```python
from google.colab import drive
import os

drive.mount('/content/drive')

folder_path = '/content/drive/My Drive/didd'

image_extensions = ('.jpg', '.jpeg', '.png', '.bmp', '.tiff', '.gif')

def count_images_in_folder(folder_path):
    image_count = 0
    for root, _, files in os.walk(folder_path):
        for file in files:
            if file.lower().endswith(image_extensions):
                image_count += 1
    return image_count

uploaded_images_count = count_images_in_folder(folder_path)

print(f"Total successfully uploaded images: {uploaded_images_count}")
```

```
Mounted at /content/drive
Total successfully uploaded images: 14760
```

```python
import os


def count_images_by_class(folder_path):
    class_counts = {}
    for root, dirs, files in os.walk(folder_path):
        if not dirs:
            class_name = os.path.basename(root)
            image_count = sum(1 for file in files if
file.lower().endswith(image_extensions))
            class_counts[class_name] = image_count
    return class_counts


class_counts = count_images_by_class(folder_path)

print("Images in each class folder:")
for class_name, count in class_counts.items():
    print(f"{class_name}: {count}")
```

```
Images in each class folder:
SafeDriving: 3732
Yawn: 439
Drinking: 347
SleepyDriving: 785
Distracted: 1676
```

```
DangerousDriving: 4874
.ipynb_checkpoints: 0

import os

dataset_path = '/content/drive/My Drive/didd'


image_extensions = ('.jpg', '.jpeg', '.png', '.bmp', '.tiff', '.gif')


def count_images_in_folder(folder_path):
    image_count = 0
    for root, _, files in os.walk(folder_path):
        for file in files:
            if file.lower().endswith(image_extensions):
                image_count += 1
    return image_count


train_path = os.path.join(dataset_path, 'train')
test_path = os.path.join(dataset_path, 'test')
valid_path = os.path.join(dataset_path, 'valid')

train_count = count_images_in_folder(train_path)
test_count = count_images_in_folder(test_path)
valid_count = count_images_in_folder(valid_path)

print(f"Total images in 'train' folder: {train_count}")
print(f"Total images in 'test' folder: {test_count}")
print(f"Total images in 'valid' folder: {valid_count}")

Total images in 'train' folder: 11853
Total images in 'test' folder: 985
Total images in 'valid' folder: 1922

import os


image_extensions = ('.jpg', '.jpeg', '.png')


def count_images_by_class(folder_path):
    class_counts = {}
    for root, dirs, files in os.walk(folder_path):
        if not dirs:
            class_name = os.path.basename(root)
            image_count = sum(1 for file in files if
file.lower().endswith(image_extensions))
            class_counts[class_name] = image_count
    return class_counts
```

```python
train_path = os.path.join(dataset_path, 'train')
test_path = os.path.join(dataset_path, 'test')
valid_path = os.path.join(dataset_path, 'valid')


train_class_counts = count_images_by_class(train_path)
test_class_counts = count_images_by_class(test_path)
valid_class_counts = count_images_by_class(valid_path)

print("Class distribution in 'train' folder:")
for class_name, count in train_class_counts.items():
