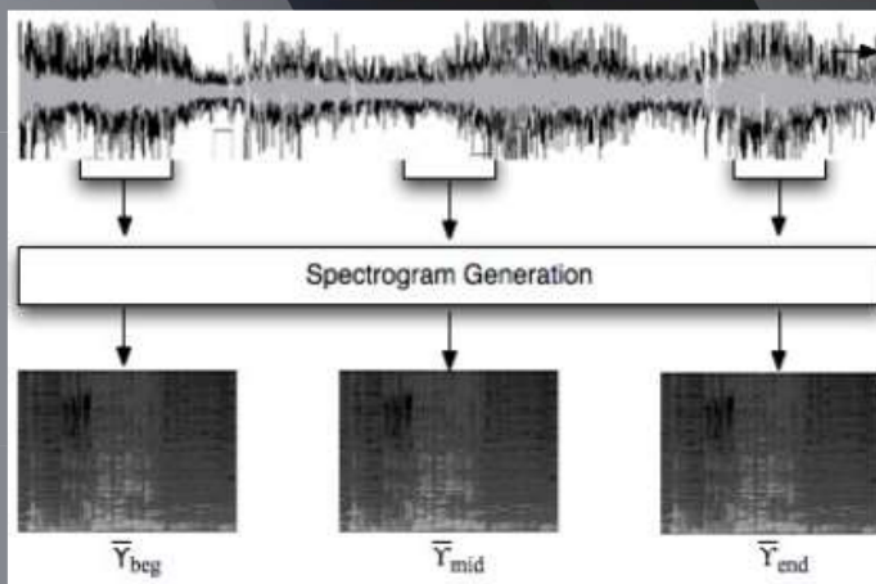
**Sugeng W. H – Lancaran Kebogiro
(Gamelan)**



**The Beatles – Blackbird
(Non-Gamelan)**



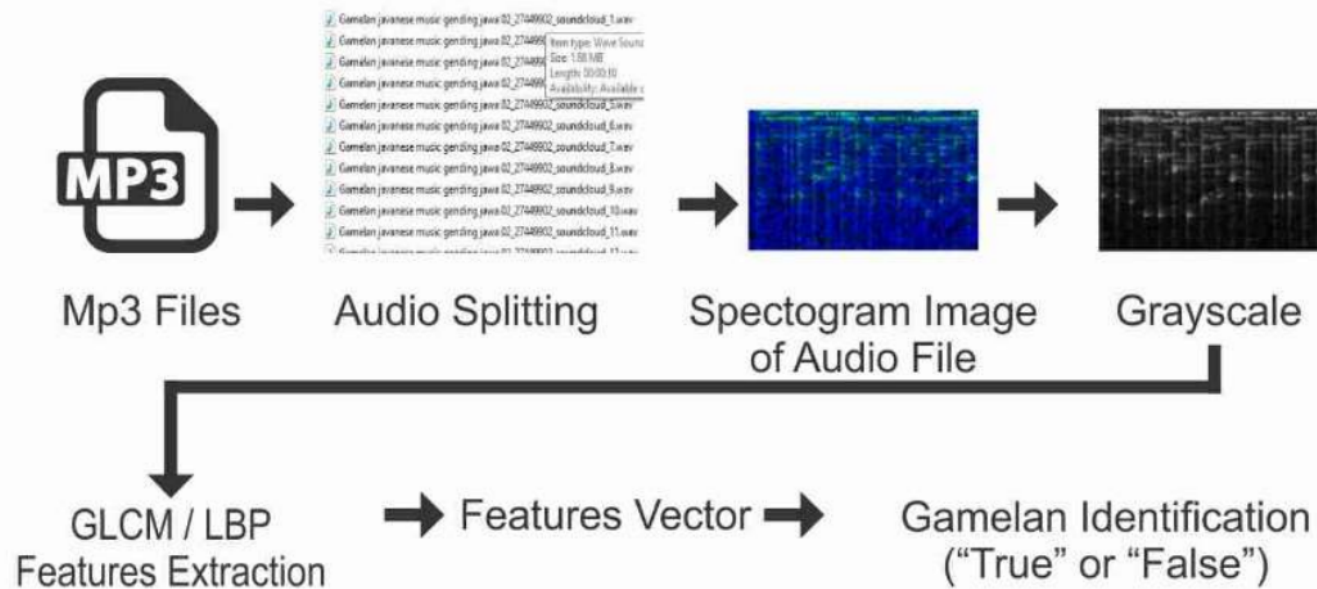
- The research will mostly talk about the Image Processing rather than Signal Processing
- The features were extracted from Image Processing called **textural features**
- Textural feature = hard and soft of a surface
- The graylevel will be treated as a surface



