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Certificate

This is to certify that

Vinno Christmantara

has participated in International Conference on
Innovation in Education: Opportunities and Challenges in Southeast Asia , 29-30 October 2019
Soegijapranata Catholic University, Semarang, Indonesia
as a Presenter

President of United Board

Nancy E. Chapman

Nancy E. Chapman, Ph.D

Semarang, 30 October 2019
Rector of Soegijapranata Catholic University

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Program Book

International Conference on
Innovation in Education:
Opportunities and Challenges in Southeast Asia

Soegijapranata
Catholic University
October 29 - 30, 2019

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GROUP	NAME, AFFILIATION, EMAIL	PRESENTATION TITLE
	Mr. Putu Chris Susanto Dhyana Pura University, Indonesia *chris.susanto@undhirabali.ac.id*	Enhancing Classroom Interaction through Self-Disclosing Social Media Posts
	Ms. Monica Ella Harendita (First Author), Mega Wulandari, and Vittalis Ayu Sanata Dharma University, Indonesia *meharendita@usd.ac.id*	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 *vinno@widyakarya.ac.id*	Javanese Music Gamelan Identification Based on Gray Level Coocurrences Matrix (GLCM) Features Extraction of Spectogram Images
	Ms. Tri Pujiani Harapan Bangsa University, Indonesia *tripujiani@uhb.ac.id*	E-learning for Industry 4.0 and Its Effectiveness in Improving Students' Learning Motivation

Time	Activity
	• *Enhancing Classroom Interaction through Self-Disclosing Social Media Posts*, Mr. Putu Chris Susanto, Dhyana Pura University • *Are we ready yet to flip our classes? Analysis on students' and lecturers' use of technology*, Ms. Monica Ella Harendita, Ms. Mega Wulandari, and Ms. Vittalis Ayu, Sanata Dharma University
	Room Three - Panel Chair: Dr. Natalia Paranoan **[RK 3, 4th Floor, Thomas Aquinas Building]** Online, Distance, Virtual, and Augmented Reality Learning (3) • *Javanese Music Gamelan Identification Based on Gray Level Coocurrences Matrix (Glcm) Features Extraction of Spectogram Images*, Mr. Vinno Christmantara, Widya Karya Catholic University • *E-learning for Industry 4.0 and Its Effectiveness in Improving Students' Learning Motivation*, Ms. Tri Pujiani, Universitas Harapan Bangsa • *Developing and creating Board Game as a Media to Lear English Vocabulary for Senior High Student*, 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 spectogram image will be generated from those 10-seconds audio file. All of these steps called as pre-processing phase. Once collection of spectogram 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 Widya 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.

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Opportunities and Challenges in Southeast Asia
Keynote Speakers
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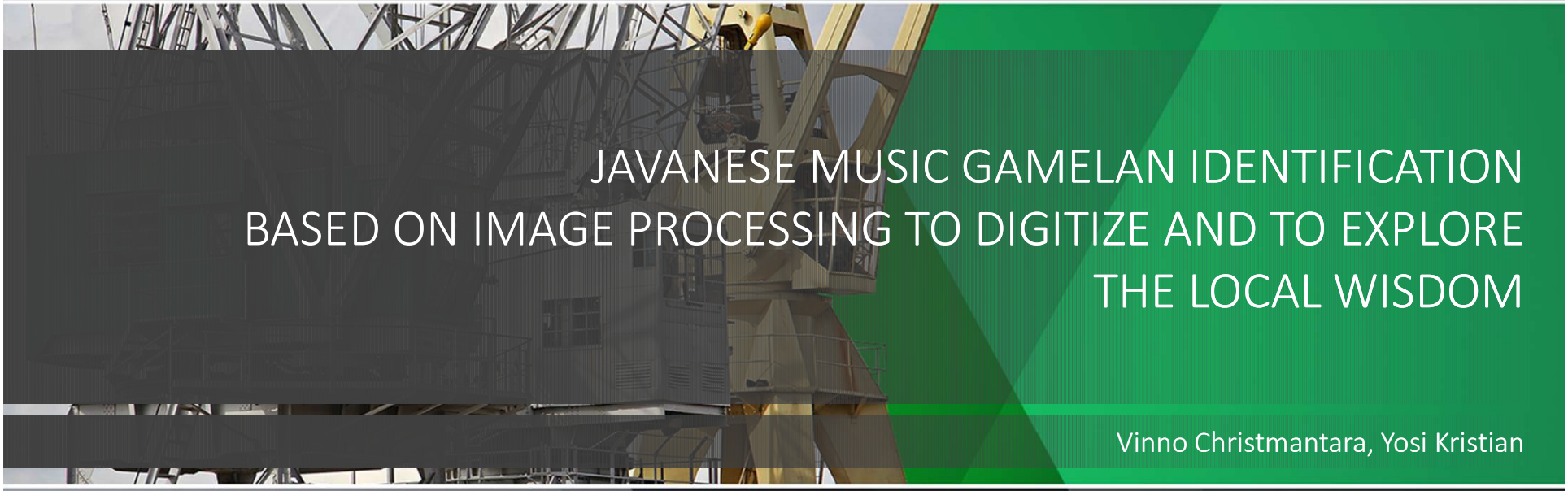
Hong Kong Baptist University
Hong Kong
Dr. Dave Marcial
Silliman University
Philippines
Kevin Henderson
United Board
U.S.A
Dr. Guydeuk Yoon
Christ University
India
Prof. Dr. Yasuhisa Tamura
Sophia University
Japan
Soegijapranata
Catholic University
October 29-30, 2019

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

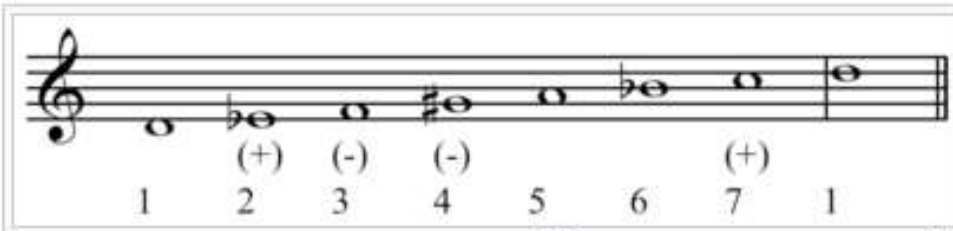
United Board International Conference

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

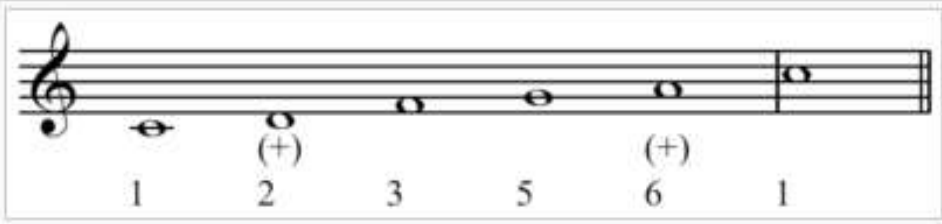
Why Gamelan?

- 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)