    print(f"{class_name}: {count}")

print("\nClass distribution in 'test' folder:")
for class_name, count in test_class_counts.items():
    print(f"{class_name}: {count}")

print("\nClass distribution in 'valid' folder:")
for class_name, count in valid_class_counts.items():
    print(f"{class_name}: {count}")
```

```
Class distribution in 'train' folder:
Yawn: 439
SleepyDriving: 785
DangerousDriving: 4874
SafeDriving: 3732
Drinking: 347
Distracted: 1676

Class distribution in 'test' folder:
Yawn: 26
Drinking: 25
DangerousDriving: 412
SafeDriving: 301
SleepyDriving: 69
Distracted: 152

Class distribution in 'valid' folder:
SafeDriving: 609
Yawn: 81
Drinking: 56
SleepyDriving: 125
Distracted: 252
DangerousDriving: 799
```

```python
from sklearn.utils.class_weight import compute_class_weight
import numpy as np

class_labels = ['DangerousDriving', 'Distracted', 'Drinking',
```

```python
'SafeDriving', 'SleepyDriving', 'Yawn']
class_counts = [4874, 1676, 347, 3732, 785, 439]

class_weights = compute_class_weight('balanced',
classes=np.arange(len(class_labels)),
y=np.repeat(np.arange(len(class_labels)), class_counts))
class_weights_dict = dict(enumerate(class_weights))

print("Class Weights:", class_weights_dict)

Class Weights: {0: 0.405313910545753, 1: 1.1786992840095465, 2:
5.693083573487032, 3: 0.5293408360128617, 4: 2.5165605095541403, 5:
4.5}

import tensorflow as tf
from tensorflow import keras
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.applications import MobileNetV2
from tensorflow.keras.layers import Dense, GlobalAveragePooling2D,
Dropout
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import EarlyStopping

from tensorflow.keras.preprocessing.image import ImageDataGenerator

train_datagen = ImageDataGenerator(
    rescale=1./255,
    rotation_range=20,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    fill_mode='nearest'
)

val_datagen = ImageDataGenerator(rescale=1./255)

train_dir = "/content/drive/My Drive/didd/train"
val_dir = "/content/drive/My Drive/didd/valid"

train_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size=(224, 224),
    batch_size=32,
    class_mode='categorical'
)

val_generator = val_datagen.flow_from_directory(
    val_dir,
```

```
        target_size=(224, 224),
        batch_size=32,
        class_mode='categorical'
)
```

Found 11853 images belonging to 6 classes.
Found 1922 images belonging to 6 classes.

```python
from tensorflow.keras.applications import MobileNetV2

base_model = MobileNetV2(weights='imagenet', include_top=False,
input_shape=(224, 224, 3))
```

Downloading data from https://storage.googleapis.com/tensorflow/keras-
applications/mobilenet_v2/
mobilenet_v2_weights_tf_dim_ordering_tf_kernels_1.0_224_no_top.h5
9406464/9406464 ─────────────────────── 0s 0us/step

```python
from tensorflow.keras.layers import GlobalAveragePooling2D, Dense,
Dropout
from tensorflow.keras.regularizers import l2

x = base_model.output
x = GlobalAveragePooling2D()(x)
x = Dense(256, activation='relu', kernel_regularizer=l2(0.001))(x)
x = Dropout(0.4)(x)
output_layer = Dense(6, activation='softmax')(x)
```

```python
from tensorflow.keras.models import Model

