DistractedDriverDetection

May 16, 2025

[1]:
```
# importing libraries
import os
import numpy as np
import pandas as pd
import tensorflow as tf
```

[2]:
```
# loading dataset
data = pd.read_csv("/kaggle/input/state-farm-distracted-driver-detection/
 ↪driver_imgs_list.csv");
print(data.shape);
print(data.head());
```

```
(22424, 3)
  subject classname            img
0    p002        c0  img_44733.jpg
1    p002        c0  img_72999.jpg
2    p002        c0  img_25094.jpg
3    p002        c0  img_69092.jpg
4    p002        c0  img_92629.jpg
```

[3]:
```
# function to read image
def readimage(path):
    img = tf.keras.utils.load_img(path,color_mode = "rgb");
    img = tf.keras.utils.img_to_array(img);
    return img/255;
```

[4]:
```
# plotting training images
from matplotlib import pyplot as plt
baseurl = "/kaggle/input/state-farm-distracted-driver-detection/imgs/train/";
activitymap = {'c0' : 'Safe driving','c1': 'Texting - right','c2': 'Talking on␣
 ↪the phone - right',
'c3': 'Texting - left','c4': 'Talking on the phone - left','c5': 'Operating the␣
 ↪radio',
'c6': 'Drinking','c7': 'Reaching behind','c8': 'Hair and makeup','c9': 'Talking␣
 ↪to passenger'};
fig = plt.figure(figsize = (10,4));
for i,directory in enumerate(sorted(activitymap.keys())):
    imagefile = os.listdir(os.path.join(baseurl,directory))[0];
```

```
    imagepath = os.path.join(baseurl,directory,imagefile);
    image = readimage(imagepath);
    ax = fig.add_subplot(2,5,i + 1);
    ax.imshow(image);
    ax.set_title(activitymap[directory]);
    ax.axis("off");
plt.tight_layout();
```

[5]:
```
# importing libraries and setting up neural network model
from tensorflow.keras import Sequential
from tensorflow.keras.layers import Dense,Conv2D,Flatten,MaxPooling2D,Dropout
model = Sequential();
```

[6]:
```
# adding layers to neural network model
model.add(Conv2D(128,(3,3),activation = "relu",input_shape = (240,240,3),
data_format = "channels_last"));
model.add(MaxPooling2D((2,2)));
model.add(Conv2D(64,(3,3),activation = "relu"));
model.add(MaxPooling2D((2,2)));
model.add(Conv2D(32,(3,3),activation = "relu"));
model.add(MaxPooling2D((2,2)));
model.add(Flatten());
model.add(Dense(1024,activation = "relu"));
model.add(Dropout(0.2));
model.add(Dense(1024,activation = "relu"));
model.add(Dropout(0.2));
model.add(Dense(256,activation = "relu"));
model.add(Dropout(0.2));
model.add(Dense(10,activation = "softmax"));
```

```
/usr/local/lib/python3.10/dist-
packages/keras/src/layers/convolutional/base_conv.py:107: UserWarning: Do not
pass an `input_shape`/`input_dim` argument to a layer. When using Sequential
```

```
models, prefer using an `Input(shape)` object as the first layer in the model
instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

[7]:
```
# compiling the model
model.compile(optimizer = "adam",loss = "categorical_crossentropy",
metrics = ["accuracy",tf.keras.metrics.Precision(),tf.keras.metrics.Recall(),tf.
 ↪keras.metrics.AUC()]);
```

[8]:
```
# Import ImageDataGenerator and define paths, generators for training,␣
 ↪validation, and test sets
from tensorflow.keras.preprocessing.image import ImageDataGenerator
train_dir = "/kaggle/input/state-farm-distracted-driver-detection/imgs/train";
test_dir = "/kaggle/input/state-farm-distracted-driver-detection/imgs/";
train_datagen = ImageDataGenerator(rescale = 1.0/255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True,
                                   validation_split = 0.2);
train_generator = train_datagen.flow_from_directory(
    train_dir,target_size = (240,240),class_mode = "categorical",batch_size =␣
 ↪32,
    subset = "training"
);
validation_generator = train_datagen.flow_from_directory(
    train_dir,target_size = (240,240),class_mode = "categorical",batch_size =␣
 ↪32,
    subset = "validation"
);
test_datagen = ImageDataGenerator(rescale = 1.0/255);
test_generator = test_datagen.flow_from_directory(
     test_dir,target_size = (240,240),classes = ["test"],class_mode =␣
 ↪None,batch_size = 32,shuffle = False
)
```

