penelitian_kln_2021_ser_beais_github

July 22, 2022

1 Connect to Github and Download dataset

```
[1]: #!git clone https://github.com/2black0/sound-emotion-recognition-javanese.git
```

```
Cloning into 'sound-emotion-recognition-javanese'…
remote: Enumerating objects: 1697, done.
remote: Counting objects: 100% (10/10), done.
remote: Compressing objects: 100% (10/10), done.
remote: Total 1697 (delta 1), reused 6 (delta 0), pack-reused 1687
Receiving objects: 100% (1697/1697), 124.20 MiB | 26.08 MiB/s, done.
Resolving deltas: 100% (1/1), done.
Checking out files: 100% (1686/1686), done.
```

2 Check Dataset

```
[28]: import os
      rootdir = os.getcwd()
      dirdataset = rootdir+"/dataset"
```

```
[29]: %cd $dirdataset
```

```
/home/ubuntu/Documents/GitHub/sound-emotion-recognition-javanese/dataset
```

```
[30]: %pwd
```

```
[30]: '/home/ubuntu/Documents/GitHub/sound-emotion-recognition-javanese/dataset'
```

```
[ ]: !ls
```

3 Check the train and test file

```
[32]: dirmodel = rootdir+"/model"
      %cd $dirmodel
```

```
/home/ubuntu/Documents/GitHub/sound-emotion-recognition-javanese/model
```

[33]:

```
!ls -l
```

```
total 592
-rw-rw-r-- 1 ubuntu ubuntu 134528 Jul 22 05:59 x_test.npy
-rw-rw-r-- 1 ubuntu ubuntu 403008 Jul 22 05:59 x_train.npy
-rw-rw-r-- 1 ubuntu ubuntu  15248 Jul 22 05:59 y_test.npy
-rw-rw-r-- 1 ubuntu ubuntu  45452 Jul 22 05:59 y_train.npy
```

4 Training & Testing

Perhatikan komentar di atas kode sebelum di-run

[34]:

```
#load module used
import os
import re
import glob
import pickle
import soundfile
import librosa
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split, cross_val_score
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score, classification_report,␣
  ↪confusion_matrix, ConfusionMatrixDisplay
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.gaussian_process import GaussianProcessClassifier
from sklearn.gaussian_process.kernels import RBF
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier, AdaBoostClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
import matplotlib.pyplot as plt

plt.style.use('seaborn-whitegrid')
%matplotlib inline
```

[36]:

```
#get the all file
def getListOfFiles(dirName):
  listOfFile = os.listdir(dirName)
  allFiles = list()
  for entry in listOfFile:
    fullPath = os.path.join(dirName, entry)
    if os.path.isdir(fullPath):
      allFiles = allFiles + getListOfFiles(fullPath)
    else:
      allFiles.append(fullPath)
  return allFiles
```

[37]:

```
#list of all the file, change dirName to directory of the dataset used
listOfFiles = getListOfFiles(dirdataset)
```

[ ]:

```
print(listOfFiles)
```

[39]:

```
#feature extraction using mfcc, chroma, and mel
def feature_extractor(file, mfcc, chroma, mel):
  with soundfile.SoundFile(file) as sound_file:
    file_array = sound_file.read(dtype="float32")
    sample_rate=sound_file.samplerate
    result=np.array([])
    if mfcc:
      mfccs=np.mean(librosa.feature.mfcc(y=file_array, sr=sample_rate,␣
 ↪n_mfcc=40).T, axis=0)
      result=np.hstack((result, mfccs))
    if chroma:
      stft=np.abs(librosa.stft(file_array))
      chroma=np.mean(librosa.feature.chroma_stft(S=stft, sr=sample_rate).
 ↪T,axis=0)
      result=np.hstack((result, chroma))
    if mel:
      mel=np.mean(librosa.feature.melspectrogram(file_array, sr=sample_rate).
 ↪T,axis=0)
      result=np.hstack((result, mel))
  return result
```

[40]:

```
#list of emotion
emotions={
        '01':'neutral',
        '02':'sad',
        '03':'happy',
        '04':'surprised',
        '05':'fearful',
        '06':'angry',
        }

observed_emotions=['neutral', 'sad', 'happy', 'surprised', 'fearful', 'angry']
```

[ ]:

```
#pastikan tercetak 3 data:
# -path lengkap dari file dataset (contoh: /content/drive/MyDrive/Colab/
 ↪penelitian-kln/clean-dataset/04-01-06_02.wav)
# -nama file (contoh: 04-01-06_02.wav)
# -emotion(contoh: angry)

for file in listOfFiles:
  #print(file)
  file_name=os.path.basename(file)
  emotion=emotions[re.split("-|_", file_name)[2]]
  print('file:{} file_name:{} emotion:{}'.format(file, file_name, emotion))
```