model = Model(inputs=base_model.input, outputs=output_layer)
model.summary()
```

Model: "functional"

Layer (type) Connected to	Output Shape	Param #
input_layer (InputLayer) -	(None, 224, 224, 3)	0
Conv1 (Conv2D) input_layer[0][0]	(None, 112, 112, 32)	864
bn_Conv1 Conv1[0][0]	(None, 112, 112, 32)	128
```

| (BatchNormalization) | | |
|---|---|---|
| Conv1_relu (ReLU)<br>bn_Conv1[0][0] | (None, 112, 112, 32) | 0 |
| expanded_conv_depthwise<br>Conv1_relu[0][0]<br>(DepthwiseConv2D) | (None, 112, 112, 32) | 288 |
| expanded_conv_depthwise_…<br>expanded_conv_depthwi…<br>(BatchNormalization) | (None, 112, 112, 32) | 128 |
| expanded_conv_depthwise_…<br>expanded_conv_depthwi…<br>(ReLU) | (None, 112, 112, 32) | 0 |
| expanded_conv_project<br>expanded_conv_depthwi…<br>(Conv2D) | (None, 112, 112, 16) | 512 |
| expanded_conv_project_BN<br>expanded_conv_project…<br>(BatchNormalization) | (None, 112, 112, 16) | 64 |
| block_1_expand (Conv2D)<br>expanded_conv_project… | (None, 112, 112, 96) | 1,536 |
| block_1_expand_BN<br>block_1_expand[0][0]<br>(BatchNormalization) | (None, 112, 112, 96) | 384 |
| block_1_expand_relu | (None, 112, 112, 96) | 0 |

| block_1_expand_BN[0][… (ReLU) | | |
|---|---|---|
| block_1_pad block_1_expand_relu[0… (ZeroPadding2D) | (None, 113, 113, 96) | 0 |
| block_1_depthwise block_1_pad[0][0] (DepthwiseConv2D) | (None, 56, 56, 96) | 864 |
| block_1_depthwise_BN block_1_depthwise[0][… (BatchNormalization) | (None, 56, 56, 96) | 384 |
| block_1_depthwise_relu block_1_depthwise_BN[… (ReLU) | (None, 56, 56, 96) | 0 |
| block_1_project (Conv2D) block_1_depthwise_rel… | (None, 56, 56, 24) | 2,304 |
| block_1_project_BN block_1_project[0][0] (BatchNormalization) | (None, 56, 56, 24) | 96 |
| block_2_expand (Conv2D) block_1_project_BN[0]… | (None, 56, 56, 144) | 3,456 |
| block_2_expand_BN block_2_expand[0][0] (BatchNormalization) | (None, 56, 56, 144) | 576 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_2_expand_relu block_2_expand_BN[0][… (ReLU) | (None, 56, 56, 144) | 0 |
| block_2_depthwise block_2_expand_relu[0… (DepthwiseConv2D) | (None, 56, 56, 144) | 1,296 |
| block_2_depthwise_BN block_2_depthwise[0][… (BatchNormalization) | (None, 56, 56, 144) | 576 |
| block_2_depthwise_relu block_2_depthwise_BN[… (ReLU) | (None, 56, 56, 144) | 0 |
| block_2_project (Conv2D) block_2_depthwise_rel… | (None, 56, 56, 24) | 3,456 |
| block_2_project_BN block_2_project[0][0] (BatchNormalization) | (None, 56, 56, 24) | 96 |
| block_2_add (Add) block_1_project_BN[0]… block_2_project_BN[0]… | (None, 56, 56, 24) | 0 |
| block_3_expand (Conv2D) block_2_add[0][0] | (None, 56, 56, 144) | 3,456 |
| block_3_expand_BN block_3_expand[0][0] (BatchNormalization) | (None, 56, 56, 144) | 576 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_3_expand_relu<br>block_3_expand_BN[0][…<br>(ReLU) | (None, 56, 56, 144) | 0 |
| block_3_pad<br>block_3_expand_relu[0…<br>(ZeroPadding2D) | (None, 57, 57, 144) | 0 |
| block_3_depthwise<br>block_3_pad[0][0]<br>(DepthwiseConv2D) | (None, 28, 28, 144) | 1,296 |
| block_3_depthwise_BN<br>block_3_depthwise[0][…<br>(BatchNormalization) | (None, 28, 28, 144) | 576 |