```
Found 17943 images belonging to 10 classes.
Found 4481 images belonging to 10 classes.
Found 79726 images belonging to 1 classes.
```

[9]:
```
# using earlystopping
from tensorflow.keras.callbacks import EarlyStopping
earlystopping = EarlyStopping(monitor = "val_accuracy",patience = 5,min_delta =␣
 ↪0.005,
                              restore_best_weights = True);
```

[10]:
```
# fitting the model
history = model.fit(train_generator,epochs = 10,validation_data =␣
 ↪validation_generator,callbacks = [earlystopping],verbose = 2)
```

```
Epoch 1/10

/usr/local/lib/python3.10/dist-
packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:122:
UserWarning: Your `PyDataset` class should call `super().__init__(**kwargs)` in
its constructor. `**kwargs` can include `workers`, `use_multiprocessing`,
`max_queue_size`. Do not pass these arguments to `fit()`, as they will be
ignored.
  self._warn_if_super_not_called()

561/561 - 347s - 618ms/step - accuracy: 0.3872 - auc: 0.8175 - loss: 1.6514 -
precision: 0.7688 - recall: 0.2294 - val_accuracy: 0.7353 - val_auc: 0.9687 -
val_loss: 0.7484 - val_precision: 0.8307 - val_recall: 0.6340
Epoch 2/10
561/561 - 299s - 534ms/step - accuracy: 0.8355 - auc: 0.9831 - loss: 0.5035 -
precision: 0.8887 - recall: 0.7889 - val_accuracy: 0.9105 - val_auc: 0.9930 -
val_loss: 0.2839 - val_precision: 0.9317 - val_recall: 0.8924
Epoch 3/10
561/561 - 291s - 518ms/step - accuracy: 0.9180 - auc: 0.9933 - loss: 0.2695 -
precision: 0.9362 - recall: 0.9008 - val_accuracy: 0.9306 - val_auc: 0.9956 -
val_loss: 0.2309 - val_precision: 0.9446 - val_recall: 0.9127
Epoch 4/10
561/561 - 291s - 519ms/step - accuracy: 0.9395 - auc: 0.9955 - loss: 0.2013 -
precision: 0.9512 - recall: 0.9264 - val_accuracy: 0.9493 - val_auc: 0.9970 -
val_loss: 0.1639 - val_precision: 0.9575 - val_recall: 0.9409
Epoch 5/10
561/561 - 291s - 519ms/step - accuracy: 0.9510 - auc: 0.9964 - loss: 0.1666 -
precision: 0.9613 - recall: 0.9434 - val_accuracy: 0.9580 - val_auc: 0.9967 -
val_loss: 0.1418 - val_precision: 0.9660 - val_recall: 0.9514
Epoch 6/10
561/561 - 292s - 520ms/step - accuracy: 0.9592 - auc: 0.9973 - loss: 0.1357 -
precision: 0.9665 - recall: 0.9523 - val_accuracy: 0.9621 - val_auc: 0.9973 -
val_loss: 0.1298 - val_precision: 0.9695 - val_recall: 0.9574
Epoch 7/10
561/561 - 313s - 559ms/step - accuracy: 0.9637 - auc: 0.9974 - loss: 0.1211 -
precision: 0.9702 - recall: 0.9580 - val_accuracy: 0.9565 - val_auc: 0.9975 -
val_loss: 0.1375 - val_precision: 0.9655 - val_recall: 0.9502
Epoch 8/10
561/561 - 298s - 532ms/step - accuracy: 0.9678 - auc: 0.9980 - loss: 0.1055 -
precision: 0.9730 - recall: 0.9637 - val_accuracy: 0.9587 - val_auc: 0.9963 -
val_loss: 0.1397 - val_precision: 0.9646 - val_recall: 0.9547
Epoch 9/10
561/561 - 295s - 526ms/step - accuracy: 0.9702 - auc: 0.9980 - loss: 0.1007 -
precision: 0.9755 - recall: 0.9663 - val_accuracy: 0.9734 - val_auc: 0.9982 -
val_loss: 0.0942 - val_precision: 0.9775 - val_recall: 0.9696
Epoch 10/10
561/561 - 291s - 518ms/step - accuracy: 0.9738 - auc: 0.9985 - loss: 0.0907 -
precision: 0.9779 - recall: 0.9696 - val_accuracy: 0.9748 - val_auc: 0.9985 -
val_loss: 0.0795 - val_precision: 0.9784 - val_recall: 0.9726
```

[11]:
```
# evaluating the model on validation data
print(model.evaluate(validation_generator));
```