"Music Genre Recognition Using Spectrograms"

Yandre M. G. Costa, Luiz S. Oliveira, Alessandro L. Koerich, Fabien Gouyon (2011)

Flow Process

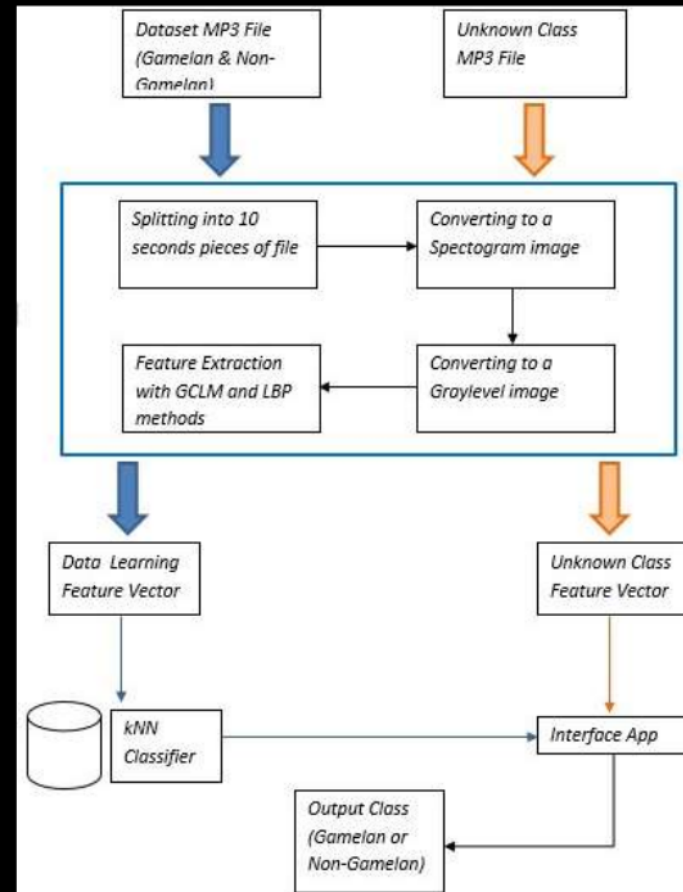




Research Goal

To identify the Music Gamelan audio files with high accuracy using Gray Level Cooccurrences Matrix (GLCM)

LEARNING FLOW





Research Flow (1)

- .mp3 audio files will be splitted into pieces of 10 seconds (using BASS audio library)
- These pieces will be generated into RGB image called spectrograms
- This RGB spectrograms will be converted into a grayscale image then
- Grayscale images will be processed into a matrix using GLCM method



Research Flow (2)

- Using the same sequence of steps, the unknown class data (data testing) will be processed into a GLCM Matrix (See: Research Flow Image slide 9)
- Calculating the distance between the dataset versus the data testing using kNN algorithm

