Chess pieces classification using Deep Learning

This project tackles chess piece classification using a deep learning model built upon the InceptionResNetV2 architecture. InceptionResNetV2 leverages residual connections within Inception modules, enabling the network to learn complex features from chess piece images while mitigating the vanishing gradient problem. This approach aims to achieve high accuracy in distinguishing between different chess pieces (king, queen, rook, bishop, knight, pawn) for applications like computer chess analysis or augmented reality chess boards.

In [3]:
```
#import libraries

import os
import glob
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.layers import Dense
from tensorflow.keras.models import Model
from tensorflow.keras.callbacks import Callback, EarlyStopping
from sklearn.metrics import confusion_matrix, classification_report
```

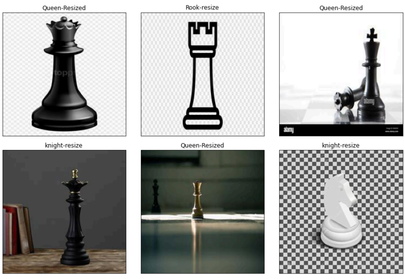
In [4]:
```
#loading data

path="Downloads/project"
path_img = list(glob.glob(path+'/**/*.jpg'))
```

In [5]:
```
labels = list(map(lambda x:os.path.split(os.path.split(x)[0])[1], path_img))
file_path = pd.Series(path_img, name='File_Path').astype(str)
labels = pd.Series(labels, name='Labels')
data = pd.concat([file_path, labels], axis=1)
data = data.sample(frac=1).reset_index(drop=True)
data.head()
```

Out[5]:

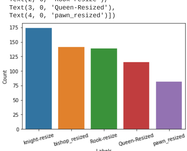
	File_Path	Labels
0	Downloads/project\Queen-Resized\00000028_resiz...	Queen-Resized
1	Downloads/project\Rook-resize\00000060_resized...	Rook-resize
2	Downloads/project\Queen-Resized\00000090_resiz...	Queen-Resized
3	Downloads/project\knight-resize\00000299_resiz...	knight-resize
4	Downloads/project\Queen-Resized\00000104_resiz...	Queen-Resized

In [6]:
```
fig, axes = plt.subplots(nrows=2, ncols=3, figsize=(12, 8),
                         subplot_kw={'xticks': [], 'yticks': []})
for i, ax in enumerate(axes.flat):
    ax.imshow(plt.imread(data.File_Path[i]))
    ax.set_title(data.Labels[i])
plt.tight_layout()
plt.show()
```



In [8]:
```
counts=data.Labels.value_counts()
sns.barplot(x=counts.index,y=counts)
plt.xlabel("Labels")
plt.ylabel("Count")
plt.xticks(rotation=15)
```

Out[8]:
```
(array([0, 1, 2, 3, 4]),
 [Text(0, 0, 'knight-resize'),
  Text(1, 0, 'bishop_resized'),
  Text(2, 0, 'Rook-resize'),
  Text(3, 0, 'Queen-Resized'),
  Text(4, 0, 'pawn_resized')])
```



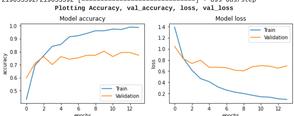
In [10]:
```
#spliting of data into training and testing data

train_df, test_df = train_test_split(data, test_size=0.25, random_state=1)
```