[42]:

```
def data_loarder(listOfFiles, test_size=0.25):
  x,y=[],[]
  for file in listOfFiles:
    file_name=os.path.basename(file)
    emotion=emotions[re.split("-|_", file_name)[2]]
    if emotion not in observed_emotions:
      continue
    feature=feature_extractor(file, mfcc=True, chroma=False, mel=False)
    x.append(feature)
    y.append(emotion)
  return train_test_split(np.array(x), y, test_size=test_size)
```

4.1 PERHATIAN:

Apabila sudah terdapat file x_test.npy x_train.npy y_test.npy y_train.npy pada folder model tidak perlu menjalankan cell ini

[ ]:

```
#cukup jalankan 1x saja apabila file2 di bawah ini belum ada
x_train, x_test, y_train, y_test = data_loarder(listOfFiles, test_size=0.25)

%cd /home/ubuntu/Documents/GitHub/sound-emotion-recognition-javanese/model
np.save('x_train.npy', x_train)
np.save('x_test.npy', x_test)
np.save('y_train.npy', y_train)
np.save('y_test.npy', y_test)
```

PERHATIAN: Apabila pada bagian ini error, silahkan jalankan kode di atas dan pastikan sudah terdapat file *x_test.npy x_train.npy y_test.npy y_train.npy pada folder model

[44]:

```
%cd $dirmodel
x_trains = np.load('x_train.npy')
x_tests = np.load('x_test.npy')
y_trains = np.load('y_train.npy')
y_tests = np.load('y_test.npy')
```

```
/home/ubuntu/Documents/GitHub/sound-emotion-recognition-javanese/model
```

[45]:

```
#menghitung persebaran dataset yang ada pada train dan test pada masing2 label
emotions, counts = np.unique(y_trains, return_counts=True)
print('label train:', dict(zip(emotions, counts)))

emotions, counts = np.unique(y_tests, return_counts=True)
print('label test:', dict(zip(emotions, counts)))
```

```
label train: {'angry': 196, 'fearful': 219, 'happy': 213, 'neutral': 208, 'sad':
216, 'surprised': 207}
label test: {'angry': 84, 'fearful': 61, 'happy': 66, 'neutral': 72, 'sad': 64,
'surprised': 73}
```

[87]:

```
#beberapa algoritma untuk klasifikasi
classifiers = [
    KNeighborsClassifier(),
    SVC(kernel="linear", C=0.025),
    RandomForestClassifier(max_depth=5, random_state=43),
    MLPClassifier(alpha=0.01, max_iter=1000),
    QuadraticDiscriminantAnalysis()]
```

[88]:

```
names = ["Nearest Neighbors", "Linear SVC", "Random Forest", "Neural Net",␣
 ↪"QDA"]
```

[89]:

```
# iterate over classifiers
for name, clf in zip(names, classifiers):
    clf.fit(x_trains, y_trains)
    score = clf.score(x_tests, y_tests)
    print(f"Accuracy of {name} Classifier is:{score}")
```

```
Accuracy of Nearest Neighbors Classifier is:0.8119047619047619
Accuracy of Linear SVC Classifier is:0.7214285714285714
Accuracy of Random Forest Classifier is:0.6952380952380952
Accuracy of Neural Net Classifier is:0.8452380952380952
Accuracy of QDA Classifier is:0.8642857142857143
```

5 Hyper Parameter Tuning

5.1 Neural Network Hyperparameter

[49]:

```
import optuna
```

[ ]:

```
def objective(trial):
    layers = trial.suggest_categorical('layers',[1,2])
    h1 = trial.suggest_int('h1',10,500)
    max_i = trial.suggest_int('max_i',10,1000)
    lr_init = trial.suggest_uniform('lr',0.00001,0.1)
    ni = trial.suggest_int('noi',10,30)
    #act = trial.suggest_categorical('activation',['identity', 'logistic',␣
  ↪'tanh', 'relu'])
    #sol = trial.suggest_categorical('solver',['lbfgs', 'sgd', 'adam'])

    if layers==1:
        clf = MLPClassifier(random_state=11,
                            hidden_layer_sizes=(h1),
                            max_iter=max_i,
                            learning_rate_init=lr_init,
                            n_iter_no_change=ni)
                            #activation=act,
                            #solver=sol)
    else:
        h2 = trial.suggest_int('h2',10,500)
        clf = MLPClassifier(random_state=11,
                            hidden_layer_sizes=(h1,h2),
                            max_iter=max_i,
                            learning_rate_init=lr_init,
                            n_iter_no_change=ni)
                            #activation=act,
                            #solver=sol)

    #clf.fit(x_trains, y_trains)
    #return clf.score(x_tests, y_tests)
    score = cross_val_score(clf, x_trains, y_trains, n_jobs=-1, cv=3)
    accuracy = score.mean()
    return accuracy

study = optuna.create_study(direction='maximize')
study.optimize(objective, n_trials=500)
print(study.best_params)
```

{‘layers’: 2, ‘h1’: 406, ‘max_i’: 679, ‘lr’: 6.885053259405357e-05, ‘noi’: 25, ‘h2’: 374}