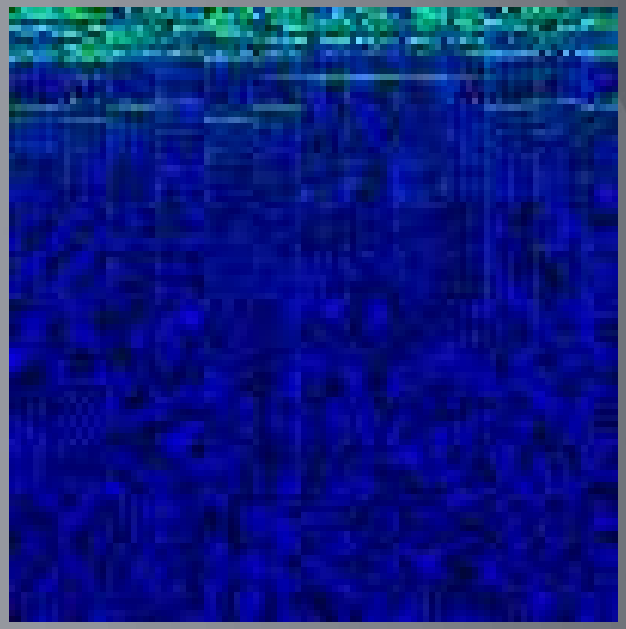
Background

- 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

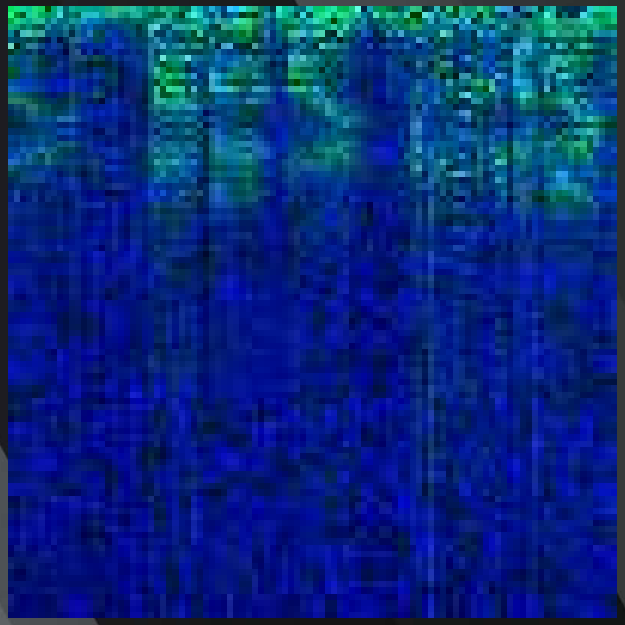
Image Processing

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

Spectogram



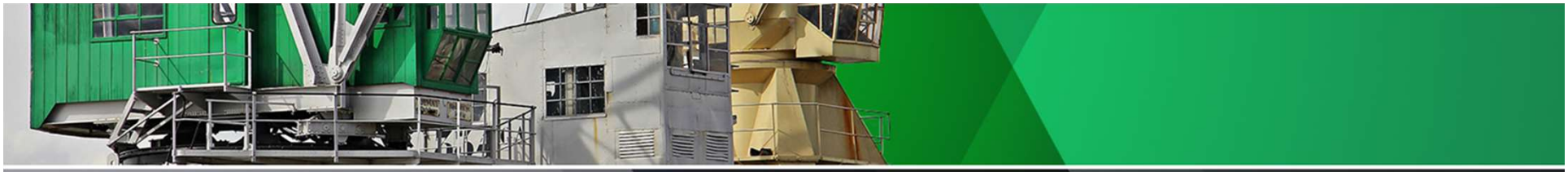
Sugeng W. H – Lancaran Kebogiro (Gamelan)

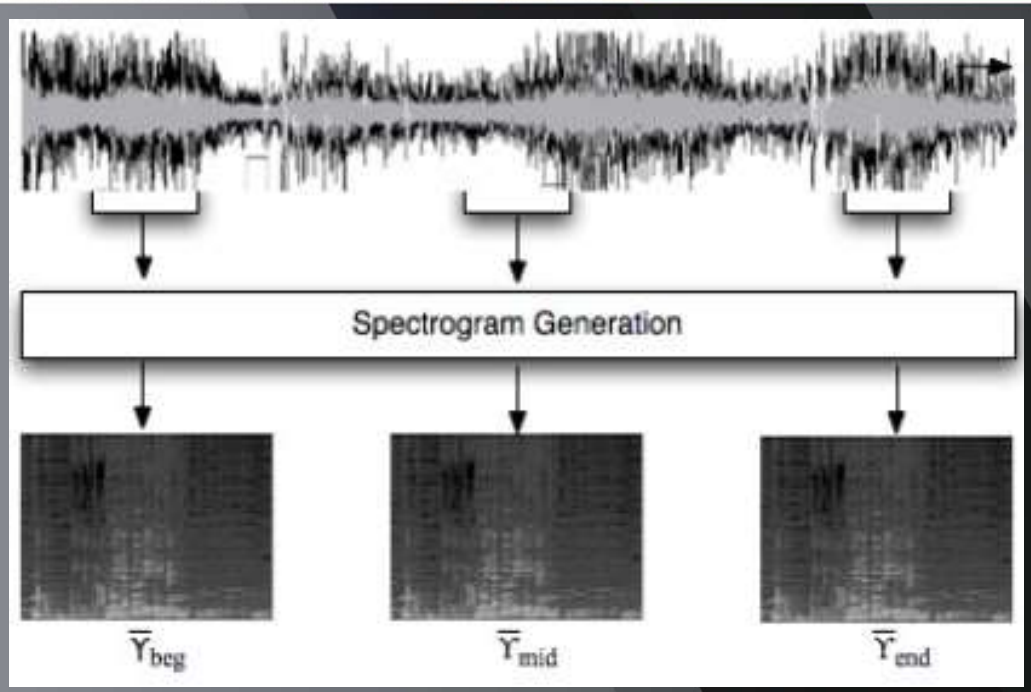


The Beatles – Blackbird (Non-Gamelan)

Image Processing

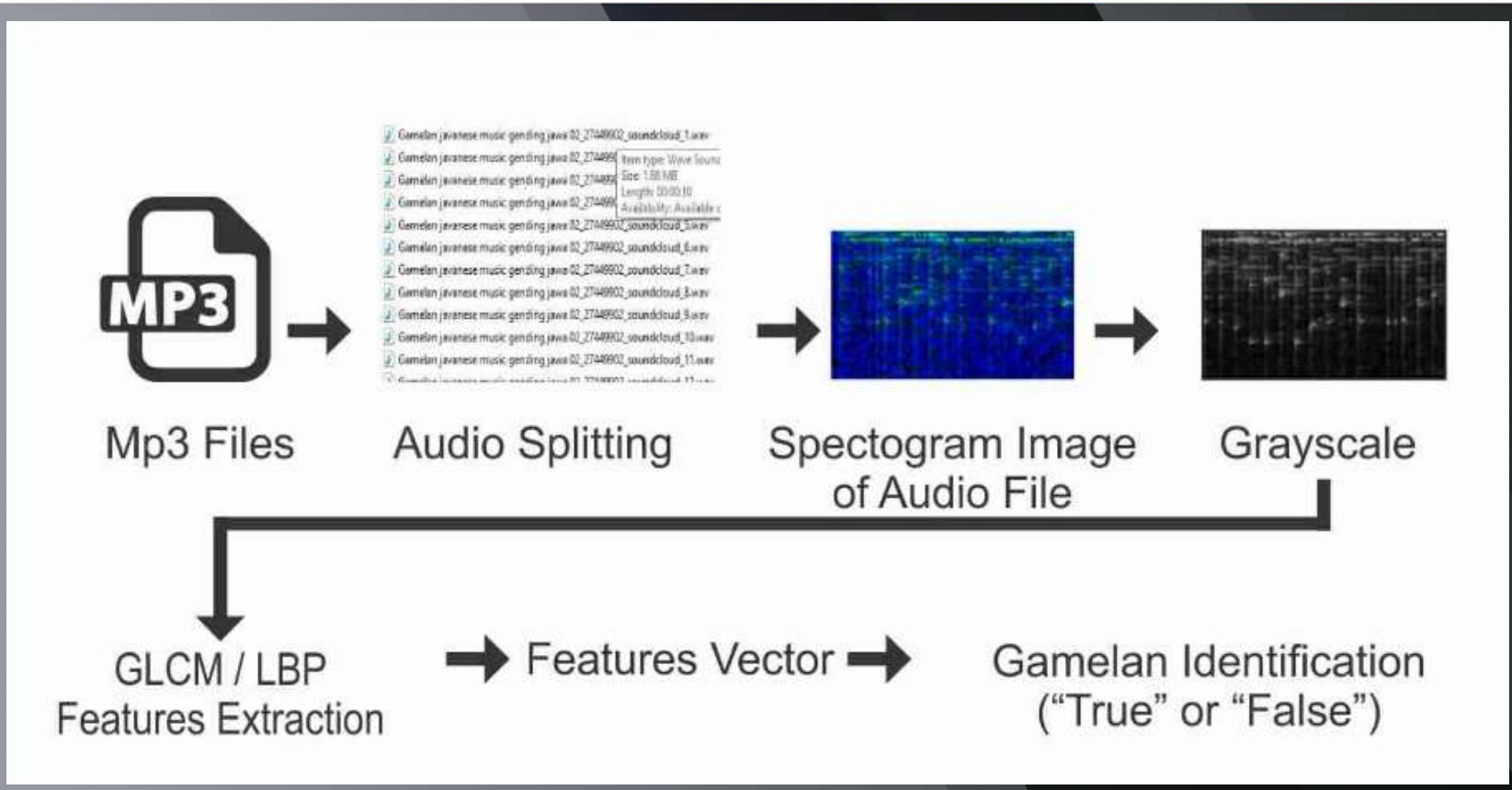
- The research will mostly talk about the Image Processing rather than Signal Processing
- The features were extracted from Image Processing called **textural features**
- Textural feature = hard and soft of a surface
- The graylevel will be treated as a surface