In [11]:
```
def func(pre,name_model,size):
    print('#####Model => {}'.format(name_model))
    train_datagen = ImageDataGenerator(preprocessing_function=pre, validation_split=0.2)
    test_datagen = ImageDataGenerator(preprocessing_function=pre)

    train_gen = train_datagen.flow_from_dataframe(
        dataframe=train_df,
        x_col='File_Path',
        y_col='Labels',
        target_size=(size,size),
        class_mode='categorical',
        batch_size=32,
        shuffle=True,
        seed=0,
        subset='training',
        rotation_range=30,
        zoom_range=0.15,
        width_shift_range=0.2,
        height_shift_range=0.2,
        shear_range=0.15,
        horizontal_flip=True,
        fill_mode="nearest")
    valid_gen = train_datagen.flow_from_dataframe(
        dataframe=train_df,
        x_col='File_Path',
        y_col='Labels',
        target_size=(size,size),
        class_mode='categorical',
        batch_size=32,
        shuffle=False,
        seed=0,
        subset='validation',
        rotation_range=30,
        zoom_range=0.15,
        width_shift_range=0.2,
        height_shift_range=0.2,
        shear_range=0.15,
        horizontal_flip=True,
        fill_mode="nearest")
    test_gen = test_datagen.flow_from_dataframe(
        dataframe=test_df,
        x_col='File_Path',
        y_col='Labels',
        target_size=(size,size),
        color_mode='rgb',
        class_mode='categorical',
        batch_size=32,
        verbose=0,
        shuffle=False)

    pre_model = name_model(input_shape=(size,size, 3),
                   include_top=False,
                   weights='imagenet',
                   pooling='avg')
    pre_model.trainable = False
    inputs = pre_model.input
    x = Dense(64, activation='relu')(pre_model.output)
    x = Dense(64, activation='relu')(x)
    outputs = Dense(5, activation='softmax')(x)
    model = Model(inputs=inputs, outputs=outputs)
    model.compile(loss = 'categorical_crossentropy',optimizer='Adam',metrics=['accuracy'])
    my_callbacks  = [EarlyStopping(monitor='val_loss',
                                   min_delta=0,
                                   patience=5,
                                   mode='auto')]

    history = model.fit(train_gen,validation_data=valid_gen,epochs=100,callbacks=my_callbacks,verbose=0);
    print('\033[01m                Plotting Accuracy, val_accuracy, loss, val_loss \033[0m')
    # Plotting Accuracy, val_accuracy, loss, val_loss
    fig, ax = plt.subplots(1, 2, figsize=(10, 3))
    ax = ax.ravel()

    for i, met in enumerate(['accuracy', 'loss']):
        ax[i].plot(history.history[met])
        ax[i].plot(history.history['val_' + met])
        ax[i].set_title('Model {}'.format(met))
        ax[i].set_xlabel('epochs')
        ax[i].set_ylabel(met)
        ax[i].legend(['Train', 'Validation'])
    plt.show()

    # Predict Data Test
    pred = model.predict(test_gen )
    pred = np.argmax(pred,axis=1)
    labels = (train_gen.class_indices)
    labels = dict((v,k) for k,v in labels.items())
    pred = [labels[k] for k in pred]

    print('\033[01m                Classification_report \033[0m')
    # Classification report
    cm=confusion_matrix(test_df.Labels,pred)
    clr = classification_report(test_df.Labels, pred)
    print(clr)
    print('\033[01m Display 6 pictures of the dataset with their labels \033[0m')
    # Display 6 pictures of the dataset with their labels
    fig, axes = plt.subplots(nrows=2, ncols=3, figsize=(12, 8),
                             subplot_kw={'xticks': [], 'yticks': []})

    for i, ax in enumerate(axes.flat):
        ax.imshow(plt.imread(test_df.File_Path.iloc[i+1]))
        ax.set_title(f"True: {test_df.Labels.iloc[i+1]}\nPredicted: {pred[i+1]}")
    plt.tight_layout()
    plt.show()

    print('\033[01m              Results \033[0m')
    # Results
    results = model.evaluate(test_gen, verbose=0)
    print("    Test Loss:\033[31m \033[01m {:.5f} \033[30m \033[0m".format(results[0]))
    print("Test Accuracy:\033[32m \033[01m {:.2f}% \033[30m \033[0m".format(results[1] * 100))

    return results
```

In [12]:
```
#Using InceptionResNetV2 as backbone

from tensorflow.keras.applications import InceptionResNetV2
from tensorflow.keras.applications.inception_resnet_v2 import preprocess_input
result_InceptionResNetV2 = func(preprocess_input,InceptionResNetV2,224)
```

```
#####Model => <function InceptionResNetV2 at 0x0000018FECEBF5E0>
Found 391 validated image filenames belonging to 5 classes.
Found 97 validated image filenames belonging to 5 classes.
Found 163 validated image filenames belonging to 5 classes.
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/inception_resnet_v2/inception_resnet_v2_weights_tf_dim_ordering_tf_kernels_notop.h5
219055592/219055592 [==============================] - 89s 0us/step
```

Plotting Accuracy, val_accuracy, loss, val_loss




```
6/6 [==============================] - 27s 3s/step
```

Classification_report

```
                precision    recall  f1-score   support

  Queen-Resized       0.65      0.41      0.50        32
    Rook-resize       0.87      0.89      0.88        37
bishop_resized       0.63      0.88      0.73        33
knight-resize        0.95      0.95      0.95        41
 pawn_resized        0.72      0.65      0.68        20

       accuracy                           0.78       163
      macro avg        0.76      0.76      0.75       163
   weighted avg        0.78      0.78      0.77       163
```

Display 6 pictures of the dataset with their labels

Results

```
    Test Loss:  0.68525
Test Accuracy:  77.91%
```

In [ ]:
```
```