[50]:

```
classifier = MLPClassifier(learning_rate_init=6.885053259405357e-05,␣
  ↪max_iter=679, n_iter_no_change=25, hidden_layer_sizes=(406,374))

classifier.fit(x_trains, y_trains)
score = classifier.score(x_tests, y_tests)
print(f"Accuracy of Neural Network Classifier is:{score}")
```

```
Accuracy of Neural Network Classifier is:0.8976190476190476
```

```
/home/ubuntu/miniconda3/envs/kln/lib/python3.9/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (679) reached and
the optimization hasn't converged yet.
  warnings.warn(
```

5.2 KNN Hyperparameter

[ ]:

```
def objective(trial):
    optimizer = trial.suggest_categorical('algorithm',␣
 ↪['auto','ball_tree','kd_tree','brute'])
    rf_max_depth = trial.suggest_int("k_n_neighbors", 2, 15, log=True)
    clf = KNeighborsClassifier(algorithm=optimizer, n_neighbors=rf_max_depth)

    score = cross_val_score(clf, x_trains, y_trains, n_jobs=-1, cv=3)
    accuracy = score.mean()
    return accuracy

    #classifier_obj.fit(x_trains, y_trains)
    #return classifier_obj.score(x_tests, y_tests)

study = optuna.create_study(direction='maximize')
study.optimize(objective, n_trials=1000)
print(study.best_params)
```

[51]:

```
classifier = KNeighborsClassifier(algorithm='kd_tree', n_neighbors=3)

classifier.fit(x_trains, y_trains)
score = classifier.score(x_tests, y_tests)
print(f"Accuracy of KNeighbors Classifier is:{score}")
```

```
Accuracy of KNeighbors Classifier is:0.8261904761904761
```

5.3 SVM Hyperparameter

[ ]:

```
def objective(trial):
    #kernel = trial.suggest_categorical('kernel', ['linear', 'poly', 'rbf',␣
 ↪'sigmoid'])
    kernel = trial.suggest_categorical('kernel', ['linear', 'poly'])
    regularization = trial.suggest_uniform('svm-regularization', 0.01, 10)
    degree = trial.suggest_discrete_uniform('degree', 1, 5, 1)
    clf = SVC(kernel=kernel, C=regularization, degree=degree)

    score = cross_val_score(clf, x_trains, y_trains, n_jobs=-1, cv=3)
    accuracy = score.mean()
    return accuracy

study = optuna.create_study(direction='maximize')
study.optimize(objective, n_trials=200)
print(study.best_params)
```

[53]:

```
#classifier = SVC(kernel='linear', C=1.4965680888866226, degree=1.0)
classifier = SVC(kernel='linear', C=1.4873029879624768, degree=2.0)
```

```
classifier.fit(x_trains, y_trains)
score = classifier.score(x_tests, y_tests)
print(f"Accuracy of SVM Classifier is:{score}")
```

```
Accuracy of SVM Classifier is:0.7166666666666667
```

5.4 Random Forest Hyperparameter

[ ]:

```
def objective(trial):
    rf_n_estimators = trial.suggest_int("rf_n_estimators", 10, 1000)
    rf_max_depth = trial.suggest_int("rf_max_depth", 2, 32, log=True)
    classifier_obj = RandomForestClassifier(max_depth=rf_max_depth,␣
  ↪n_estimators=rf_n_estimators)

    score = cross_val_score(clf, x_trains, y_trains, n_jobs=-1, cv=3)
    accuracy = score.mean()
    return accuracy

study = optuna.create_study(direction='maximize')
study.optimize(objective, n_trials=500)
print(study.best_params)
```

[54]:

```
classifier = RandomForestClassifier(max_depth=8, n_estimators=90)

classifier.fit(x_trains, y_trains)
score = classifier.score(x_tests, y_tests)
print(f"Accuracy of Random Forest Classifier is:{score}")
```

```
Accuracy of Random Forest Classifier is:0.8142857142857143
```

---

6 Report

6.1 Kearest Neighbors Classifier

[105]:

```
#cetak precision, recall, f1-score, dan support dari Nearest Neighbors␣
  ↪Classifier
y_pred=classifiers[0].predict(x_tests)

print("Classification Report of KNearest Neighbors Classifier")
print("Accuracy = %0.2f" % accuracy_score(y_tests, y_pred))
print(classification_report(y_tests, y_pred))
```

```
Classification Report of KNearest Neighbors Classifier
Accuracy = 0.81
              precision    recall  f1-score   support
```