"Music Genre Recognition Using Spectograms"
Yandre M. G. Costa, Luiz S. Oliveira, Alessandro L. Koericb, Fabien Gouyon (2011)

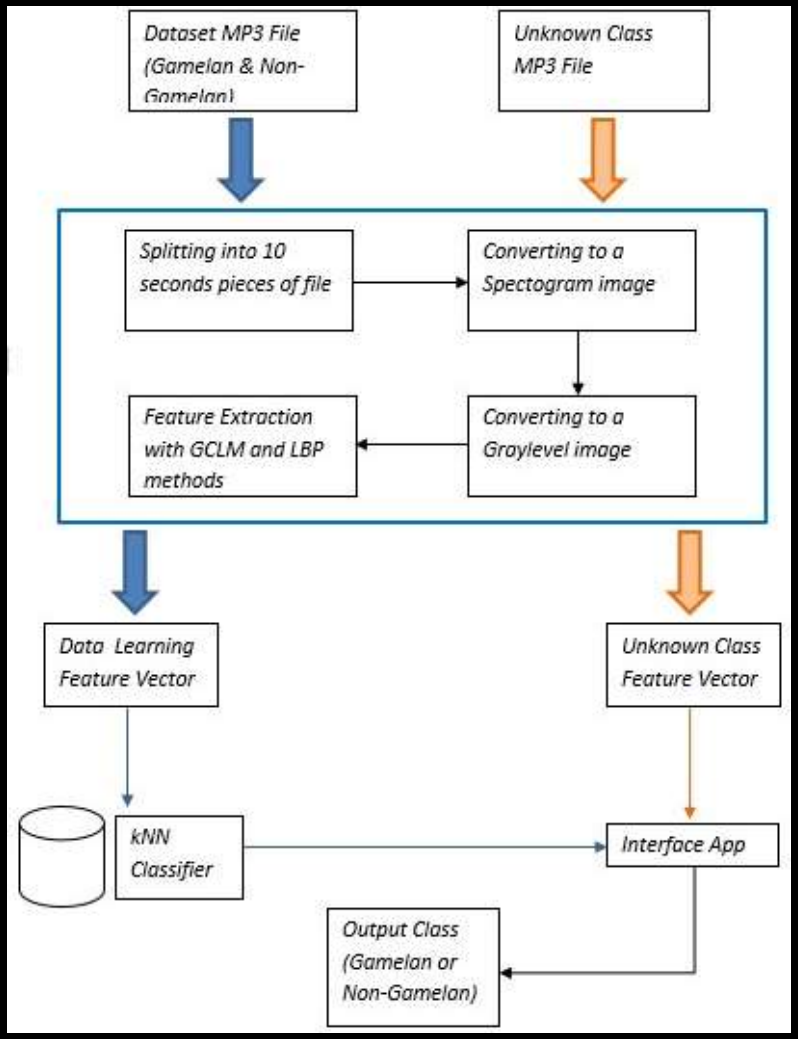
Flow Process



Research Goal

To identify the Music Gamelan audio files with high accuracy using Gray Level Coocurrences 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 spectograms 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

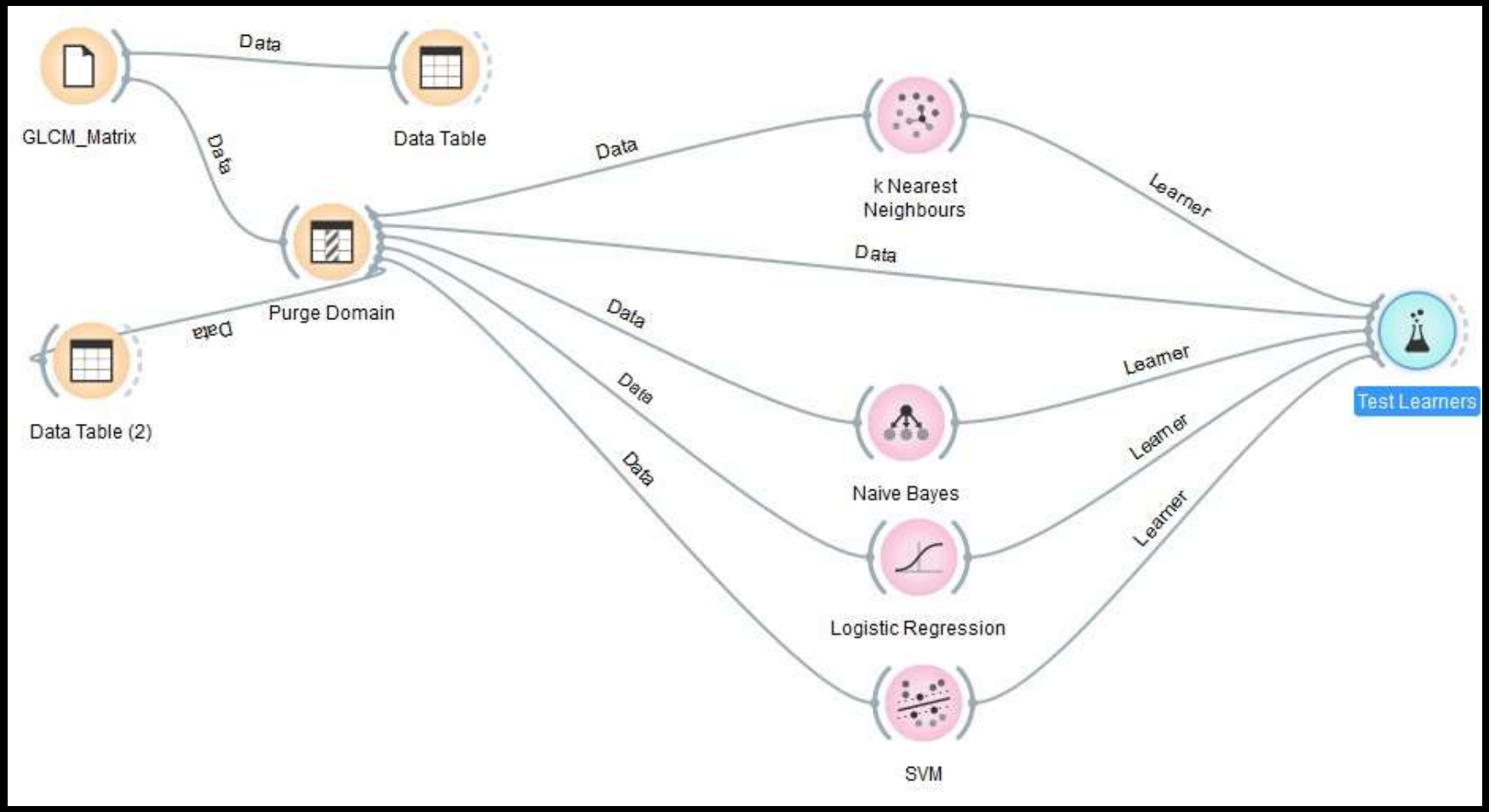
Dataset

- 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


GLCM_Matrix
Data
Data Table
Data
Purge Domain
Data
Data Table (2)
Data
k Nearest
Neighbours
Data
Learner
Data
Data
Data
Naive Bayes
Learner
Logistic Regression
Learner
SVM
Learner
Test Learners