| block_3_depthwise_relu<br>block_3_depthwise_BN[…<br>(ReLU) | (None, 28, 28, 144) | 0 |
| block_3_project (Conv2D)<br>block_3_depthwise_rel… | (None, 28, 28, 32) | 4,608 |
| block_3_project_BN<br>block_3_project[0][0]<br>(BatchNormalization) | (None, 28, 28, 32) | 128 |
| block_4_expand (Conv2D)<br>block_3_project_BN[0]… | (None, 28, 28, 192) | 6,144 |
| block_4_expand_BN<br>block_4_expand[0][0]<br>(BatchNormalization) | (None, 28, 28, 192) | 768 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_4_expand_relu block_4_expand_BN[0][… (ReLU) | (None, 28, 28, 192) | 0 |
| block_4_depthwise block_4_expand_relu[0… (DepthwiseConv2D) | (None, 28, 28, 192) | 1,728 |
| block_4_depthwise_BN block_4_depthwise[0][… (BatchNormalization) | (None, 28, 28, 192) | 768 |
| block_4_depthwise_relu block_4_depthwise_BN[… (ReLU) | (None, 28, 28, 192) | 0 |
| block_4_project (Conv2D) block_4_depthwise_rel… | (None, 28, 28, 32) | 6,144 |
| block_4_project_BN block_4_project[0][0] (BatchNormalization) | (None, 28, 28, 32) | 128 |
| block_4_add (Add) block_3_project_BN[0]… block_4_project_BN[0]… | (None, 28, 28, 32) | 0 |
| block_5_expand (Conv2D) block_4_add[0][0] | (None, 28, 28, 192) | 6,144 |
| block_5_expand_BN block_5_expand[0][0] (BatchNormalization) | (None, 28, 28, 192) | 768 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_5_expand_relu block_5_expand_BN[0][… (ReLU) | (None, 28, 28, 192) | 0 |
| block_5_depthwise block_5_expand_relu[0… (DepthwiseConv2D) | (None, 28, 28, 192) | 1,728 |
| block_5_depthwise_BN block_5_depthwise[0][… (BatchNormalization) | (None, 28, 28, 192) | 768 |
| block_5_depthwise_relu block_5_depthwise_BN[… (ReLU) | (None, 28, 28, 192) | 0 |
| block_5_project (Conv2D) block_5_depthwise_rel… | (None, 28, 28, 32) | 6,144 |
| block_5_project_BN block_5_project[0][0] (BatchNormalization) | (None, 28, 28, 32) | 128 |
| block_5_add (Add) block_4_add[0][0], block_5_project_BN[0]… | (None, 28, 28, 32) | 0 |
| block_6_expand (Conv2D) block_5_add[0][0] | (None, 28, 28, 192) | 6,144 |
| block_6_expand_BN block_6_expand[0][0] | (None, 28, 28, 192) | 768 |

| Layer | Output Shape | Param # |
|---|---|---|
| (BatchNormalization) | | |
| block_6_expand_relu<br>block_6_expand_BN[0][…<br>(ReLU) | (None, 28, 28, 192) | 0 |
| block_6_pad<br>block_6_expand_relu[0…<br>(ZeroPadding2D) | (None, 29, 29, 192) | 0 |
| block_6_depthwise<br>block_6_pad[0][0]<br>(DepthwiseConv2D) | (None, 14, 14, 192) | 1,728 |
| block_6_depthwise_BN<br>block_6_depthwise[0][…<br>(BatchNormalization) | (None, 14, 14, 192) | 768 |
| block_6_depthwise_relu<br>block_6_depthwise_BN[…<br>(ReLU) | (None, 14, 14, 192) | 0 |
| block_6_project (Conv2D)<br>block_6_depthwise_rel… | (None, 14, 14, 64) | 12,288 |
| block_6_project_BN<br>block_6_project[0][0]<br>(BatchNormalization) | (None, 14, 14, 64) | 256 |
| block_7_expand (Conv2D)<br>block_6_project_BN[0]… | (None, 14, 14, 384) | 24,576 |
| block_7_expand_BN | (None, 14, 14, 384) | 1,536 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_7_expand[0][0] (BatchNormalization) | | |
| block_7_expand_relu block_7_expand_BN[0][… (ReLU) | (None, 14, 14, 384) | 0 |