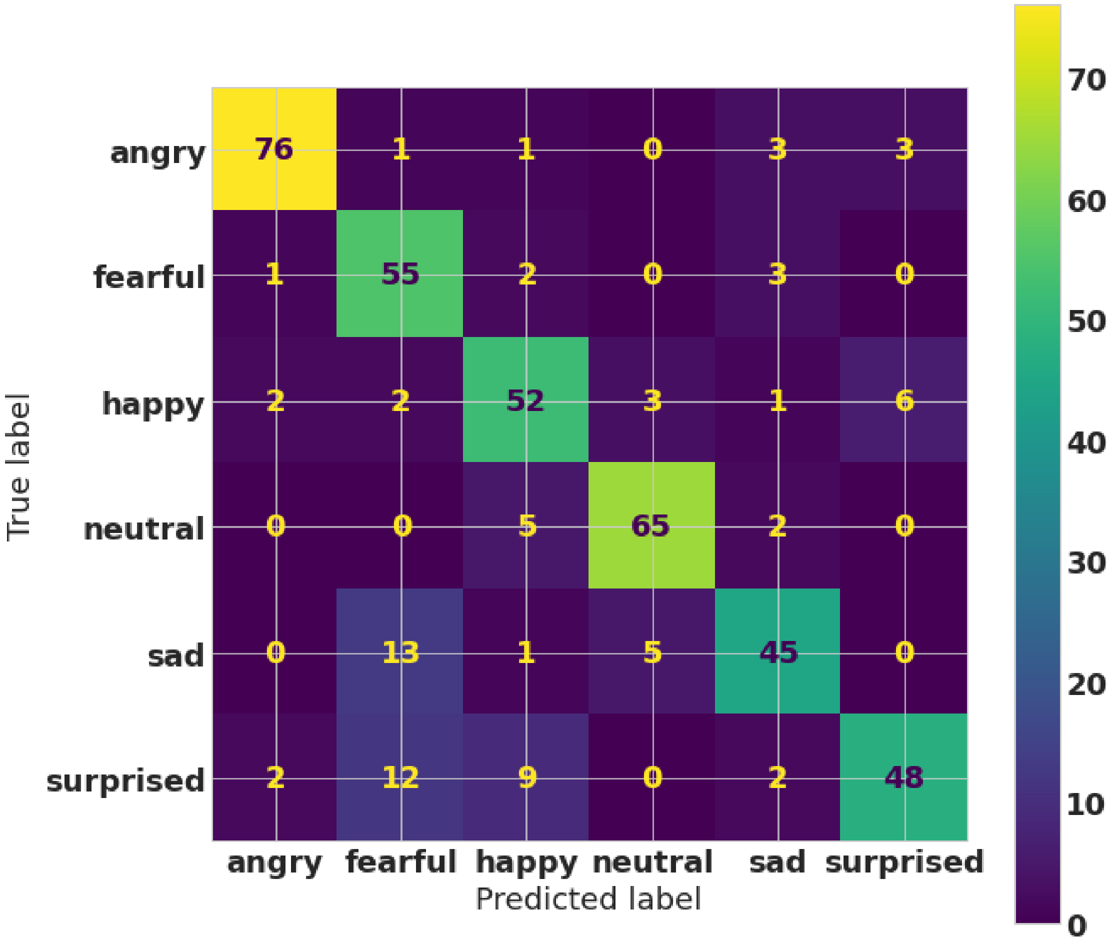
```
       angry       0.94      0.90      0.92        84
     fearful       0.66      0.90      0.76        61
       happy       0.74      0.79      0.76        66
     neutral       0.89      0.90      0.90        72
         sad       0.80      0.70      0.75        64
   surprised       0.84      0.66      0.74        73

    accuracy                           0.81       420
   macro avg       0.81      0.81      0.81       420
weighted avg       0.82      0.81      0.81       420
```

[106]:

```
#plot confusion matrix Nearest Neighbors Classifier
cm = confusion_matrix(y_tests, y_pred)
cmp = ConfusionMatrixDisplay(cm, display_labels=classifiers[0].classes_)
fig, ax = plt.subplots(figsize=(10,10))
cmp.plot(ax=ax)
```

[106]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ff5bd45c6d0>
```



6.2 Linear SVC

[107]:

```
#cetak precision, recall, f1-score, dan support dari Linear SVC Classifier
y_pred=classifiers[1].predict(x_tests)

print("Classification Report of Linear SVC Classifier")
print("Accuracy = %0.2f" % accuracy_score(y_tests, y_pred))
print(classification_report(y_tests, y_pred))
```

```
Classification Report of Linear SVC Classifier
Accuracy = 0.72
              precision    recall  f1-score   support