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 clasiffier 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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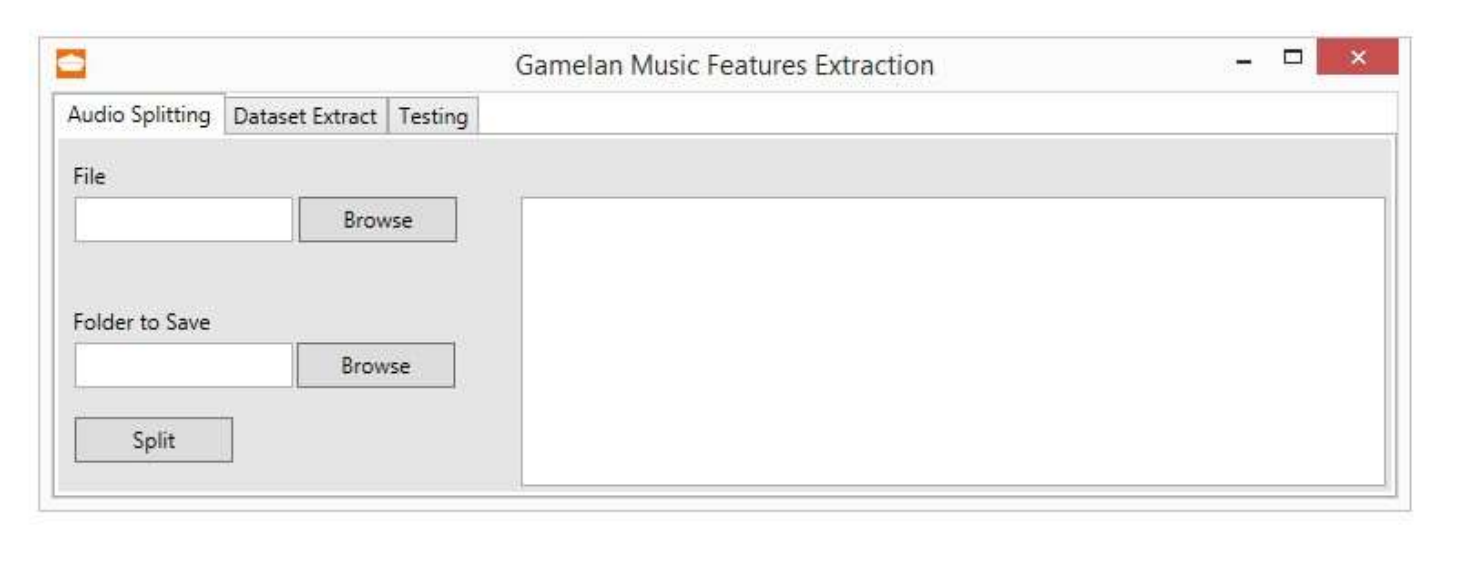
- Yandre M. G. Costa, Luiz S. Oliveira, Alessandro L. Koericb, Fabien Gouyon (2011), *"Music Genre Recognition Using Spectograms"*, 18th International Conference on System, Signals and Image Processing (IWSSIP) June 16-18, 2011, published on IEEE August 2011.