| block_7_depthwise block_7_expand_relu[0… (DepthwiseConv2D) | (None, 14, 14, 384) | 3,456 |
| block_7_depthwise_BN block_7_depthwise[0][… (BatchNormalization) | (None, 14, 14, 384) | 1,536 |
| block_7_depthwise_relu block_7_depthwise_BN[… (ReLU) | (None, 14, 14, 384) | 0 |
| block_7_project (Conv2D) block_7_depthwise_rel… | (None, 14, 14, 64) | 24,576 |
| block_7_project_BN block_7_project[0][0] (BatchNormalization) | (None, 14, 14, 64) | 256 |
| block_7_add (Add) block_6_project_BN[0]… block_7_project_BN[0]… | (None, 14, 14, 64) | 0 |
| block_8_expand (Conv2D) block_7_add[0][0] | (None, 14, 14, 384) | 24,576 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_8_expand_BN block_8_expand[0][0] (BatchNormalization) | (None, 14, 14, 384) | 1,536 |
| block_8_expand_relu block_8_expand_BN[0][… (ReLU) | (None, 14, 14, 384) | 0 |
| block_8_depthwise block_8_expand_relu[0… (DepthwiseConv2D) | (None, 14, 14, 384) | 3,456 |
| block_8_depthwise_BN block_8_depthwise[0][… (BatchNormalization) | (None, 14, 14, 384) | 1,536 |
| block_8_depthwise_relu block_8_depthwise_BN[… (ReLU) | (None, 14, 14, 384) | 0 |
| block_8_project (Conv2D) block_8_depthwise_rel… | (None, 14, 14, 64) | 24,576 |
| block_8_project_BN block_8_project[0][0] (BatchNormalization) | (None, 14, 14, 64) | 256 |
| block_8_add (Add) block_7_add[0][0], block_8_project_BN[0]… | (None, 14, 14, 64) | 0 |
| block_9_expand (Conv2D) block_8_add[0][0] | (None, 14, 14, 384) | 24,576 |

| Layer (type) | Output Shape | Param # |
|---|---|---|
| block_9_expand_BN block_9_expand[0][0] (BatchNormalization) | (None, 14, 14, 384) | 1,536 |
| block_9_expand_relu block_9_expand_BN[0][… (ReLU) | (None, 14, 14, 384) | 0 |
| block_9_depthwise block_9_expand_relu[0… (DepthwiseConv2D) | (None, 14, 14, 384) | 3,456 |
| block_9_depthwise_BN block_9_depthwise[0][… (BatchNormalization) | (None, 14, 14, 384) | 1,536 |
| block_9_depthwise_relu block_9_depthwise_BN[… (ReLU) | (None, 14, 14, 384) | 0 |
| block_9_project (Conv2D) block_9_depthwise_rel… | (None, 14, 14, 64) | 24,576 |
| block_9_project_BN block_9_project[0][0] (BatchNormalization) | (None, 14, 14, 64) | 256 |
| block_9_add (Add) block_8_add[0][0], block_9_project_BN[0]… | (None, 14, 14, 64) | 0 |
| block_10_expand (Conv2D) block_9_add[0][0] | (None, 14, 14, 384) | 24,576 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_10_expand_BN block_10_expand[0][0] (BatchNormalization) | (None, 14, 14, 384) | 1,536 |
| block_10_expand_relu block_10_expand_BN[0]… (ReLU) | (None, 14, 14, 384) | 0 |
| block_10_depthwise block_10_expand_relu[… (DepthwiseConv2D) | (None, 14, 14, 384) | 3,456 |
| block_10_depthwise_BN block_10_depthwise[0]… (BatchNormalization) | (None, 14, 14, 384) | 1,536 |
| block_10_depthwise_relu block_10_depthwise_BN… (ReLU) | (None, 14, 14, 384) | 0 |
| block_10_project (Conv2D) block_10_depthwise_re… | (None, 14, 14, 96) | 36,864 |
| block_10_project_BN block_10_project[0][0] (BatchNormalization) | (None, 14, 14, 96) | 384 |
| block_11_expand (Conv2D) block_10_project_BN[0… | (None, 14, 14, 576) | 55,296 |
| block_11_expand_BN block_11_expand[0][0] (BatchNormalization) | (None, 14, 14, 576) | 2,304 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_11_expand_relu<br>block_11_expand_BN[0]…<br>(ReLU) | (None, 14, 14, 576) | 0 |