       angry       0.79      0.88      0.83        84
     fearful       0.61      0.66      0.63        61
       happy       0.63      0.68      0.66        66
     neutral       0.89      0.88      0.88        72
         sad       0.66      0.59      0.62        64
```

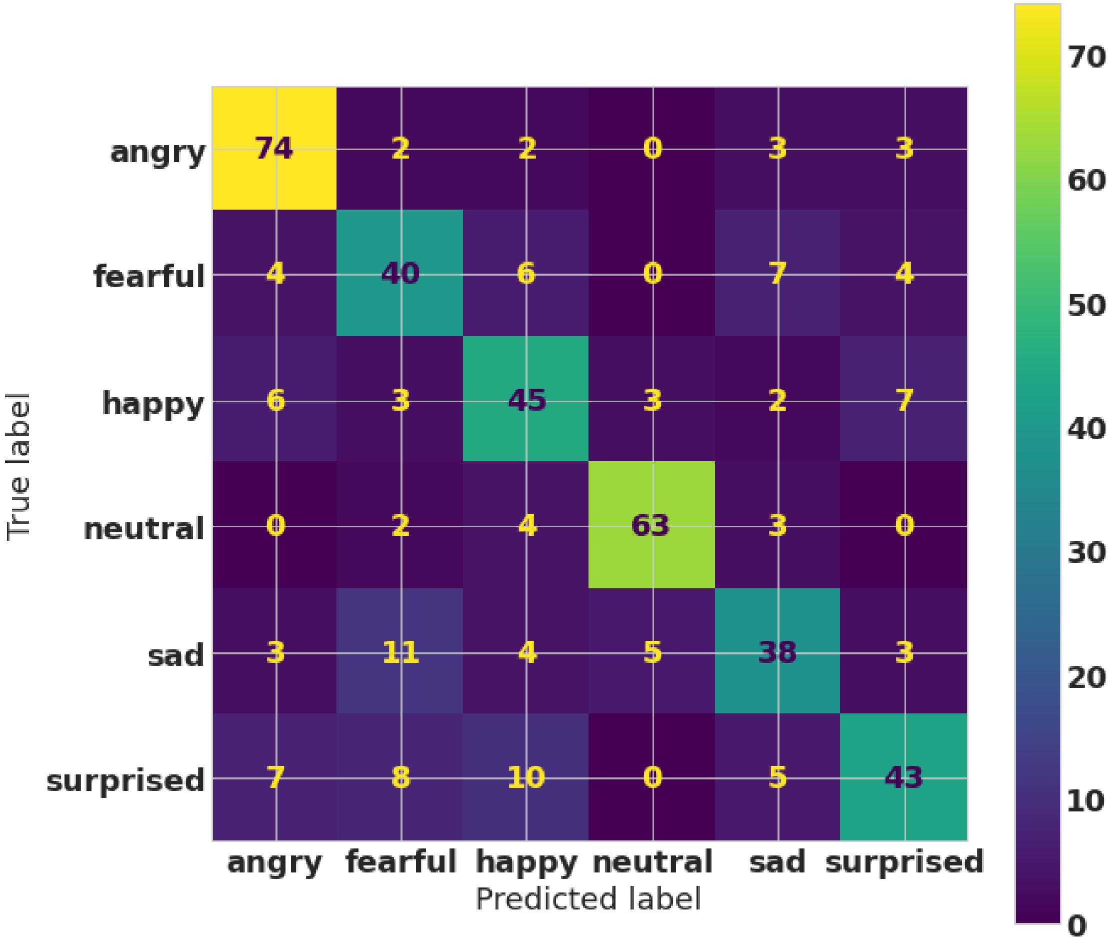
```
   surprised       0.72      0.59      0.65        73

    accuracy                           0.72       420
   macro avg       0.71      0.71      0.71       420
weighted avg       0.72      0.72      0.72       420
```

[108]:

```
#plot confusion matrix Nearest Neighbors Classifier
cm = confusion_matrix(y_tests, y_pred)
cmp = ConfusionMatrixDisplay(cm, display_labels=classifiers[1].classes_)
fig, ax = plt.subplots(figsize=(10,10))
cmp.plot(ax=ax)
```

[108]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ff5bd339b50>
```



	angry	fearful	happy	neutral	sad	surprised
angry	74	2	2	0	3	3
fearful	4	40	6	0	7	4
happy	6	3	45	3	2	7
neutral	0	2	4	63	3	0
sad	3	11	4	5	38	3
surprised	7	8	10	0	5	43

6.3 Random Forest

[109]:

```
#cetak precision, recall, f1-score, dan support dari Random Forest Classifier
y_pred=classifiers[2].predict(x_tests)

print("Classification Report of Random Forest Classifier")
print("Accuracy = %0.2f" % accuracy_score(y_tests, y_pred))
print(classification_report(y_tests, y_pred))
```