Show the application process in capture



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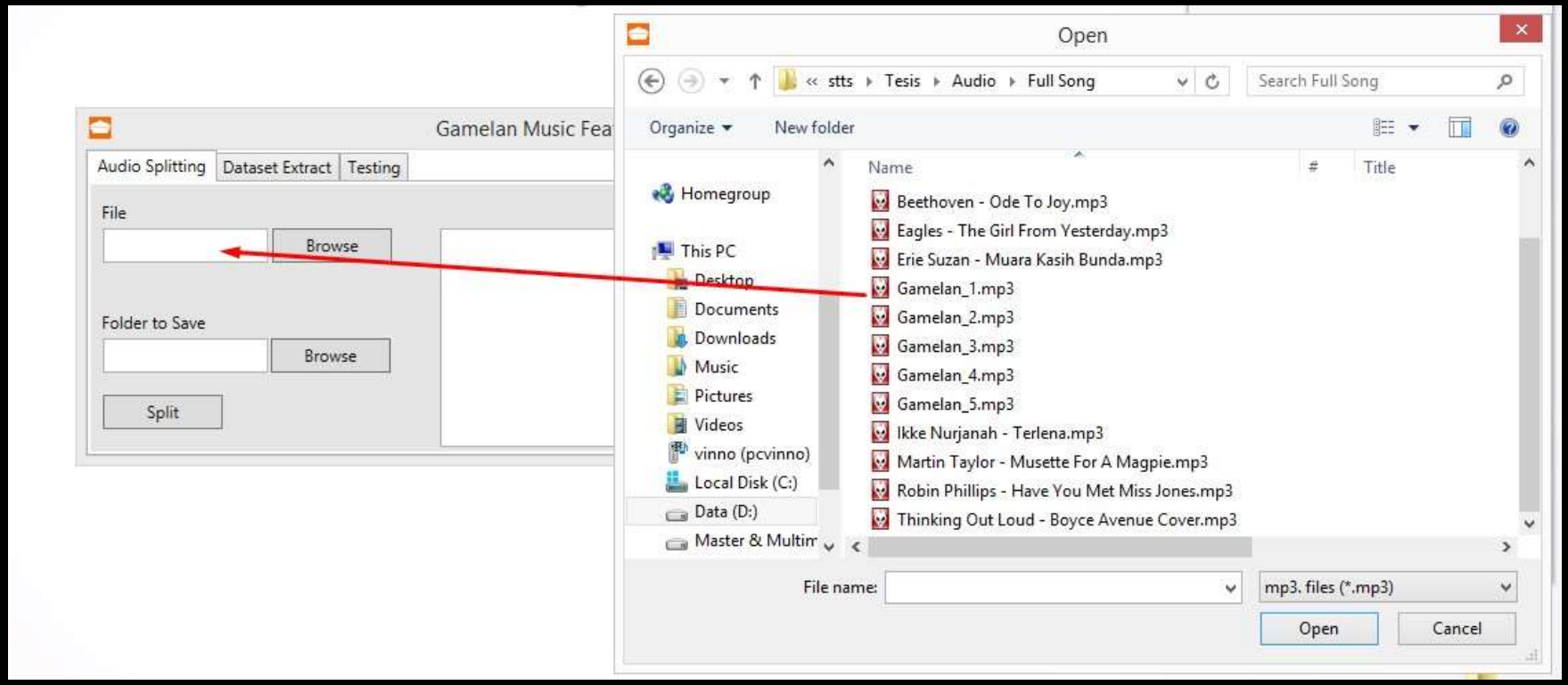
Gamelan Music Fea
Audio Splitting
Dataset Extract
Testing
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New folder
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Eagles - The Girl From Yesterday.mp3
Erie Suzan - Muara Kasih Bunda.mp3
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Ikke Nurjanah - Terlena.mp3
Martin Taylor - Musette For A Magpie.mp3
Robin Phillips - Have You Met Miss Jones.mp3
Thinking Out Loud - Boyce Avenue Cover.mp3
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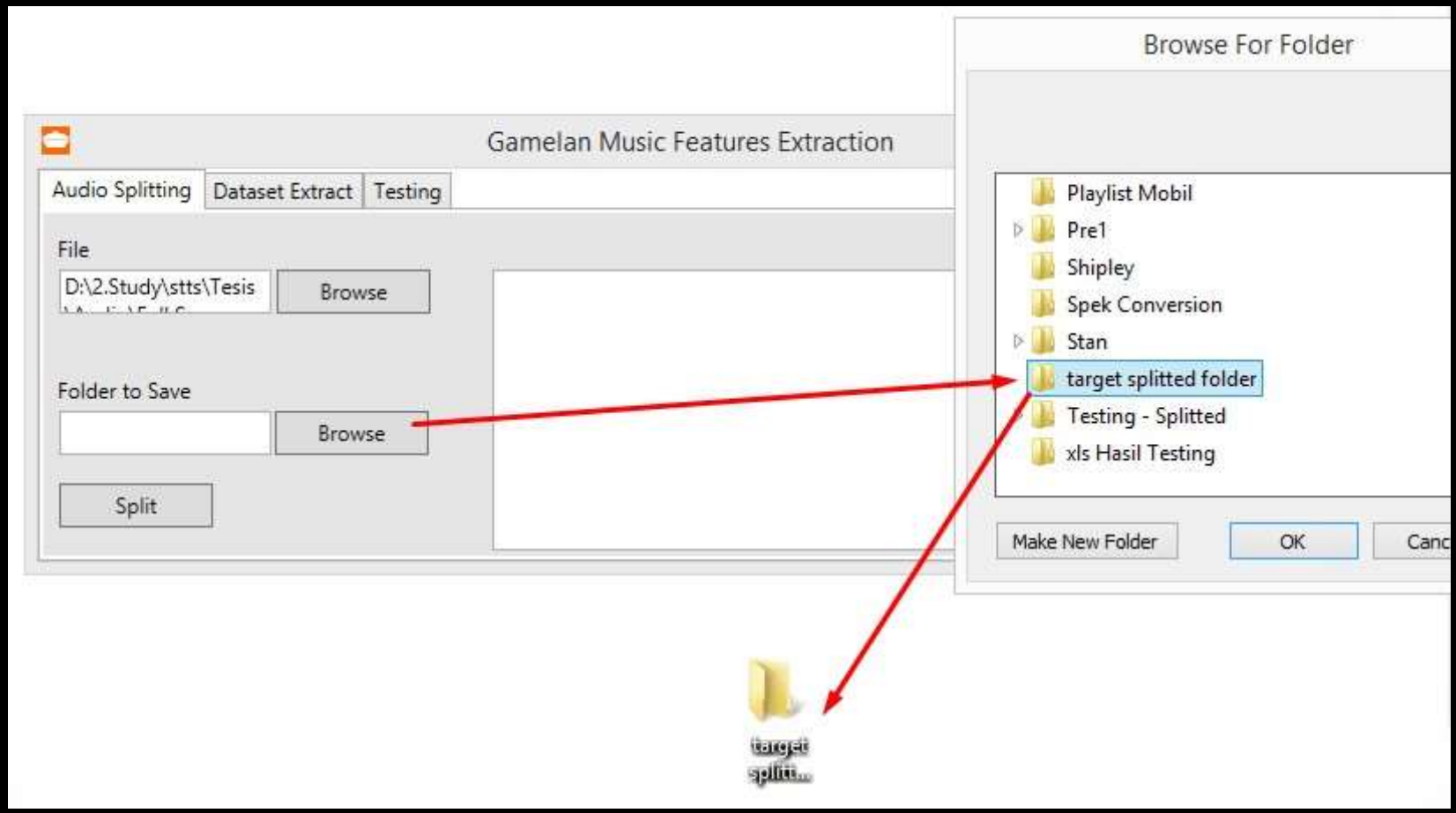
Gamelan Music Features Extraction
Audio Splitting
Dataset Extract
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Split
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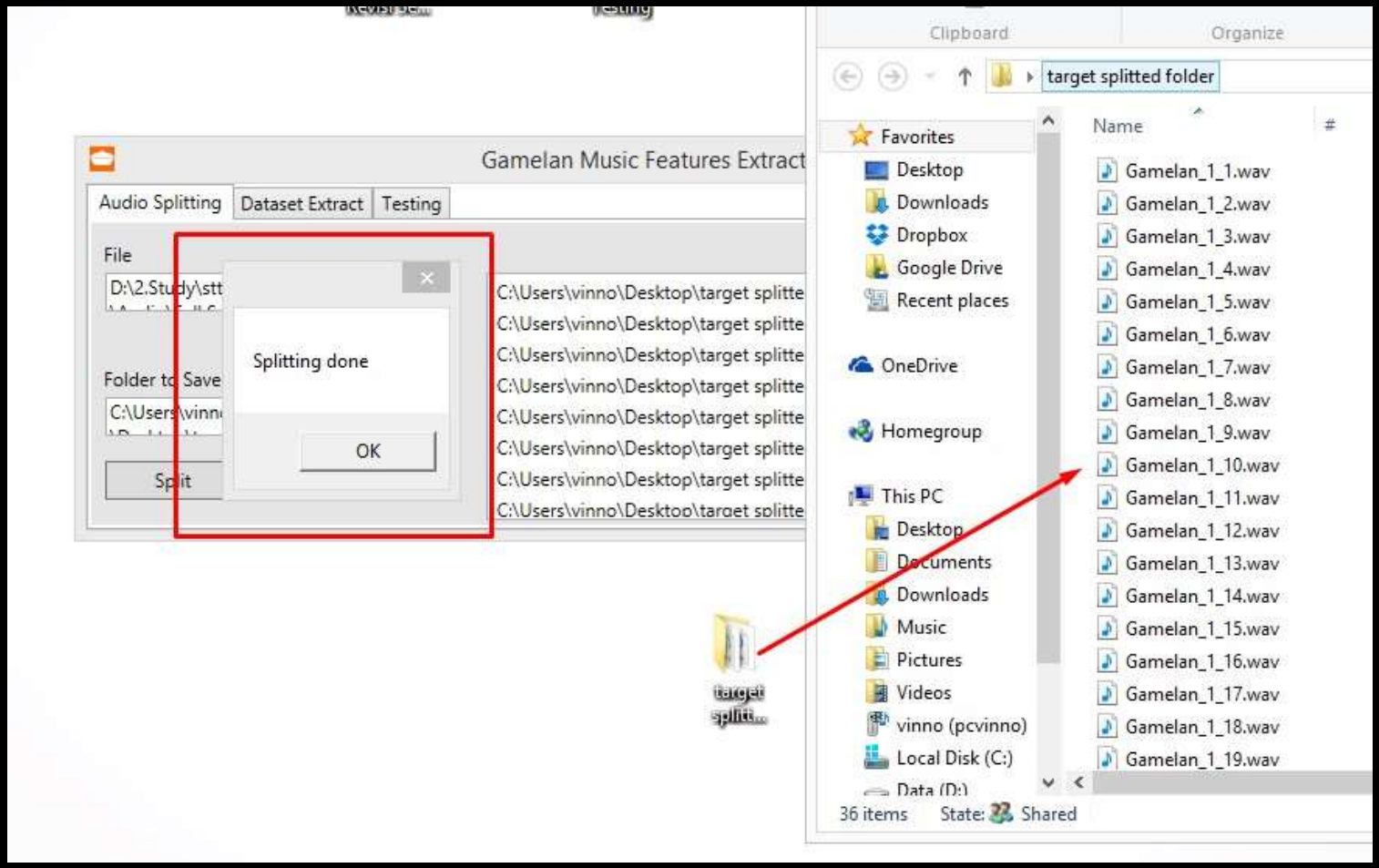
Gamelan Music Features Extract
Audio Splitting
Dataset Extract
Testing
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Favorites
Desktop
Downloads
Dropbox
Google Drive
Recent places
OneDrive
Homegroup
This PC
Desktop
Documents
Downloads
Music
Pictures
Videos
vinno (pcvinno)
Local Disk (C:)
Data (D:)
Name
Gamelan_1_1.wav
Gamelan_1_2.wav
Gamelan_1_3.wav
Gamelan_1_4.wav
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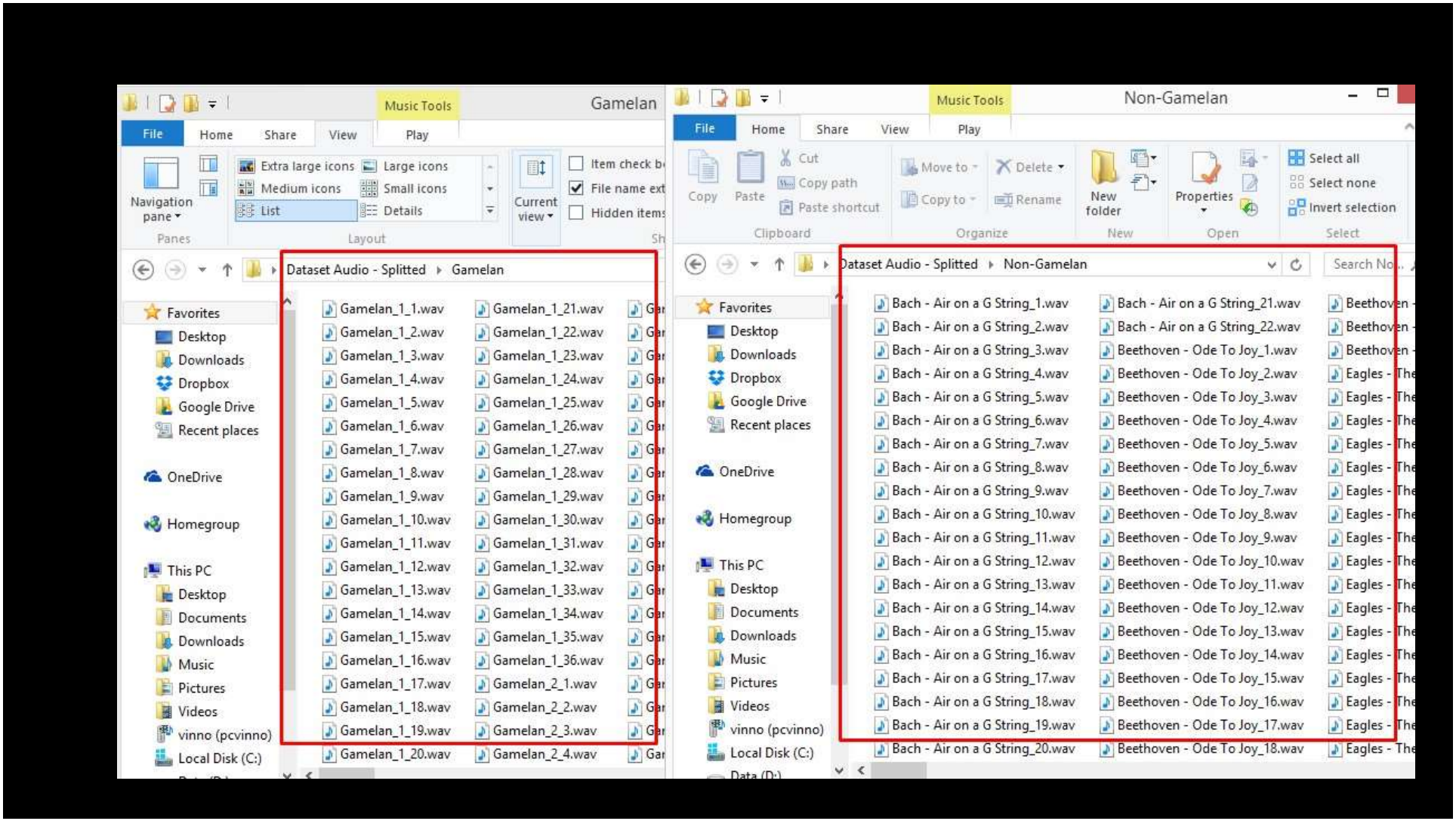
Gamelan
Music Tools
File
Home
Share
View
Play
Navigation pane
Panes
Extra large icons
Large icons
Medium icons
Small icons
List
Details
Layout
Current view
Item check b
File name ext
Hidden items