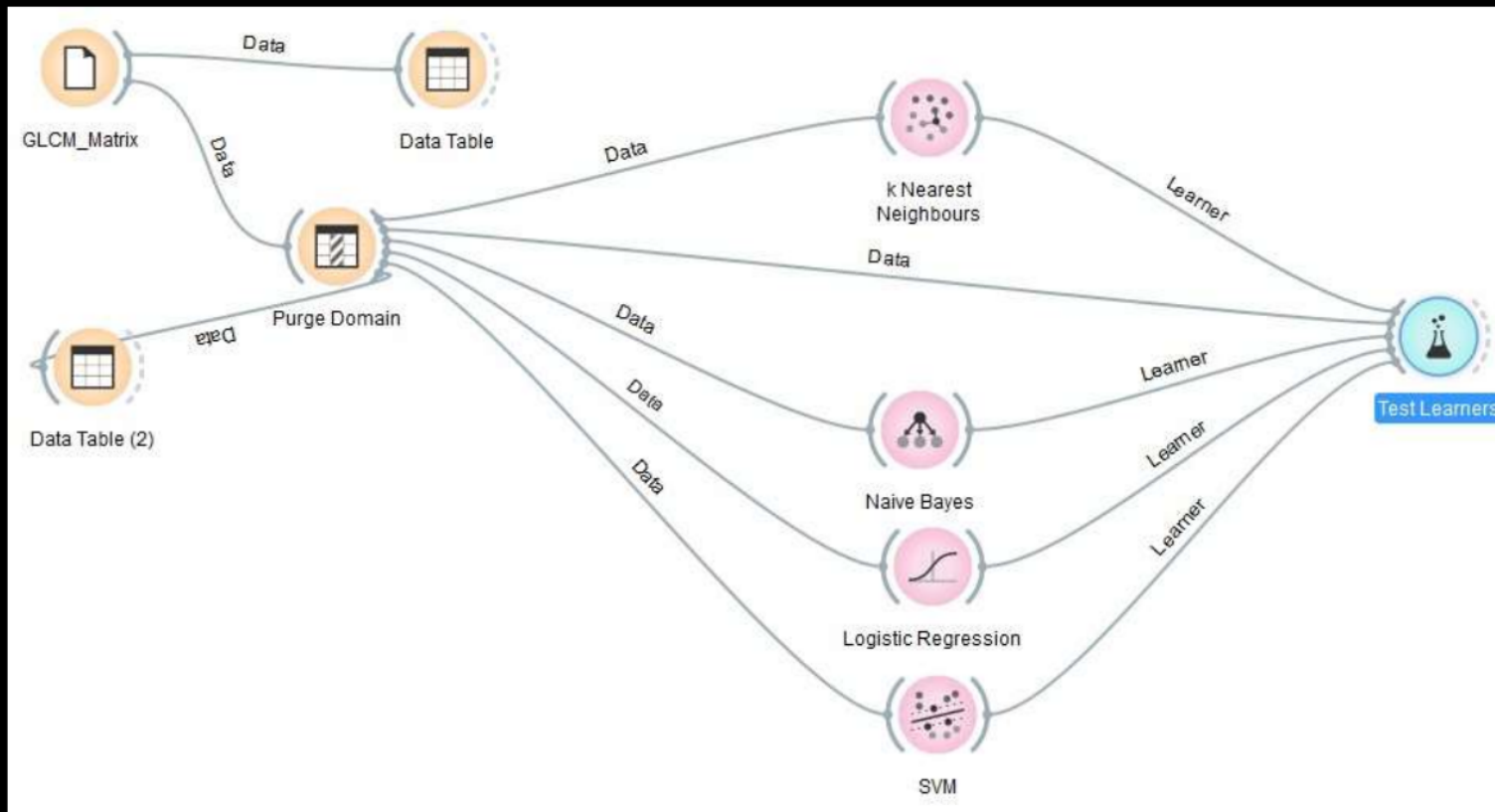


- The dataset will be built from 13 songs from two different class: Gamelan and non-Gamelan
- Non-Gamelan will covering samples from Jazz, Classical, Country, Pop, and Dangdut (Melayu Musical)
- Each of audio file will be splitted into a 10-seconds splitted audio files
- The splitting process will **generate 365 of splitted audio file**

No.	Judul Lagu	Durasi	Bitrate	Kelas
1	Gamelan_1	06:07	128kbps	Gamelan
2	Gamelan_2	08:04	128kbps	Gamelan
3	Gamelan_3	07:49	128kbps	Gamelan
4	Gamelan_4	02:46	128kbps	Gamelan
5	Gamelan_5	06:07	128kbps	Gamelan
6	Thinking Out Loud	05:00	128kbps	Non-Gamelan
7	Air on G String	03:48	128kbps	Non-Gamelan
8	Ode To Joy	03:40	128kbps	Non-Gamelan
9	The Girl From Yesterday	03:24	128kbps	Non-Gamelan
10	Muara Kasih Bunda	03:52	128kbps	Non-Gamelan
11	Terlena	04:36	128kbps	Non-Gamelan
12	Musette For A Magpie	04:18	128kbps	Non-Gamelan
13	Have You Met Miss Jones	02:31	128kbps	Non-Gamelan

TEST LEARNER – 1 – PURE GLCM

- 13 songs splitted into 365 pieces
- Each piece will generated GLCM matrix which has a **very long** index array: $256 * 256 = 65.536$ index
- The filetext that contain the dataset vector has 48Mb in size!
- Tested using Orange Data Mining with domain purging
- Purged domain reduce the index from 65.536 to 603 only by remove the column (pair of x,y) that has 0 value