```
141/141             58s 411ms/step -
accuracy: 0.9747 - auc: 0.9986 - loss: 0.0950 - precision: 0.9786 - recall:
0.9724
[0.08912034332752228, 0.9752287268638611, 0.9788906574249268,
0.9727739095687866, 0.9984093904495239]
```

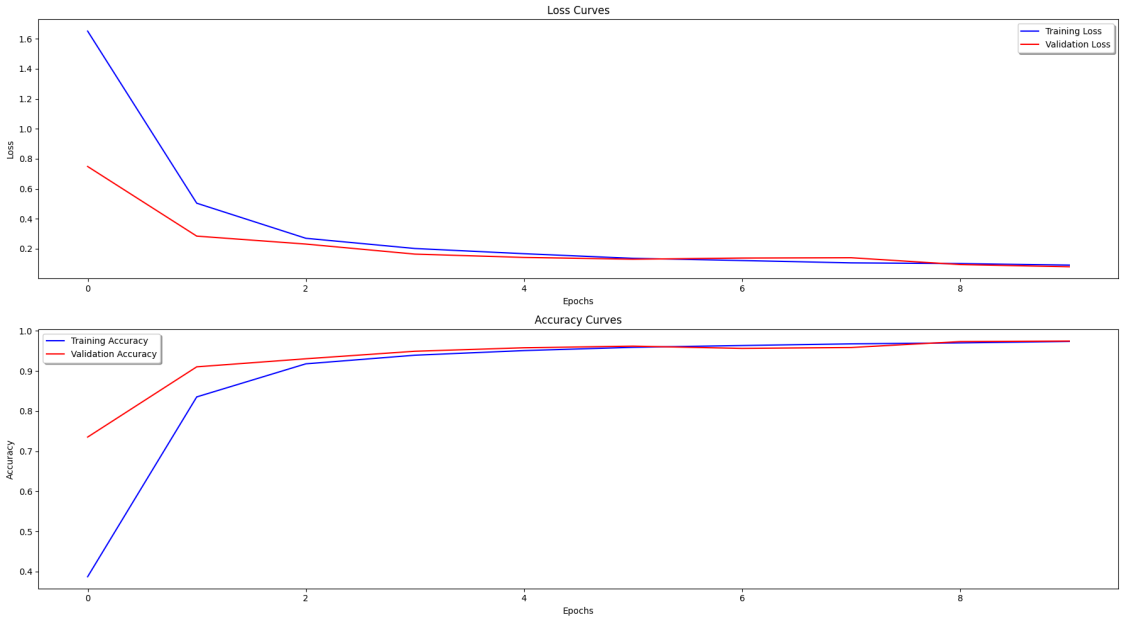
[12]:
```
# printing model summary
print(model.summary());
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 238, 238, 128)	3,584
max_pooling2d (MaxPooling2D)	(None, 119, 119, 128)	0
conv2d_1 (Conv2D)	(None, 117, 117, 64)	73,792
max_pooling2d_1 (MaxPooling2D)	(None, 58, 58, 64)	0
conv2d_2 (Conv2D)	(None, 56, 56, 32)	18,464
max_pooling2d_2 (MaxPooling2D)	(None, 28, 28, 32)	0
flatten (Flatten)	(None, 25088)	0
dense (Dense)	(None, 1024)	25,691,136
dropout (Dropout)	(None, 1024)	0
dense_1 (Dense)	(None, 1024)	1,049,600

```
dropout_1 (Dropout)                  (None, 1024)                                ␣
↪  0

dense_2 (Dense)                      (None, 256)                                 ␣
↪262,400

dropout_2 (Dropout)                  (None, 256)                                 ␣
↪  0

dense_3 (Dense)                      (None, 10)                                  ␣
↪2,570


 Total params: 81,304,640 (310.15 MB)

 Trainable params: 27,101,546 (103.38 MB)

 Non-trainable params: 0 (0.00 B)

 Optimizer params: 54,203,094 (206.77 MB)

None
```

[14]:
```
# plotting accuracy and loss curves
from matplotlib import pyplot as plt
fig,ax = plt.subplots(2,1,figsize = (18,10));
ax[0].plot(history.history["loss"],color = "b",label = "Training Loss");
ax[0].plot(history.history["val_loss"],color = "r",label = "Validation Loss");
ax[0].set_xlabel("Epochs");
ax[0].set_ylabel("Loss");
ax[0].set_title("Loss Curves");
ax[0].legend(loc = "best",shadow = True);
ax[1].plot(history.history["accuracy"],color = "b",label = "Training Accuracy");
ax[1].plot(history.history["val_accuracy"],color = "r",label = "Validation␣
 ↪Accuracy");
ax[1].set_xlabel("Epochs");
ax[1].set_ylabel("Accuracy");
ax[1].set_title("Accuracy Curves");
ax[1].legend(loc = "best",shadow = True);
plt.tight_layout();
```