Dataset Audio - Splitted ▸ Gamelan
Favorites
Desktop
Downloads
Dropbox
Google Drive
Recent places
OneDrive
Homegroup
This PC
Desktop
Documents
Downloads
Music
Pictures
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Home
Share
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Play
Copy
Paste
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Paste shortcut
Clipboard
Move to
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Delete
Rename
Organize
New folder
New
Properties
Open
Select all
Select none
Invert selection
Select
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Favorites
Desktop
Downloads
Dropbox
Google Drive
Recent places
OneDrive
Homegroup
This PC
Desktop
Documents
Downloads
Music
Pictures
Videos
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Local Disk (C:)
Bach - Air on a G String_1.wav
Bach - Air on a G String_2.wav
Bach - Air on a G String_3.wav
Bach - Air on a G String_4.wav
Bach - Air on a G String_5.wav
Bach - Air on a G String_6.wav
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Bach - Air on a G String_22.wav
Beethoven - Ode To Joy_1.wav
Beethoven - Ode To Joy_2.wav
Beethoven - Ode To Joy_3.wav
Beethoven - Ode To Joy_4.wav
Beethoven - Ode To Joy_5.wav
Beethoven - Ode To Joy_6.wav
Beethoven - Ode To Joy_7.wav
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Beethoven - Ode To Joy_12.wav
Beethoven - Ode To Joy_13.wav
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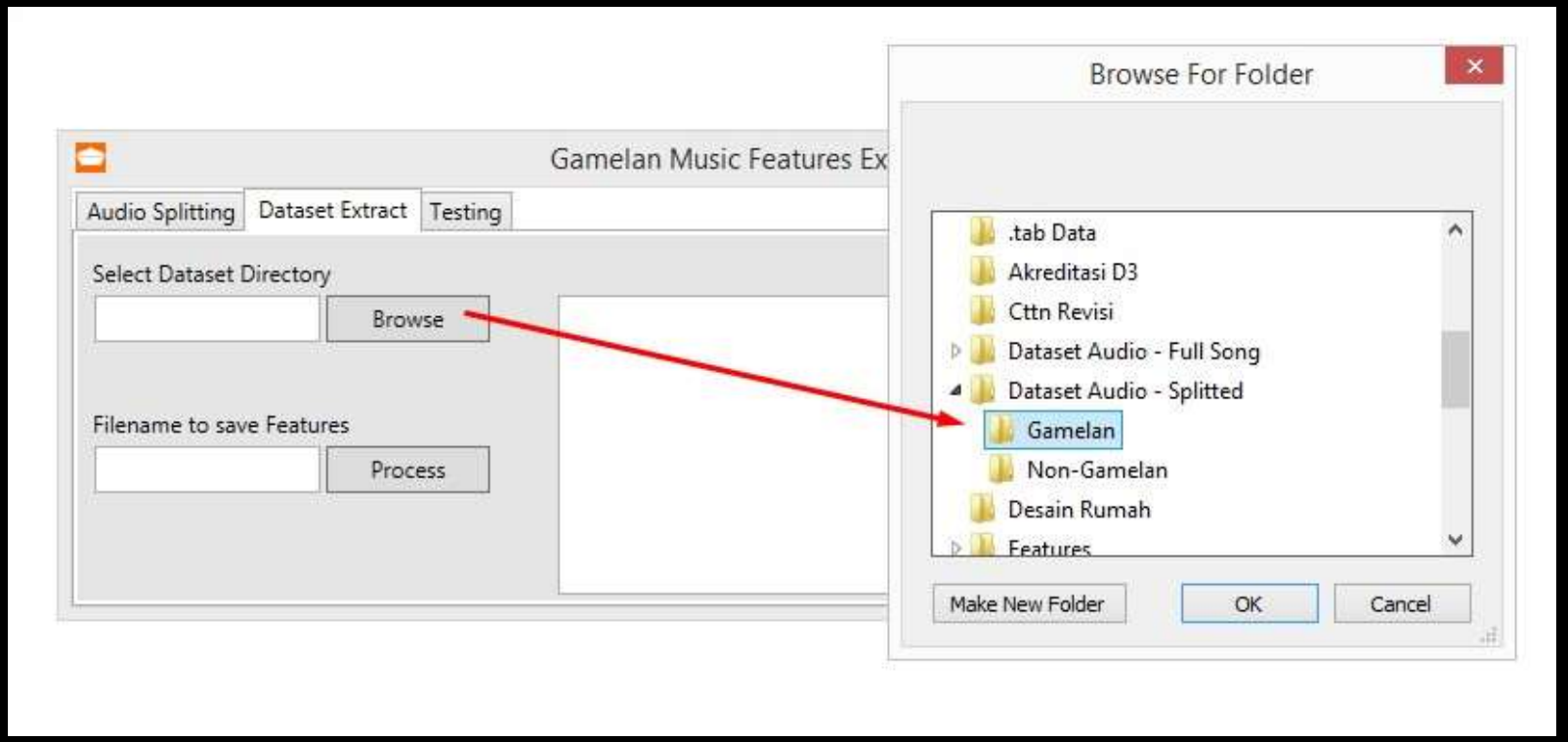
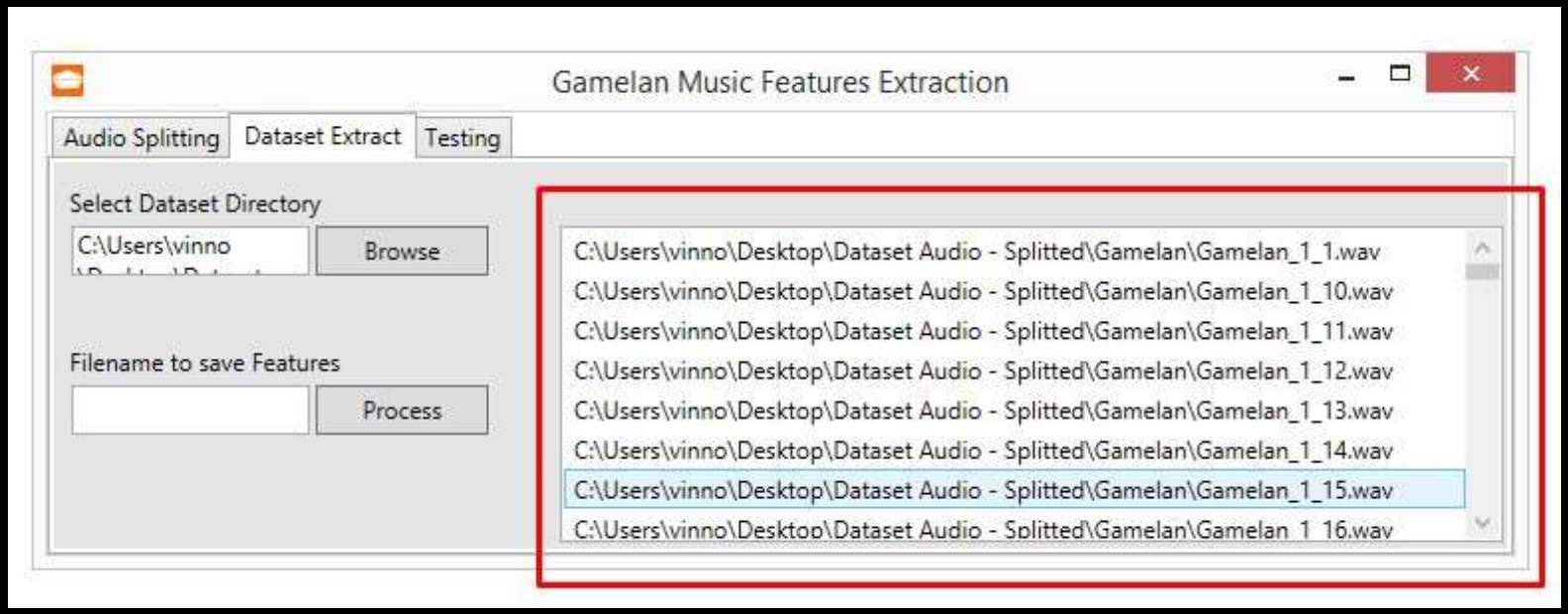
Beethoven - Ode To Joy_18.wav
Eagles - The