TEST LEARNER – 1

PURE GLCM MATRIX

Method	Accuracy	Area Under Curve	F-Measure	Precision	Recall
kNN	0.8629	0.9497	0.8718	0.8173	0.9341
Logistic Regression	0.8245	0.8987	0.8222	0.8315	0.8132
Naïve Bayes	0.7153	0.7433	0.7277	0.6950	0.7367

TEST LEARNER – 2

GLCM WITH 13 HARALICK FEATURES

- By saving the 13 Haralick Features, the vector will only save 4745 dataset vector while the full GLCM matrix had 23.920.640 dataset vector and the GLCM purged domain had 220.095 dataset vector

F01	Angular Second Momentum.	F08	Sum Entropy.
F02	Contrast.	F09	Entropy.
F03	Correlation.	F10	Difference Variance.
F04	Sum of Squares: Variance.	F11	Difference Entropy.
F05	Inverse Difference Moment.	F12	First Information Measure.
F06	Sum Average.	F13	Second Information Measure.
F07	Sum Variance.		

TEST LEARNER – 2

GLCM WITH 13 HARALICK FEATURES

Method	Accuracy	AUC *	F1 **	Precision	Recall
kNN	0.9038 [↑]	0.9530 [↑]	0.9057 [↑]	0.8889 [↑]	0.9231 [↓]
Logistic Regression	0.8079 [↓]	0.9013 [↑]	0.7917 [↓]	0.8636 [↑]	0.7308 [↓]
Naïve Bayes	0.7343 [↓]	0.8366 [↓]	0.7640 [↑]	0.6856 [↓]	0.8626 [↑]

13 HARALICK FEATURES CONCLUSION

- kNN still was the best classifier compare to two other methods: Logistic Regression and Naïve Bayes
- kNN score for Accuracy, AUC, F1, and Precision improve
- The filetext that saving the features become more efficient in size
- Smaller dataset vector filesize = better computing performance



Identification Test

- The testing will be implement to totally different files from dataset files: NO FOLDED DATA!
- The system will identify the unidentified genre of an audio file
- Song to be tested: Gamelan_testing_1.mp3 (Gamelan), The Beatles – Blackbird (Non-Gamelan Pop), Aerosmith – I Don't Want Miss a Thing (Non-Gamelan Rock)
- Those 5 songs will be generated into fair numbers of splitted files: 39 Gamelan and 39 Non-Gamelan

FINAL RESULT

GLCM	Gamelan (App Prediction)	Non-Gamelan (App Prediction)
Gamelan (Actual Genre)	27 (True Positive)	12 (False Negative)
Non-Gamelan (Actual Genre)	12 (False Positive)	27 (True Negative)

Method	Precision	Recall	F1
GLCM *	0.69	0.69	0.69



Conclusion and Discussion

1. This research offer a framework on how to recognize the gamelan music with precision and recall value equal to 69% using Image Processing method
2. Future Research
 - Next level of the Gamelan subset identification: Gamelan Jawa, Gamelan Bali, and Gamelan Sunda
 - Use other possibilities classifier to search a new best result as a comparison to current kNN result
 - Use another Textural Features (LBP, etc)
3. Open discussion to 13 Textural Features with another field of study/ research domain? A beginning step that lead to the another local wisdom exploration and automation.