[26]:
```
# predicting using test data
ypred = model.predict(test_generator);
print(ypred.shape);
```

```
2492/2492              313s 125ms/step
(79726, 10)
```

[29]:
```
# processing for submission
filenames = test_generator.filenames
imageids = [f.split("/")[-1] for f in filenames];
```

[32]:
```
# processing for submission
df = pd.DataFrame(ypred,columns = [f"c{i}" for i in range(10)])
df.insert(0,"img",imageids);
```

[33]:
```
# Creating Results.csv
df.to_csv("Results.csv",index = False);
```

[40]:
```
# generating validation data
validation_generator = train_datagen.flow_from_directory(
    train_dir,target_size = (240,240),class_mode = "categorical",batch_size =␣
 ↪32,
    subset = "validation",shuffle = False
);
```

```
Found 4481 images belonging to 10 classes.
```

[41]:
```
# changing ypred and ytest to normal form
ypred = model.predict(validation_generator);
ypred = np.argmax(ypred,axis = 1);
ytest = validation_generator.classes;
print(ypred.shape,ytest.shape);
```

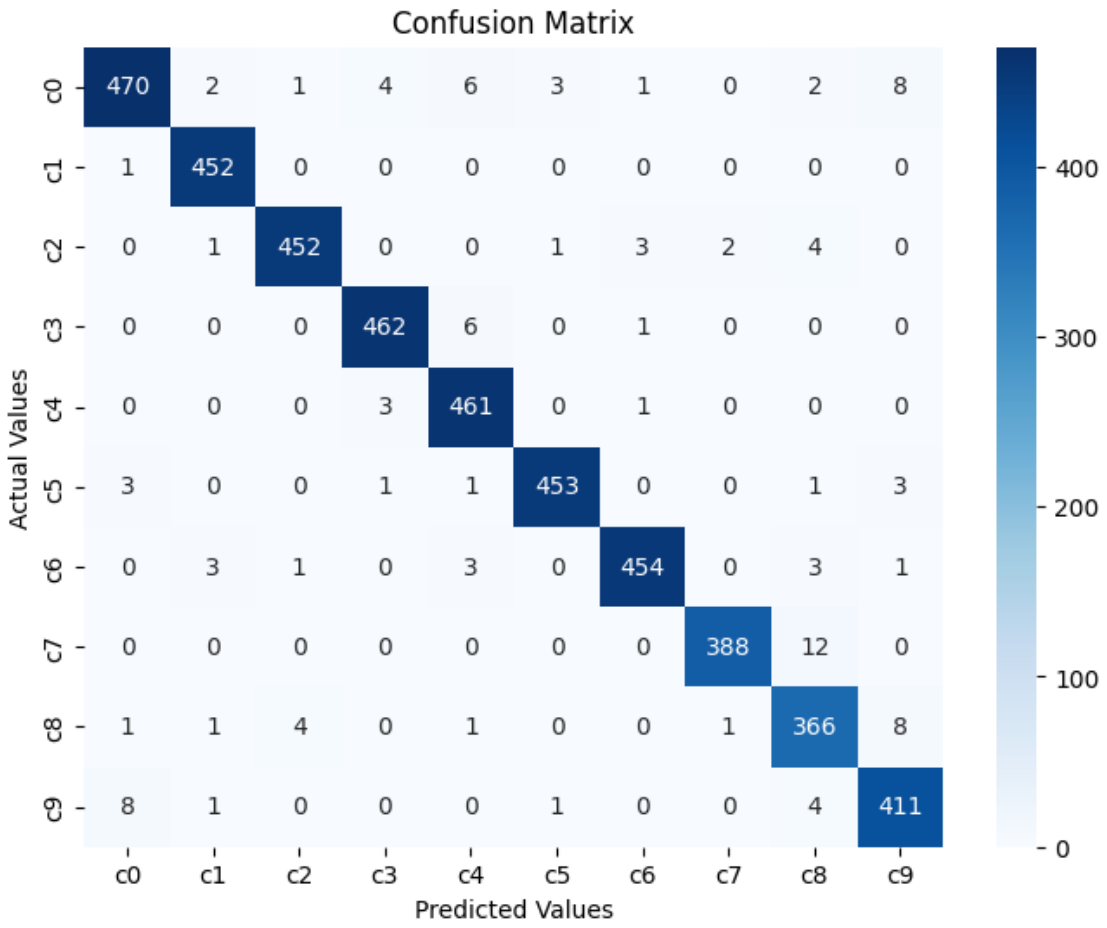
```
/usr/local/lib/python3.10/dist-
packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:122:
UserWarning: Your `PyDataset` class should call `super().__init__(**kwargs)` in
its constructor. `**kwargs` can include `workers`, `use_multiprocessing`,
`max_queue_size`. Do not pass these arguments to `fit()`, as they will be
ignored.
  self._warn_if_super_not_called()
```

```
141/141             57s 407ms/step
(4481,) (4481,)
```