2. Dataset Extract


Gamelan Music Features Extraction
Audio Splitting
Dataset Extract
Testing
Select Dataset Directory
C:\Users\vinno
Browse
Filename to save Features
Process
C:\Users\vinno\Desktop\Dataset Audio - Splitted\Gamelan\Gamelan_1_1.wav
C:\Users\vinno\Desktop\Dataset Audio - Splitted\Gamelan\Gamelan_1_10.wav
C:\Users\vinno\Desktop\Dataset Audio - Splitted\Gamelan\Gamelan_1_11.wav
C:\Users\vinno\Desktop\Dataset Audio - Splitted\Gamelan\Gamelan_1_12.wav
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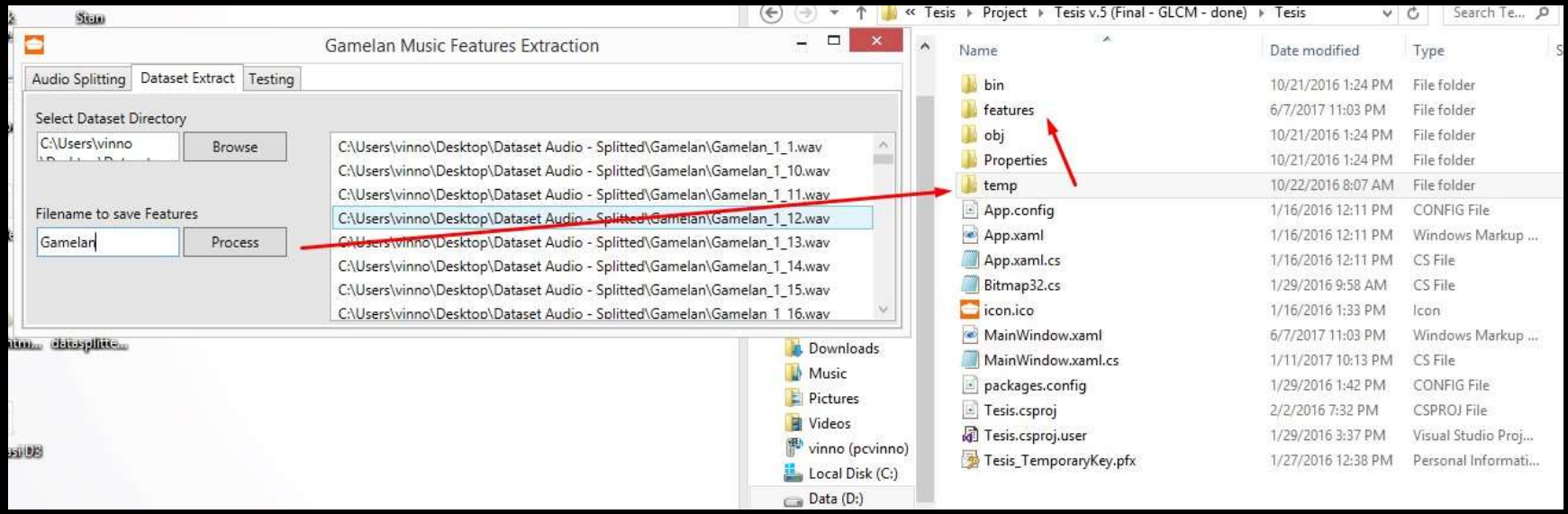
Gamelan Music Features Extraction
Audio Splitting
Dataset Extract
Testing
Select Dataset Directory
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App.config 1/16/2016 12:11 PM CONFIG File
App.xaml 1/16/2016 12:11 PM Windows Markup ...
App.xaml.cs 1/16/2016 12:11 PM CS File
Bitmap32.cs 1/29/2016 9:58 AM CS File
icon.ico 1/16/2016 1:33 PM Icon
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packages.config 1/29/2016 1:42 PM CONFIG File
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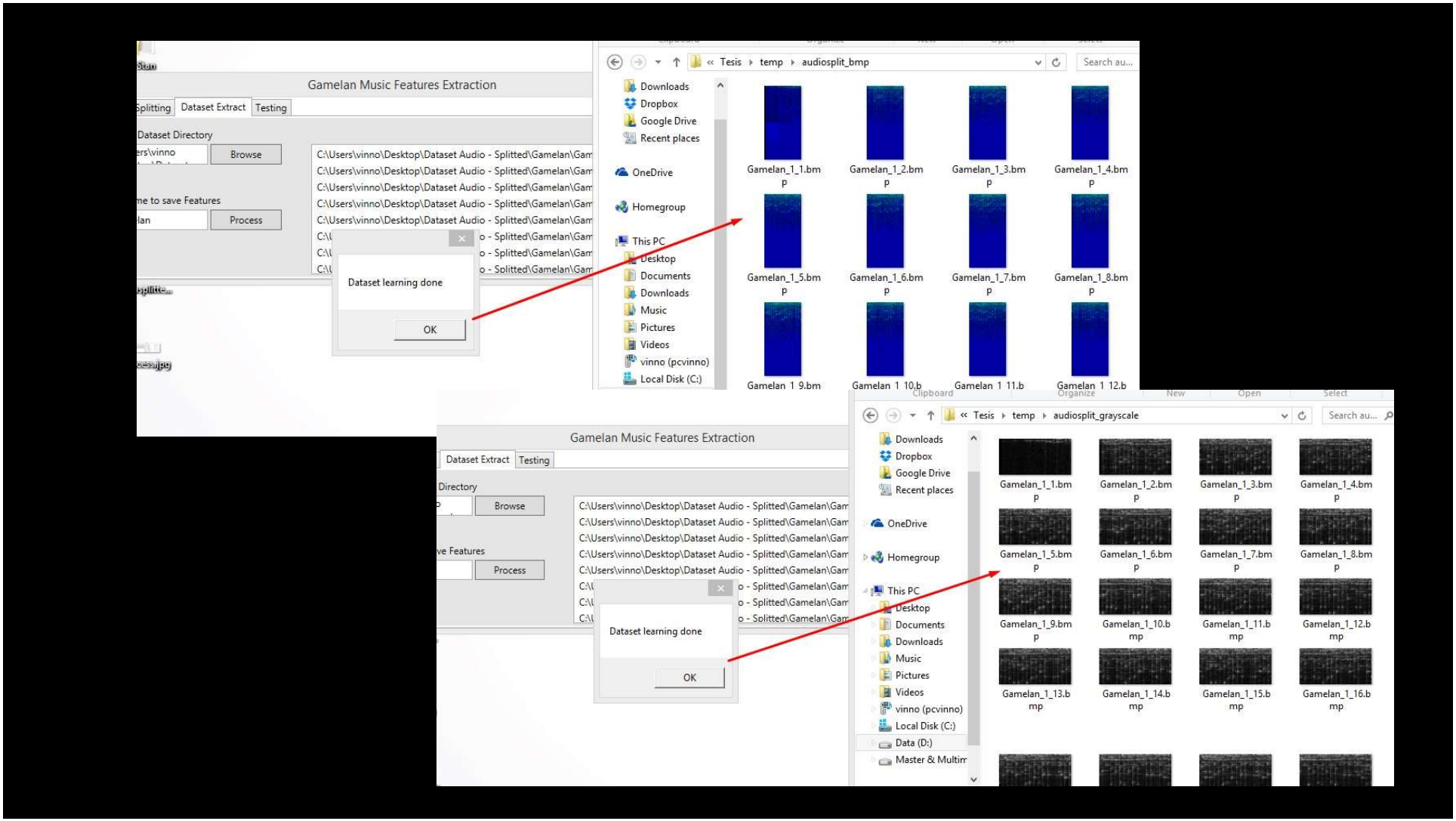
Gamelan Music Features Extraction
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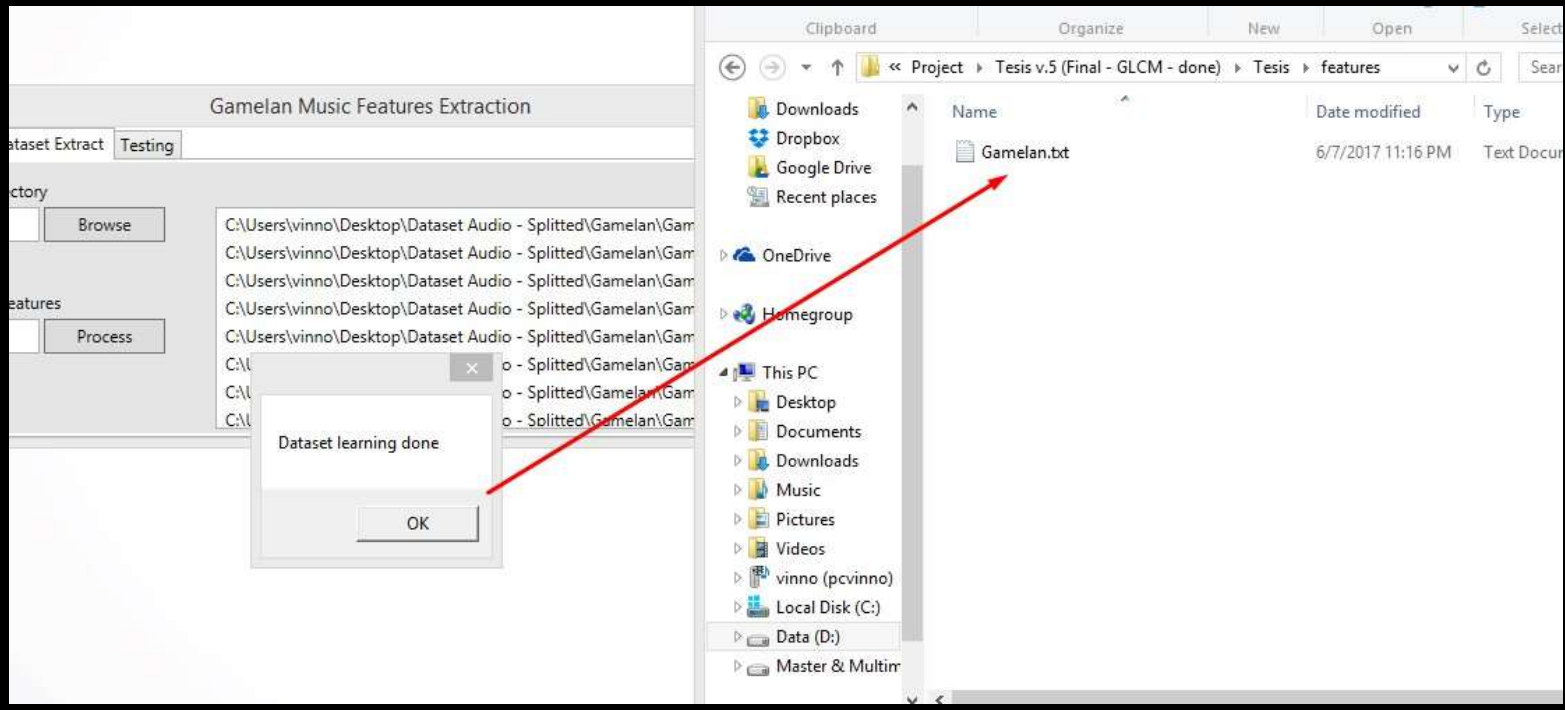
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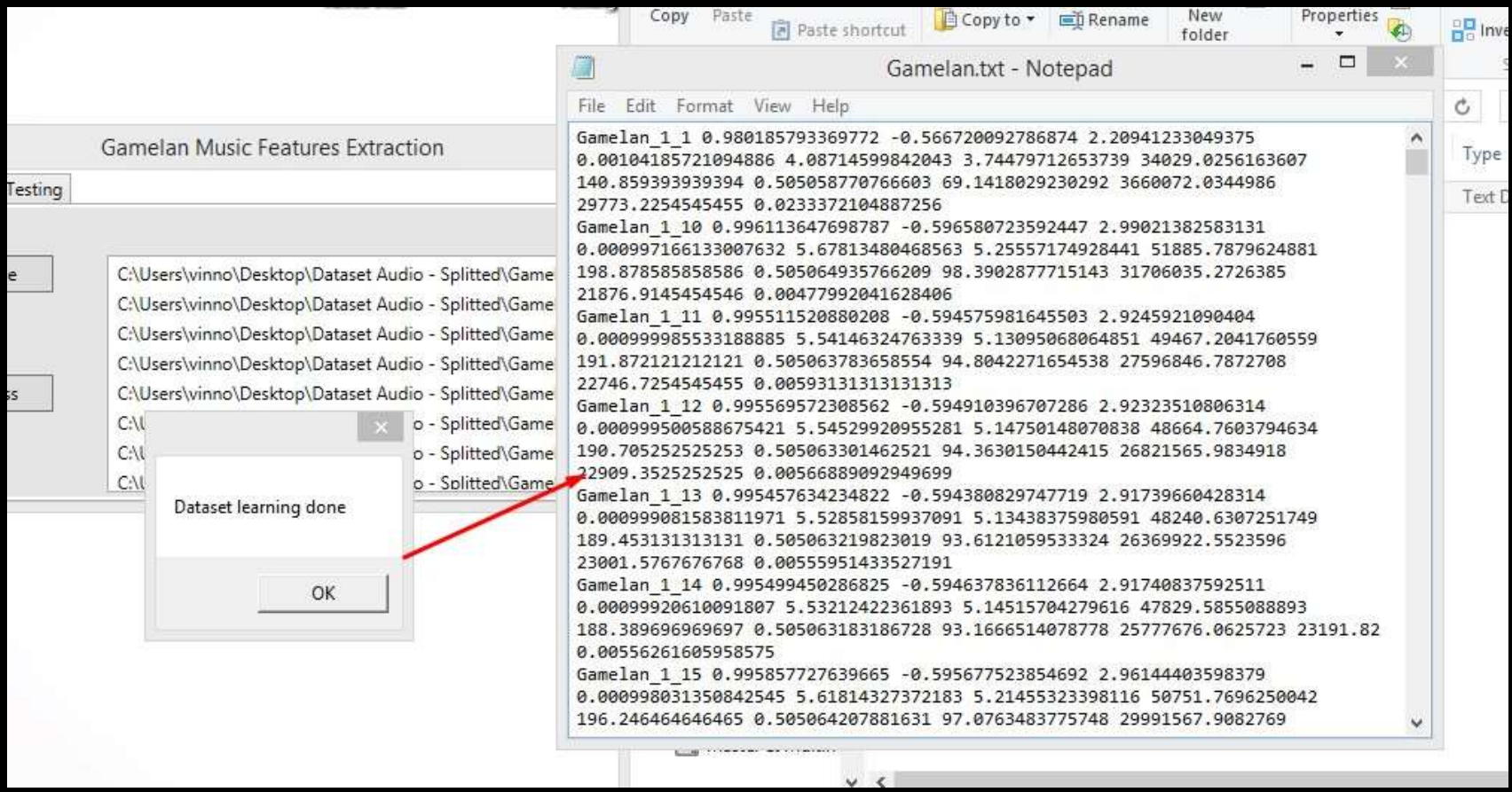
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0.00104185721094886 4.08714599842043 3.74479712653739 34029.0256163607
140.859393939394 0.505058770766603 69.1418029230292 3660072.0344986
29773.2254545455 0.0233372104887256
Gamelan_1_10 0.996113647698787 -0.596580723592447 2.99021382583131