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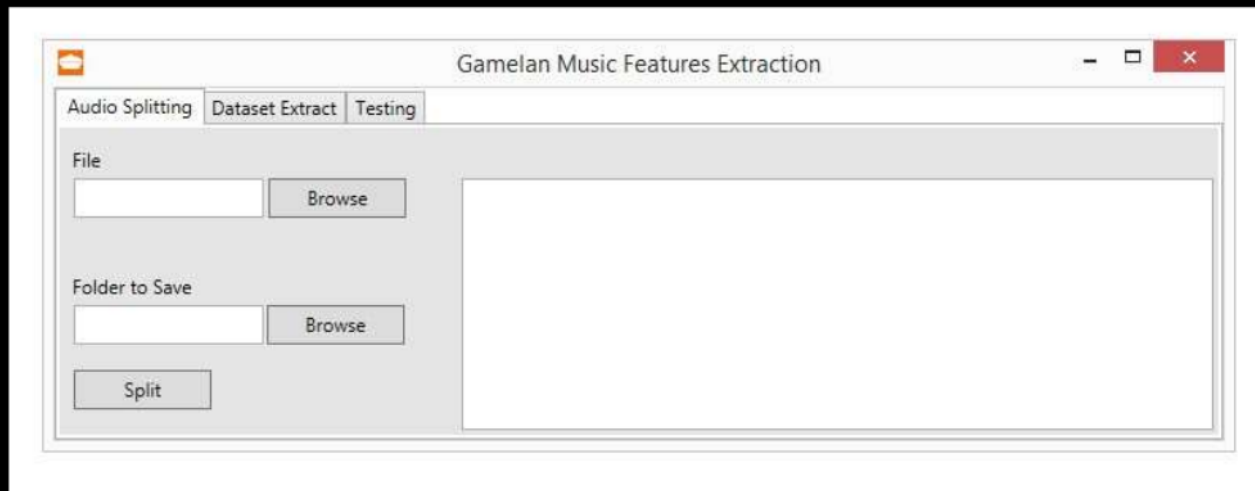
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