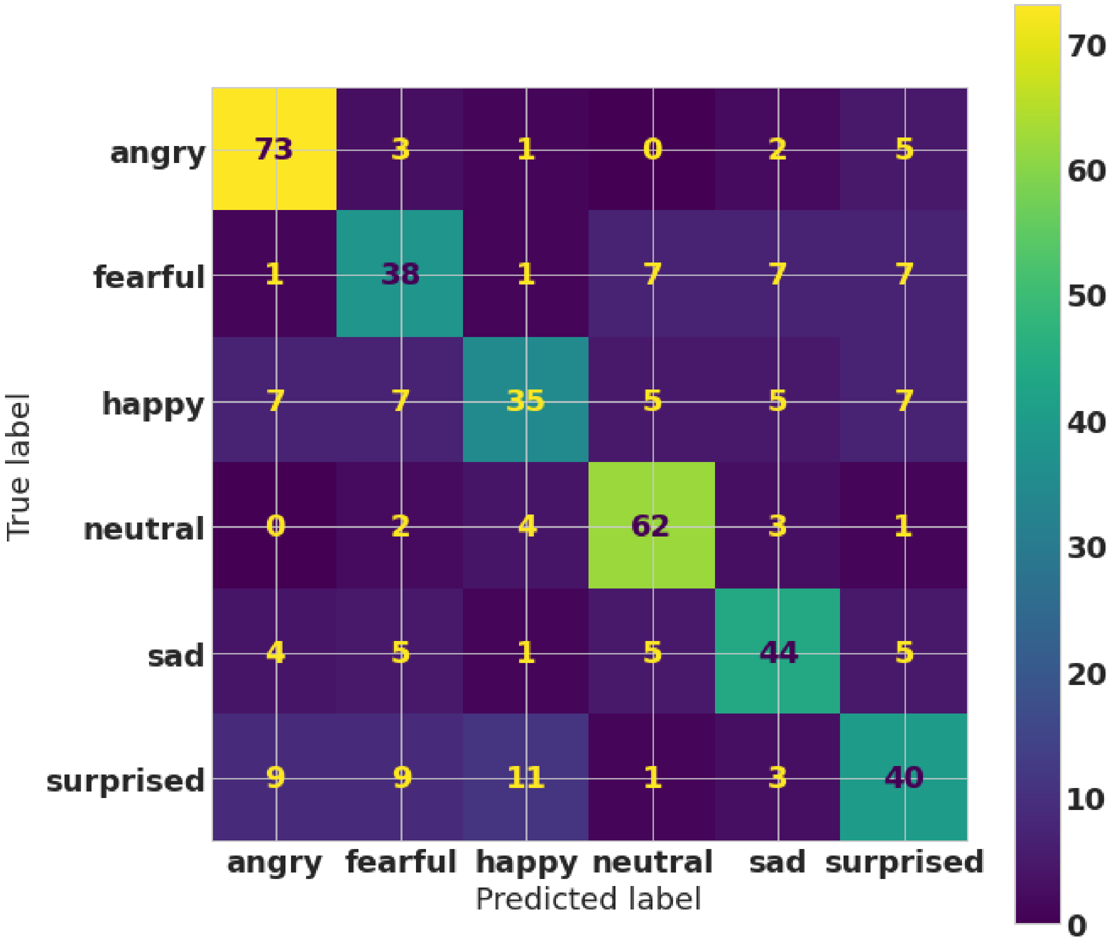
```
Classification Report of Random Forest Classifier
Accuracy = 0.70
              precision    recall  f1-score   support

       angry       0.78      0.87      0.82        84
     fearful       0.59      0.62      0.61        61
       happy       0.66      0.53      0.59        66
     neutral       0.78      0.86      0.82        72
         sad       0.69      0.69      0.69        64
   surprised       0.62      0.55      0.58        73

    accuracy                           0.70       420
   macro avg       0.68      0.69      0.68       420
weighted avg       0.69      0.70      0.69       420
```

[110]:

```
#plot confusion matrix Nearest Neighbors Classifier
cm = confusion_matrix(y_tests, y_pred)
cmp = ConfusionMatrixDisplay(cm, display_labels=classifiers[2].classes_)
fig, ax = plt.subplots(figsize=(10,10))
cmp.plot(ax=ax)
```

[110]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ff591350cd0>
```



6.4 Neural Network

[112]:
```
#cetak precision, recall, f1-score, dan support dari Neural Network Classifier
y_pred=classifiers[3].predict(x_tests)

print("Classification Report of Neural Network Classifier")
print("Accuracy = %0.2f" % accuracy_score(y_tests, y_pred))
print(classification_report(y_tests, y_pred))
```

```
Classification Report of Neural Network Classifier
Accuracy = 0.85
              precision    recall  f1-score   support

