```
#uplode kaggle.json file from local machine from downloads folder
# downl

!mkdir -p ~/.kaggle
!cp kaggle.json ~/.kaggle/
```

```
'chmod 600 /root/.kaggle/kaggle.json'
```

```
'chmod 600 /root/.kaggle/kaggle.json'
```

```
!kaggle datasets download -d salader/dogs-vs-cats --force
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix this, you can run 'chmod 600 /root/.kaggle/kaggle.json'
Downloading dogs-vs-cats.zip to /content
100% 1.06G/1.06G [00:48<00:00, 24.6MB/s]
100% 1.06G/1.06G [00:48<00:00, 23.5MB/s]
```

```
'chmod 600 /root/.kaggle/kaggle.json'
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```
'chmod 600 /root/.kaggle/kaggle.json'
```

```
import zipfile
zip_ref = zipfile.ZipFile('/content/dogs-vs-cats.zip', 'r')
zip_ref.extractall('/content')
zip_ref.close()
```

```
import tensorflow as tf
from tensorflow import keras
from keras import Sequential
from keras.layers import Dense,Conv2D,MaxPooling2D,Flatten,BatchNormalization,Dropout
```

```
# generators
train_ds = keras.utils.image_dataset_from_directory(
    directory = '/content/train',
    labels='inferred',
    label_mode = 'int',
    batch_size=32,
    image_size=(256,256)
)

validation_ds = keras.utils.image_dataset_from_directory(
    directory = '/content/test',
    labels='inferred',
    label_mode = 'int',
    batch_size=32,
    image_size=(256,256)
)

#store images in numpy array
```

```
Found 20000 files belonging to 2 classes.
Found 5000 files belonging to 2 classes.
```

```
# Normalize
def process(image,label):
    image = tf.cast(image/255. ,tf.float32)
    return image,label

train_ds = train_ds.map(process)
validation_ds = validation_ds.map(process)
```

```
# create CNN model

model = Sequential()

model.add(Conv2D(32,kernel_size=(3,3),padding='valid',activation='relu',input_shape=(256,256,3)))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Conv2D(64,kernel_size=(3,3),padding='valid',activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Conv2D(128,kernel_size=(3,3),padding='valid',activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Flatten())

model.add(Dense(128,activation='relu'))
model.add(Dropout(0.1))
model.add(Dense(64,activation='relu'))
model.add(Dropout(0.1))
model.add(Dense(1,activation='sigmoid'))
```

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 254, 254, 32)      896

 batch_normalization (Batch  (None, 254, 254, 32)      128
 Normalization)

 max_pooling2d (MaxPooling2  (None, 127, 127, 32)      0
 D)

 conv2d_1 (Conv2D)           (None, 125, 125, 64)      18496

 batch_normalization_1 (Bat  (None, 125, 125, 64)      256
 chNormalization)

 max_pooling2d_1 (MaxPoolin  (None, 62, 62, 64)        0
 g2D)

 conv2d_2 (Conv2D)           (None, 60, 60, 128)       73856

 batch_normalization_2 (Bat  (None, 60, 60, 128)       512
 chNormalization)

 max_pooling2d_2 (MaxPoolin  (None, 30, 30, 128)       0
 g2D)

 flatten (Flatten)           (None, 115200)            0

 dense (Dense)               (None, 128)               14745728

 dropout (Dropout)           (None, 128)               0

 dense_1 (Dense)             (None, 64)                8256

 dropout_1 (Dropout)         (None, 64)                0

 dense_2 (Dense)             (None, 1)                 65

=================================================================
Total params: 14848193 (56.64 MB)
Trainable params: 14847745 (56.64 MB)
Non-trainable params: 448 (1.75 KB)
_________________________________________________________________
```

```
model.compile(optimizer='adam',loss='binary_crossentropy',metrics=['accuracy'])
```

```
history = model.fit(train_ds,epochs=10,validation_data=validation_ds)
```

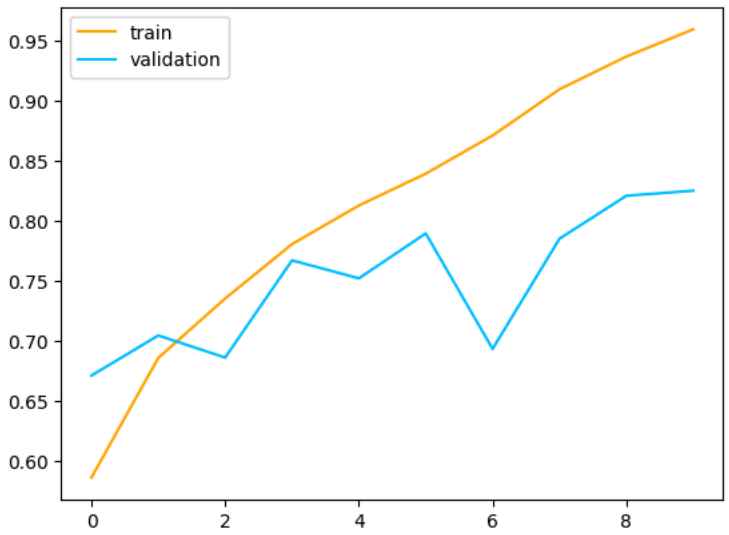
```
Epoch 1/10
625/625 [==============================] - 78s 106ms/step - loss: 1.7033 - accuracy: 0.5862 - val_loss: 0.6126 - val_accuracy: 0.6712
Epoch 2/10
```