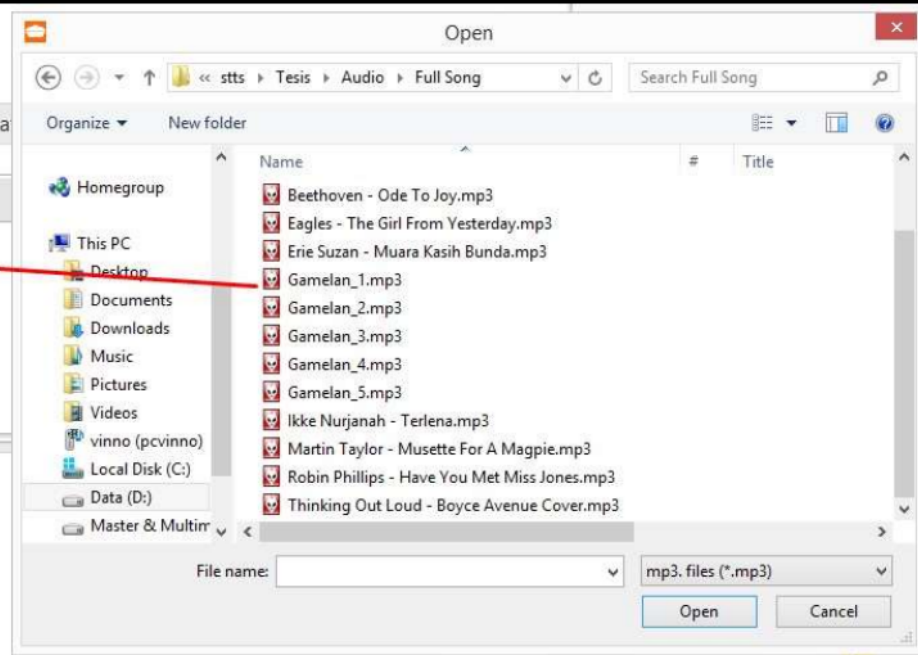
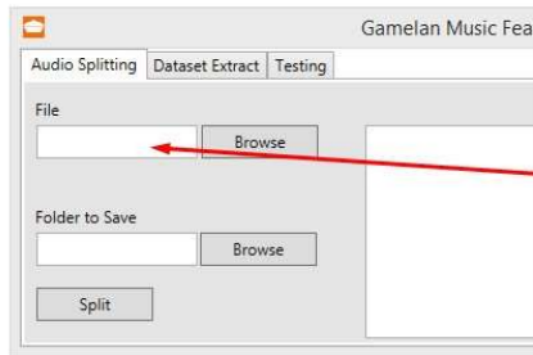
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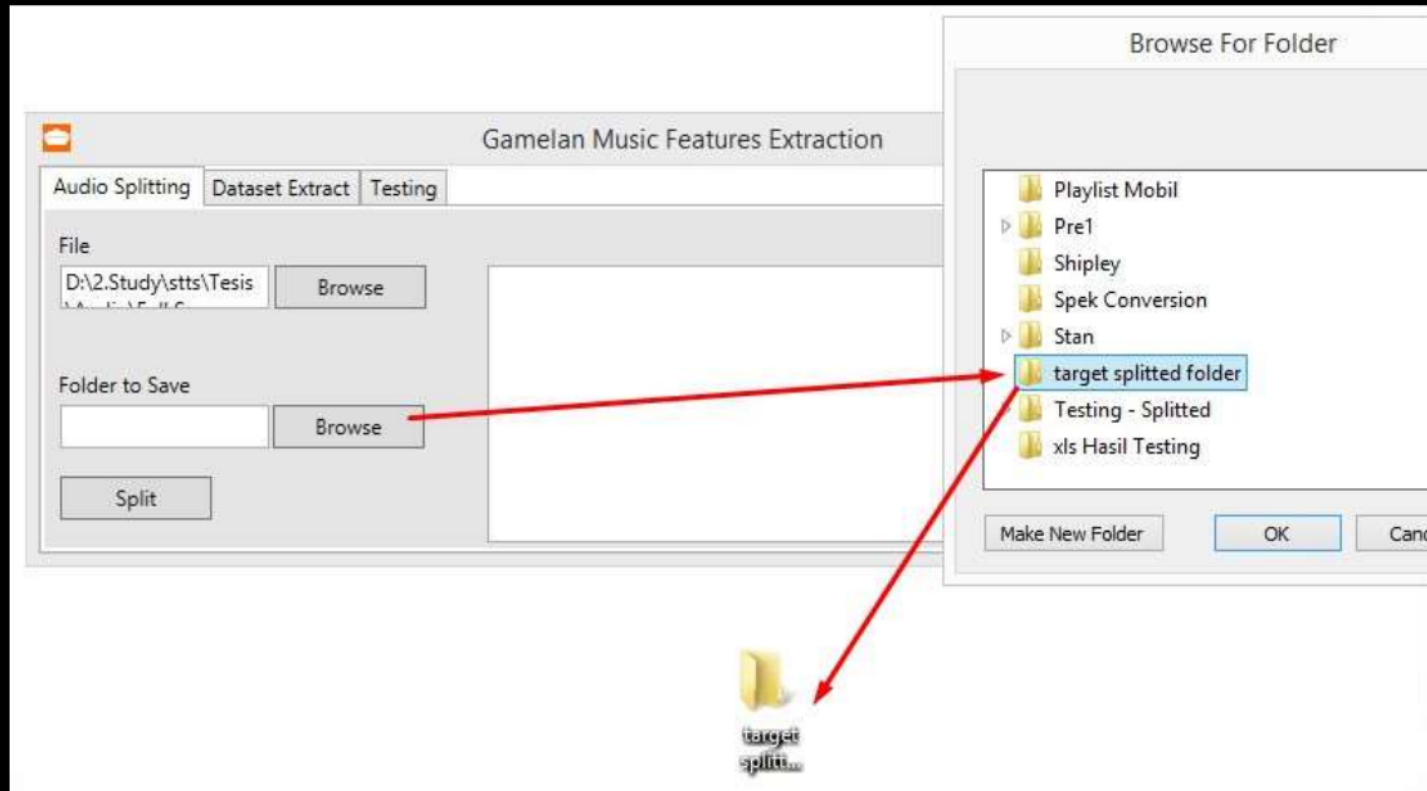