       angry       0.93      0.85      0.89        84
     fearful       0.87      0.75      0.81        61
       happy       0.71      0.92      0.80        66
     neutral       0.97      0.92      0.94        72
         sad       0.79      0.89      0.84        64
```

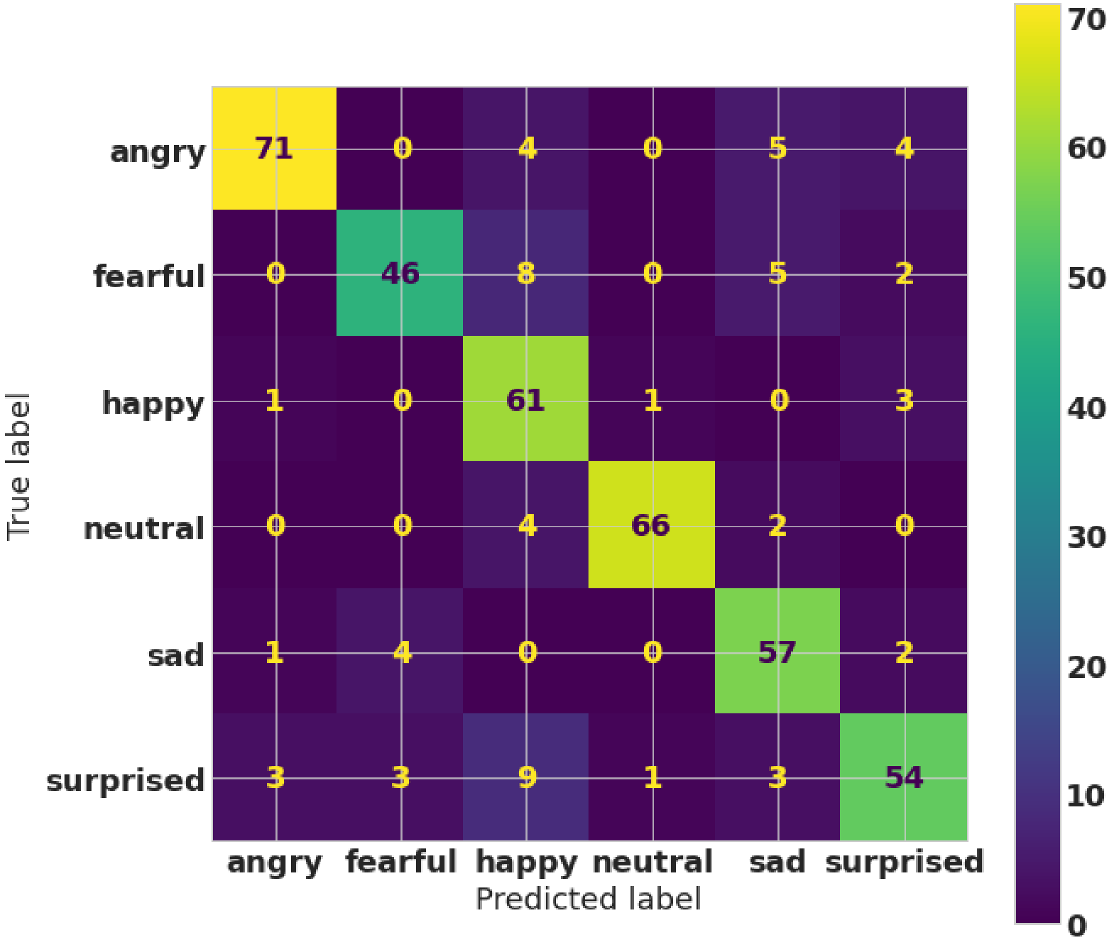
```
   surprised       0.83      0.74      0.78        73

    accuracy                           0.85       420
   macro avg       0.85      0.85      0.84       420
weighted avg       0.86      0.85      0.85       420
```

[113]:

```
#plot confusion matrix Nearest Neighbors Classifier
cm = confusion_matrix(y_tests, y_pred)
cmp = ConfusionMatrixDisplay(cm, display_labels=classifiers[3].classes_)
fig, ax = plt.subplots(figsize=(10,10))
cmp.plot(ax=ax)
```

[113]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ff589e3d1c0>
```



6.5 QDA Classifier

[114]:

```
#cetak precision, recall, f1-score, dan support dari QDA Classifier
y_pred=classifiers[4].predict(x_tests)

print("Classification Report of QDA Classifier ")
print("Accuracy = %0.2f" % accuracy_score(y_tests, y_pred))
print(classification_report(y_tests, y_pred))
```