0.000997166133007632 5.67813480468563 5.25557174928441 51885.7879624881
198.878585858586 0.505064935766209 98.3902877715143 31706035.2726385
21876.9145454546 0.00477992041628406
Gamelan_1_11 0.995511520880208 -0.594575981645503 2.9245921090404
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191.872121212121 0.505063783658554 94.8042271654538 27596846.7872708
22746.7254545455 0.00593131313131313
Gamelan_1_12 0.995569572308562 -0.594910396707286 2.92323510806314
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190.705252525253 0.505063301462521 94.3630150442415 26821565.9834918
22909.3525252525 0.00566889092949699
Gamelan_1_13 0.995457634234822 -0.594380829747719 2.91739660428314
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189.453131313131 0.505063219823019 93.6121059533324 26369922.5523596
23001.5767676768 0.00555951433527191
Gamelan_1_14 0.995499450286825 -0.594637836112664 2.91740837592511
0.00099920610091807 5.53212422361893 5.14515704279616 47829.5855088893
188.389696969697 0.505063183186728 93.1666514078778 25777676.0625723 23191.82
0.00556261605958575
Gamelan_1_15 0.995857727639665 -0.595677523854692 2.96144403598379
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196.246464646465 0.505064207881631 97.0763483775748 29991567.9082769
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Gamelan Music Features Extraction
Audio Splitting
Dataset Extract
Testing
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Extract
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Compute
RESULT
Class
Gamelan
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Integritas, Peduli, Tangguh, Etika, Kompeten

Thank you for your attention