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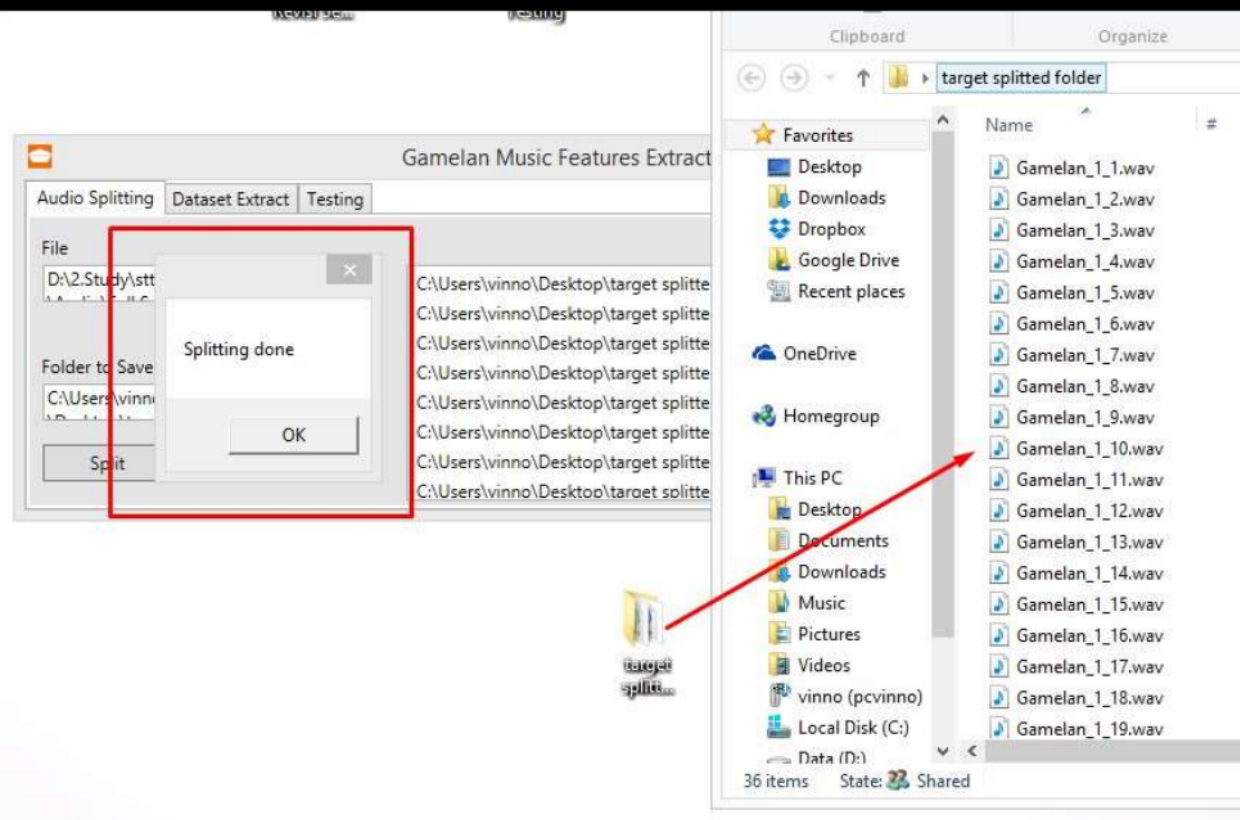
Show the application process in capture