| block_11_depthwise<br>block_11_expand_relu[…<br>(DepthwiseConv2D) | (None, 14, 14, 576) | 5,184 |
| block_11_depthwise_BN<br>block_11_depthwise[0]…<br>(BatchNormalization) | (None, 14, 14, 576) | 2,304 |
| block_11_depthwise_relu<br>block_11_depthwise_BN…<br>(ReLU) | (None, 14, 14, 576) | 0 |
| block_11_project (Conv2D)<br>block_11_depthwise_re… | (None, 14, 14, 96) | 55,296 |
| block_11_project_BN<br>block_11_project[0][0]<br>(BatchNormalization) | (None, 14, 14, 96) | 384 |
| block_11_add (Add)<br>block_10_project_BN[0…<br><br>block_11_project_BN[0… | (None, 14, 14, 96) | 0 |
| block_12_expand (Conv2D)<br>block_11_add[0][0] | (None, 14, 14, 576) | 55,296 |
| block_12_expand_BN<br>block_12_expand[0][0]<br>(BatchNormalization) | (None, 14, 14, 576) | 2,304 |

| Layer | Output Shape | Param # |
| --- | --- | --- |
| block_12_expand_relu<br>block_12_expand_BN[0]…<br>(ReLU) | (None, 14, 14, 576) | 0 |
| block_12_depthwise<br>block_12_expand_relu[…<br>(DepthwiseConv2D) | (None, 14, 14, 576) | 5,184 |
| block_12_depthwise_BN<br>block_12_depthwise[0]…<br>(BatchNormalization) | (None, 14, 14, 576) | 2,304 |
| block_12_depthwise_relu<br>block_12_depthwise_BN…<br>(ReLU) | (None, 14, 14, 576) | 0 |
| block_12_project (Conv2D)<br>block_12_depthwise_re… | (None, 14, 14, 96) | 55,296 |
| block_12_project_BN<br>block_12_project[0][0]<br>(BatchNormalization) | (None, 14, 14, 96) | 384 |
| block_12_add (Add)<br>block_11_add[0][0],<br><br>block_12_project_BN[0… | (None, 14, 14, 96) | 0 |
| block_13_expand (Conv2D)<br>block_12_add[0][0] | (None, 14, 14, 576) | 55,296 |
| block_13_expand_BN<br>block_13_expand[0][0] | (None, 14, 14, 576) | 2,304 |

| | | |
|---|---|---|
| (BatchNormalization) | | |
| block_13_expand_relu block_13_expand_BN[0]… (ReLU) | (None, 14, 14, 576) | 0 |
| block_13_pad block_13_expand_relu[… (ZeroPadding2D) | (None, 15, 15, 576) | 0 |
| block_13_depthwise block_13_pad[0][0] (DepthwiseConv2D) | (None, 7, 7, 576) | 5,184 |
| block_13_depthwise_BN block_13_depthwise[0]… (BatchNormalization) | (None, 7, 7, 576) | 2,304 |
| block_13_depthwise_relu block_13_depthwise_BN… (ReLU) | (None, 7, 7, 576) | 0 |
| block_13_project (Conv2D) block_13_depthwise_re… | (None, 7, 7, 160) | 92,160 |
| block_13_project_BN block_13_project[0][0] (BatchNormalization) | (None, 7, 7, 160) | 640 |
| block_14_expand (Conv2D) block_13_project_BN[0… | (None, 7, 7, 960) | 153,600 |
| block_14_expand_BN | (None, 7, 7, 960) | 3,840 |

| | | |
|---|---|---|
| block_14_expand[0][0] (BatchNormalization) | | |
| block_14_expand_relu block_14_expand_BN[0]… (ReLU) | (None, 7, 7, 960) | 0 |
| block_14_depthwise block_14_expand_relu[… (DepthwiseConv2D) | (None, 7, 7, 960) | 8,640 |
| block_14_depthwise_BN block_14_depthwise[0]… (BatchNormalization) | (None, 7, 7, 960) | 3,840 |
| block_14_depthwise_relu block_14_depthwise_BN… (ReLU) | (None, 7, 7, 960) | 0 |
| block_14_project (Conv2D) block_14_depthwise_re… | (None, 7, 7, 160) | 153,600 |
| block_14_project_BN block_14_project[0][0] (BatchNormalization) | (None, 7, 7, 160) | 640 |