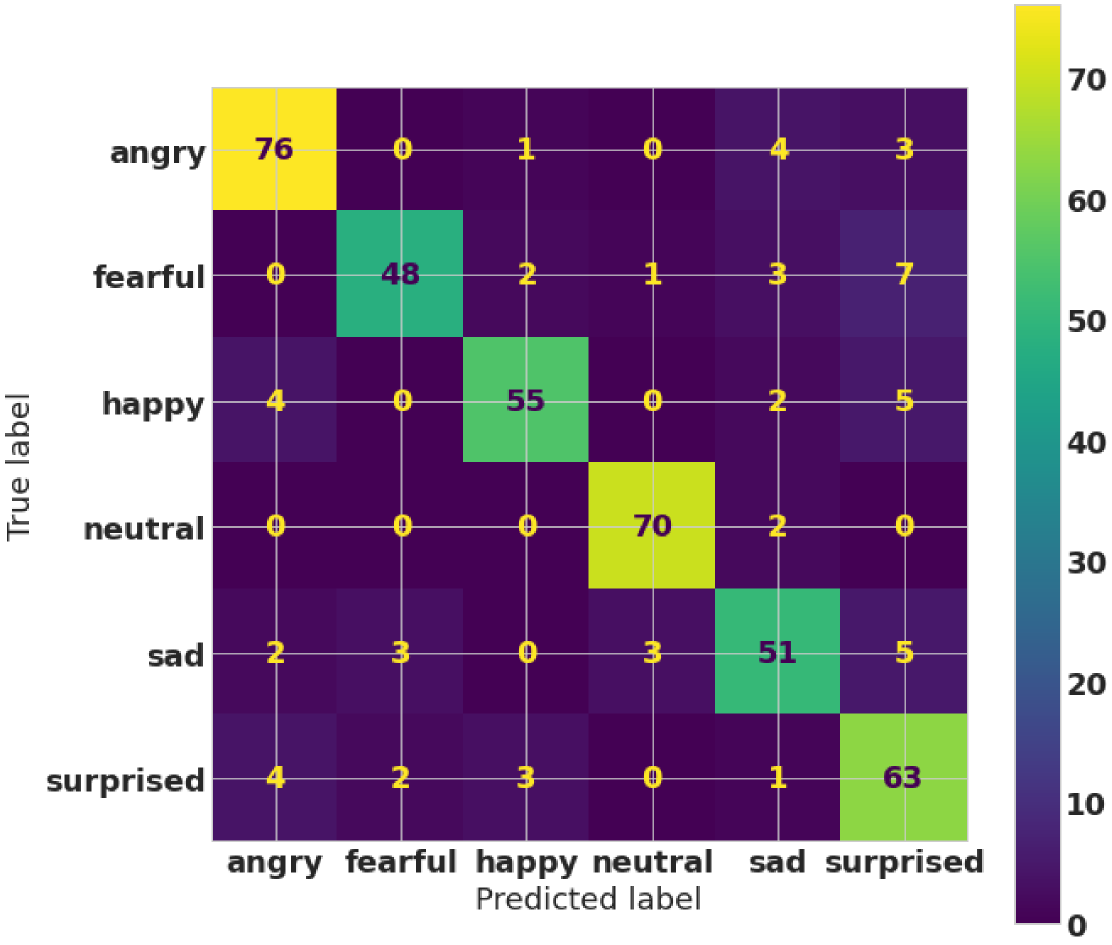
```
Classification Report of QDA Classifier
Accuracy = 0.86
              precision    recall  f1-score   support

       angry       0.88      0.90      0.89        84
     fearful       0.91      0.79      0.84        61
       happy       0.90      0.83      0.87        66
     neutral       0.95      0.97      0.96        72
         sad       0.81      0.80      0.80        64
   surprised       0.76      0.86      0.81        73

    accuracy                           0.86       420
   macro avg       0.87      0.86      0.86       420
weighted avg       0.87      0.86      0.86       420
```

[115]:

```
#plot confusion matrix Nearest Neighbors Classifier
cm = confusion_matrix(y_tests, y_pred)
cmp = ConfusionMatrixDisplay(cm, display_labels=classifiers[4].classes_)
fig, ax = plt.subplots(figsize=(10,10))
cmp.plot(ax=ax)
```

[115]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ff589e3a3d0>
```



7 Import Model

Bagian ini digunakan untuk menyimpan model hasil training

[117]:

```
import pickle
```

[118]:

```
#change directory
%cd $dirmodel
```

```
/home/ubuntu/Documents/GitHub/sound-emotion-recognition-javanese/model
```

[120]:

```
# save the model to disk
filename = 'final_model_NeuralNetwork.sav'
pickle.dump(classifiers[3], open(filename, 'wb'))
```

8 Test the Model

Bagian ini untuk meload file model agar bisa digunakan untuk prediksi

[122]:

```
# load the model from disk
filename = 'final_model_NeuralNetwork.sav'

loaded_model = pickle.load(open(filename, 'rb'))
result = loaded_model.score(x_tests, y_tests)
print(result)
```

```
0.8452380952380952
```

Penamaan File

aa-bb-cc-dd.wav

- aa -> Aktor 01-10
- bb -> Kalimat 01-04
- cc -> Ekspresi 01-06
- dd -> Pengulanan 01-07

Eskpresi: - 01 - Neutral / Biasa - 02 - Sadness / Susah - 03 - Happiness / Seneng - 04 - Surprise / Kaget - 05 - Fear / Wedi - 06 - Anger / Ness

contoh: *01-02-03-04.wav*

- 01 -> Aktor 01
- 02 -> Kalimat ke-02
- 03 -> Ekspresi ke-03
- 04 -> Pengulanan ke-04

[123]:

```
#feature extraction dari file yang akan di uji / di prediksi
x = []
file_test = dirdataset+"/01-03-02_04.wav"
feature=feature_extractor(file_test, mfcc=True, chroma=False, mel=False)
x.append(feature)
```

[124]:

```
#hasil prediksi berdasarkan model aktif
y=classifiers[3].predict(x)
print(y)
```

```
['sad']
```

[125]:

```
#hasil prediksi berdasarkan file model
y_m = loaded_model.predict(x)
print(y_m)
```

```
['sad']
```