```
625/625 [==============================] - 64s 102ms/step - loss: 0.5934 - accuracy: 0.6859 - val_loss: 0.5712 - val_accuracy: 0.7046
Epoch 3/10
625/625 [==============================] - 65s 104ms/step - loss: 0.5305 - accuracy: 0.7354 - val_loss: 0.5815 - val_accuracy: 0.6862
Epoch 4/10
625/625 [==============================] - 67s 106ms/step - loss: 0.4700 - accuracy: 0.7807 - val_loss: 0.4946 - val_accuracy: 0.7672
Epoch 5/10
625/625 [==============================] - 65s 103ms/step - loss: 0.4120 - accuracy: 0.8129 - val_loss: 0.4948 - val_accuracy: 0.7522
Epoch 6/10
625/625 [==============================] - 67s 106ms/step - loss: 0.3612 - accuracy: 0.8394 - val_loss: 0.4590 - val_accuracy: 0.7896
Epoch 7/10
625/625 [==============================] - 68s 108ms/step - loss: 0.3006 - accuracy: 0.8712 - val_loss: 0.8535 - val_accuracy: 0.6934
Epoch 8/10
625/625 [==============================] - 67s 106ms/step - loss: 0.2236 - accuracy: 0.9097 - val_loss: 0.5254 - val_accuracy: 0.7852
Epoch 9/10
625/625 [==============================] - 64s 102ms/step - loss: 0.1603 - accuracy: 0.9370 - val_loss: 0.4867 - val_accuracy: 0.8210
Epoch 10/10
625/625 [==============================] - 67s 106ms/step - loss: 0.1080 - accuracy: 0.9596 - val_loss: 0.4962 - val_accuracy: 0.8252
```

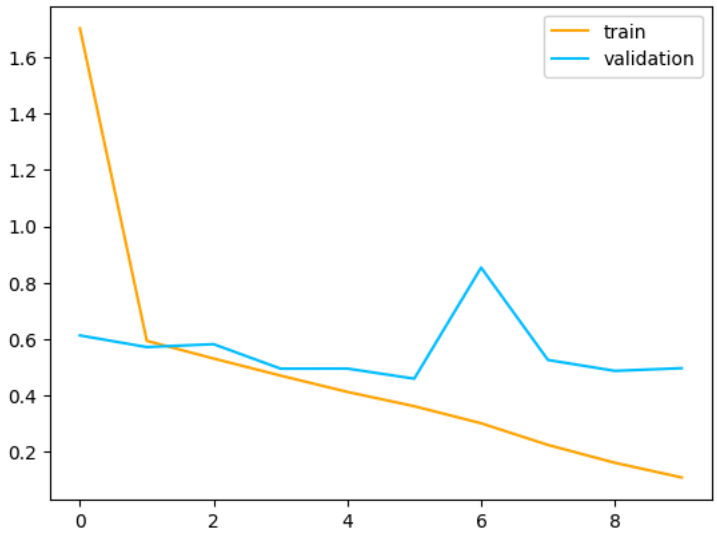
```
import matplotlib.pyplot as plt

plt.plot(history.history['accuracy'], color='orange', label='train')
plt.plot(history.history['val_accuracy'], color ='deepskyblue', label = 'validation')
plt.legend()
plt.show()

# when epoch is  inceasing trning accuracy is improving
# gap showing us its ove fitting
```



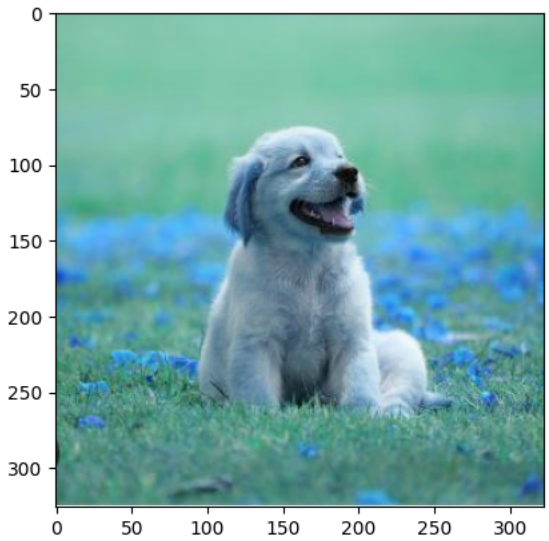

```
# validation loss
# taining loss
plt.plot(history.history['loss'], color ='orange' , label='train')
plt.plot(history.history['val_loss'], color ='deepskyblue' , label ='validation')
plt.legend()
plt.show()
# epoc isincese trinign loss in reducing but validation loss increasing slowly,
# the gap increassing which is indication better result on trainig data but poor result while testing
```