| block_14_add (Add) block_13_project_BN[0… block_14_project_BN[0… | (None, 7, 7, 160) | 0 |
| block_15_expand (Conv2D) block_14_add[0][0] | (None, 7, 7, 960) | 153,600 |

| block_15_expand_BN block_15_expand[0][0] (BatchNormalization) | (None, 7, 7, 960) | 3,840 |
|---|---|---|
| block_15_expand_relu block_15_expand_BN[0]… (ReLU) | (None, 7, 7, 960) | 0 |
| block_15_depthwise block_15_expand_relu[… (DepthwiseConv2D) | (None, 7, 7, 960) | 8,640 |
| block_15_depthwise_BN block_15_depthwise[0]… (BatchNormalization) | (None, 7, 7, 960) | 3,840 |
| block_15_depthwise_relu block_15_depthwise_BN… (ReLU) | (None, 7, 7, 960) | 0 |
| block_15_project (Conv2D) block_15_depthwise_re… | (None, 7, 7, 160) | 153,600 |
| block_15_project_BN block_15_project[0][0] (BatchNormalization) | (None, 7, 7, 160) | 640 |
| block_15_add (Add) block_14_add[0][0], block_15_project_BN[0… | (None, 7, 7, 160) | 0 |
| block_16_expand (Conv2D) block_15_add[0][0] | (None, 7, 7, 960) | 153,600 |

| Layer | Output Shape | Param # |
|---|---|---|
| block_16_expand_BN<br>block_16_expand[0][0]<br>(BatchNormalization) | (None, 7, 7, 960) | 3,840 |
| block_16_expand_relu<br>block_16_expand_BN[0]…<br>(ReLU) | (None, 7, 7, 960) | 0 |
| block_16_depthwise<br>block_16_expand_relu[…<br>(DepthwiseConv2D) | (None, 7, 7, 960) | 8,640 |
| block_16_depthwise_BN<br>block_16_depthwise[0]…<br>(BatchNormalization) | (None, 7, 7, 960) | 3,840 |
| block_16_depthwise_relu<br>block_16_depthwise_BN…<br>(ReLU) | (None, 7, 7, 960) | 0 |
| block_16_project (Conv2D)<br>block_16_depthwise_re… | (None, 7, 7, 320) | 307,200 |
| block_16_project_BN<br>block_16_project[0][0]<br>(BatchNormalization) | (None, 7, 7, 320) | 1,280 |
| Conv_1 (Conv2D)<br>block_16_project_BN[0… | (None, 7, 7, 1280) | 409,600 |
| Conv_1_bn<br>Conv_1[0][0]<br>(BatchNormalization) | (None, 7, 7, 1280) | 5,120 |

```
 ┌─────────────────────────────┬──────────────────────────┬─────────────┐
 │ out_relu (ReLU)             │ (None, 7, 7, 1280)       │           0 │
 │ Conv_1_bn[0][0]             │                          │             │
 ├─────────────────────────────┼──────────────────────────┼─────────────┤
 │ global_average_pooling2d    │ (None, 1280)             │           0 │
 │ out_relu[0][0]              │                          │             │
 │ (GlobalAveragePooling2D)    │                          │             │
 ├─────────────────────────────┼──────────────────────────┼─────────────┤
 │ dense (Dense)               │ (None, 256)              │     327,936 │
 │ global_average_poolin…      │                          │             │
 ├─────────────────────────────┼──────────────────────────┼─────────────┤
 │ dropout (Dropout)           │ (None, 256)              │           0 │
 │ dense[0][0]                 │                          │             │
 ├─────────────────────────────┼──────────────────────────┼─────────────┤
 │ dense_1 (Dense)             │ (None, 6)                │       1,542 │
 │ dropout[0][0]               │                          │             │
 └─────────────────────────────┴──────────────────────────┴─────────────┘
```

 Total params: 2,587,462 (9.87 MB)