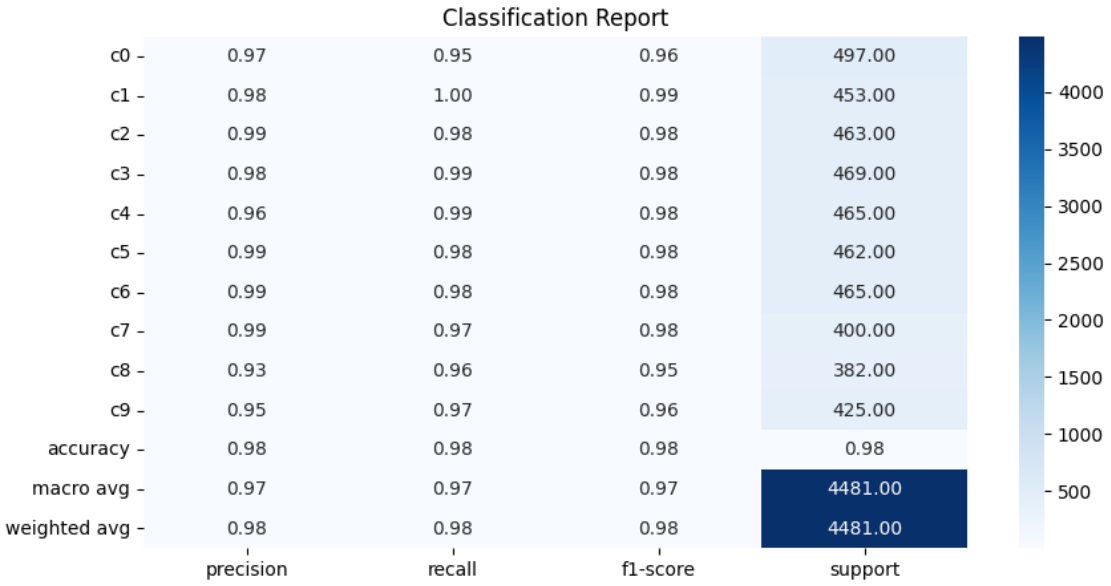
[44]:
```
# printing accuracy score
from sklearn.metrics import␣
 ↪accuracy_score,confusion_matrix,classification_report
score = accuracy_score(ytest,ypred);
print(score);
```

```
0.9750055791118054
```

[48]:
```
# printing confusion matrix
import seaborn as sns
from matplotlib import pyplot as plt
arr = [f"c{i}" for i in range(10)];
plt.figure(figsize = (8,6));
cm = confusion_matrix(ytest,ypred);
sns.heatmap(cm,cmap = "Blues",fmt = "d",annot = True,xticklabels =␣
 ↪arr,yticklabels = arr);
plt.xlabel("Predicted Values");
plt.ylabel("Actual Values");
plt.title("Confusion Matrix");
```



[49]:
```
# printing classification report
report = classification_report(ytest,ypred,output_dict = True,target_names =␣
 ↪arr);
df = pd.DataFrame(report).transpose();
plt.figure(figsize = (10,5));
sns.heatmap(df,cmap = "Blues",fmt = ".2f",annot = True);
plt.title("Classification Report");
```


Classification Report
c0
c1
c2
c3
c4
c5
c6
c7
c8
c9
accuracy
macro avg
weighted avg
0.97 0.95 0.96 497.00
0.98 1.00 0.99 453.00
0.99 0.98 0.98 463.00
0.98 0.99 0.98 469.00
0.96 0.99 0.98 465.00
0.99 0.98 0.98 462.00
0.99 0.98 0.98 465.00
0.99 0.97 0.98 400.00
0.93 0.96 0.95 382.00
0.95 0.97 0.96 425.00
0.98 0.98 0.98 0.98
0.97 0.97 0.97 4481.00
0.98 0.98 0.98 4481.00
precision
recall
f1-score
support
4000
3500
3000
2500
2000
1500
1000
500