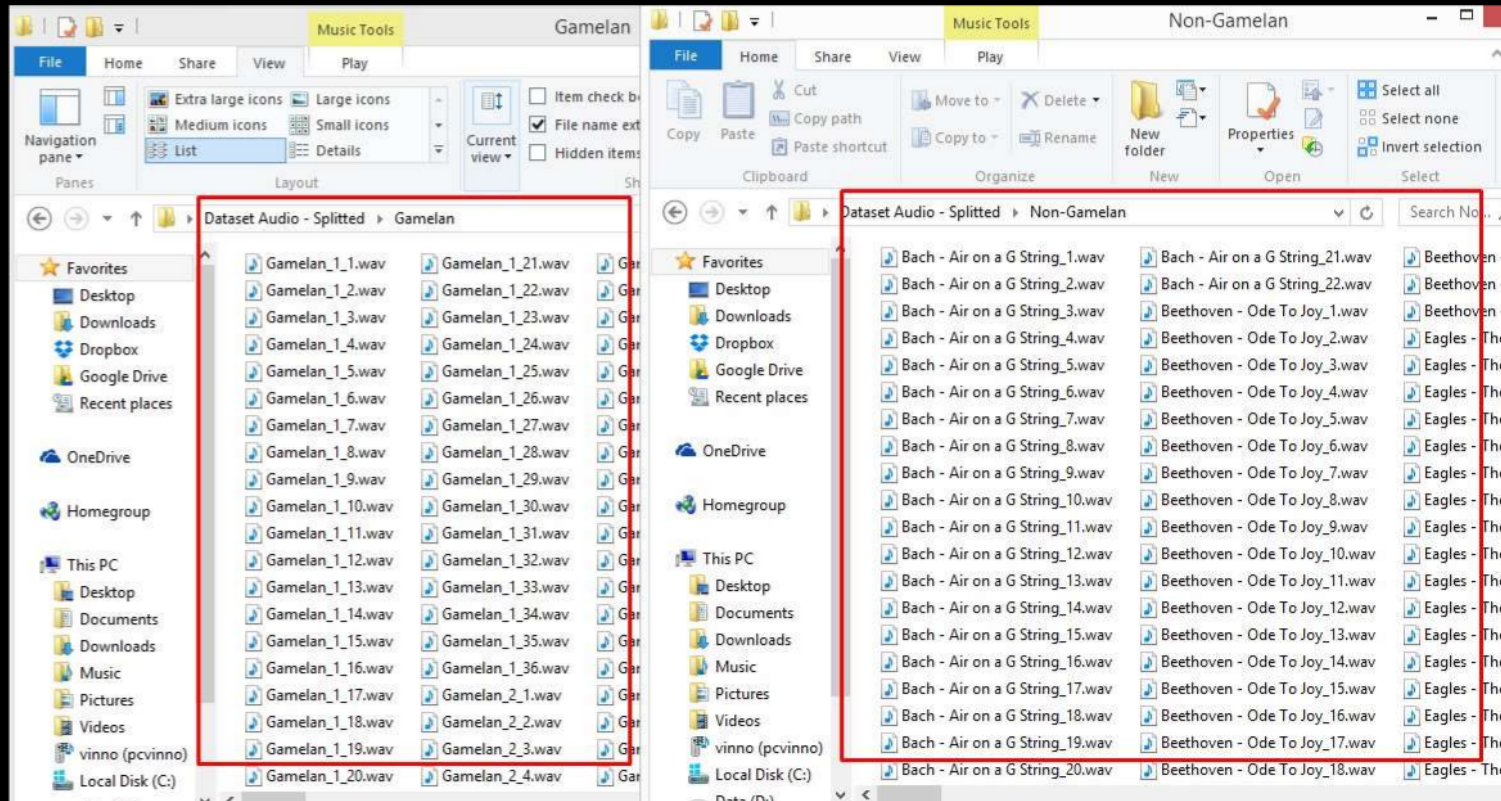


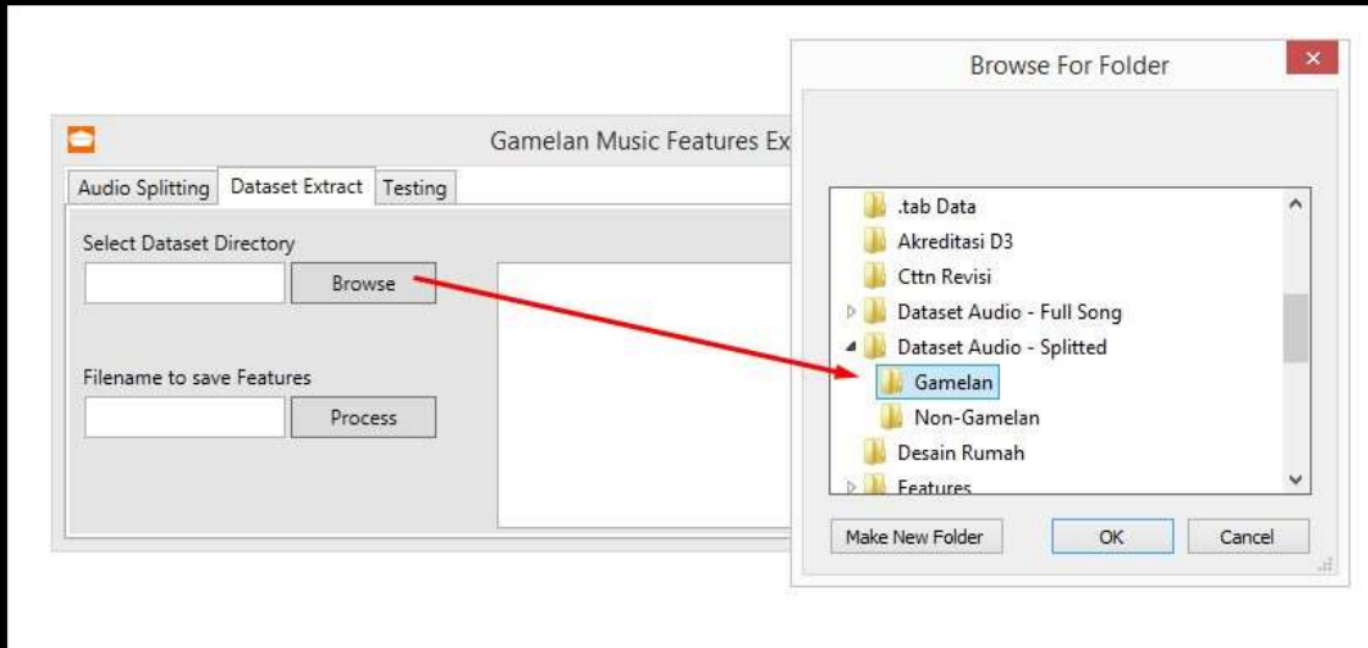
1. Audio Splitting











2. Dataset Extract