 Trainable params: 2,553,350 (9.74 MB)

 Non-trainable params: 34,112 (133.25 KB)

```python
from tensorflow.keras.optimizers import Adam

model.compile(
    optimizer=Adam(learning_rate=1e-4),
    loss='categorical_crossentropy',
    metrics=['accuracy']
)

from tensorflow.keras.callbacks import ReduceLROnPlateau,
EarlyStopping

reduce_lr = ReduceLROnPlateau(monitor='val_loss', factor=0.2,
patience=3, min_lr=1e-6, verbose=1)
early_stopping = EarlyStopping(monitor='val_loss', patience=5,
restore_best_weights=True, verbose=1)

history = model.fit(
    train_generator,
    epochs=10,
```

```
    validation_data=val_generator,
    callbacks=[reduce_lr, early_stopping]
)
```

/usr/local/lib/python3.11/dist-packages/keras/src/trainers/
data_adapters/py_dataset_adapter.py:121: 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()

Epoch 1/10
371/371 ──────────────── 3599s 10s/step - accuracy: 0.6732 - loss:
1.3263 - val_accuracy: 0.6441 - val_loss: 1.7609 - learning_rate:
1.0000e-04
Epoch 2/10
371/371 ──────────────── 1694s 5s/step - accuracy: 0.9246 - loss:
0.6423 - val_accuracy: 0.7575 - val_loss: 1.1859 - learning_rate:
1.0000e-04
Epoch 3/10
371/371 ──────────────── 1679s 5s/step - accuracy: 0.9473 - loss:
0.5379 - val_accuracy: 0.8413 - val_loss: 0.8672 - learning_rate:
1.0000e-04
Epoch 4/10
371/371 ──────────────── 1771s 5s/step - accuracy: 0.9546 - loss:
0.4920 - val_accuracy: 0.8257 - val_loss: 0.9980 - learning_rate:
1.0000e-04
Epoch 5/10
371/371 ──────────────── 1740s 5s/step - accuracy: 0.9525 - loss:
0.4559 - val_accuracy: 0.8403 - val_loss: 0.7866 - learning_rate:
1.0000e-04
Epoch 6/10
371/371 ──────────────── 1765s 5s/step - accuracy: 0.9621 - loss:
0.4007 - val_accuracy: 0.8892 - val_loss: 0.6072 - learning_rate:
1.0000e-04
Epoch 7/10
371/371 ──────────────── 1735s 5s/step - accuracy: 0.9687 - loss:
0.3599 - val_accuracy: 0.9116 - val_loss: 0.5199 - learning_rate:
1.0000e-04
Epoch 8/10
371/371 ──────────────── 1767s 5s/step - accuracy: 0.9685 - loss:
0.3306 - val_accuracy: 0.9318 - val_loss: 0.4247 - learning_rate:
1.0000e-04
Epoch 9/10
371/371 ──────────────── 1743s 5s/step - accuracy: 0.9691 - loss:
0.3040 - val_accuracy: 0.9438 - val_loss: 0.3799 - learning_rate:
1.0000e-04
Epoch 10/10
371/371 ──────────────── 1735s 5s/step - accuracy: 0.9729 - loss:
```

```
0.2755 - val_accuracy: 0.9448 - val_loss: 0.3887 - learning_rate:
1.0000e-04
Restoring model weights from the end of the best epoch: 9.

test_datagen = ImageDataGenerator(rescale=1.0/255.0)

test_dir = "/content/drive/My Drive/didd/test"

test_generator = test_datagen.flow_from_directory(
    directory=test_dir,
    target_size=(224, 224),
    batch_size= 32,
    class_mode='categorical',
    shuffle=False
)

Found 985 images belonging to 6 classes.

test_loss, test_acc = model.evaluate(test_generator)
print(f"Test Accuracy: {test_acc:.4f}")
print(f"Test Loss: {test_loss:.4f}")

/usr/local/lib/python3.11/dist-packages/keras/src/trainers/
data_adapters/py_dataset_adapter.py:121: 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()

31/31 ──────────────── 161s 5s/step - accuracy: 0.9410 - loss:
0.3338
Test Accuracy: 0.9482
Test Loss: 0.3284
```