```
# ways to reduce overfitting
# Add more data
# data aumentation
# L/L2 regulizaztin
# Dropout _______
# Batch Norm ____
# Reduce comlexity
# use some above methods to reduce gaps of overfittign
```

```
import cv2
test_img = cv2.imread('/content/dog01.JPG')
plt.imshow(test_img)
```

```
<matplotlib.image.AxesImage at 0x7dc566119e40>
```




```
test_img.shape
```

```
(326, 323, 3)
```

```
test_img = cv2.resize(test_img,(256,256))
```

```
test_input = test_img.reshape((1,256,256,3))
```

```
model.predict(test_input)
```

```
1/1 [==============================] - 0s 418ms/step
array([[1.]], dtype=float32)
```

```
# test_img = tf.reshape(test_img, (1, 256, 256, 3))
```

```
# model.predict(test_img)
```

```
# result=model.predict(test_input)
# print(result)

# if(result == 0):
#   pred = 'dog'
# else:
#   pred = 'cat'

# print('our model say it is a :' , pred)
```

Confusion Matrix

```
!pip install seaborn
```

```
Requirement already satisfied: seaborn in /usr/local/lib/python3.10/dist-packages (0.13.1)
Requirement already satisfied: numpy!=1.24.0,>=1.20 in /usr/local/lib/python3.10/dist-packages (from seaborn) (1.25.2)
Requirement already satisfied: pandas>=1.2 in /usr/local/lib/python3.10/dist-packages (from seaborn) (2.0.3)
Requirement already satisfied: matplotlib!=3.6.1,>=3.4 in /usr/local/lib/python3.10/dist-packages (from seaborn) (3.7.1)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (1.2.
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (4.5
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (1.4
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (24.0)
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Requirement already satisfied: tzdata>=2022.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.2->seaborn) (2024.1)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.7->matplotlib!=3.6.1,>=3.4->
```

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.metrics import confusion_matrix
import seaborn as sns
from tensorflow.math import confusion_matrix

# Make sure the validation dataset is not shuffled
validation_ds = validation_ds.unbatch().batch(1)

# Predict the classes
y_pred = []
y_true = []
for img, label in validation_ds:
    preds = model.predict(img)
    y_pred.append(int(preds > 0.5))
    y_true.append(label.numpy()[0])

# Generate the confusion matrix
cm = confusion_matrix(y_true, y_pred)

# Plot the confusion matrix
plt.figure(figsize=(10,7))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
plt.xlabel('Predicted Labels')
plt.ylabel('True Labels')
plt.show()
```

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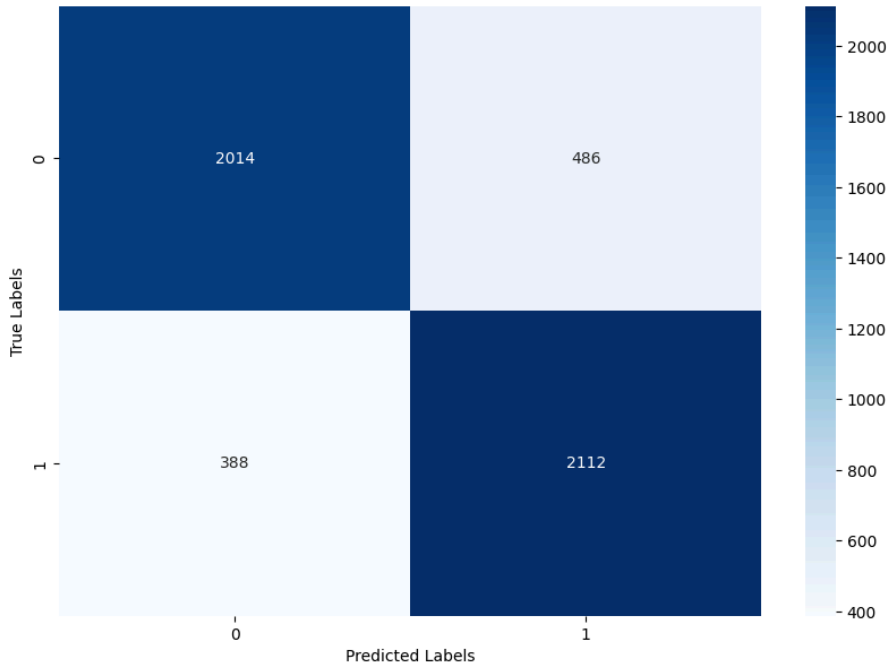

Grad-Cam model

```
!pip install gradcam
```

```
ERROR: Could not find a version that satisfies the requirement gradcam (from versions: none)
ERROR: No matching distribution found for gradcam
```

```
!pip install keras
```

```
Requirement already satisfied: keras in /usr/local/lib/python3.10/dist-packages (2.15.0)
```

```
!pip install tensorflow
```

```
Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.15.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.5.26 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.5.4)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.9.0)
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (18.1.1)
Requirement already satisfied: ml-dtypes~=0.2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: numpy<2.0.0,>=1.23.5 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.25.2)
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tensorflow) (24.0)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/python
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow) (67.7.2)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.4.0)
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.11.0)
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Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.36.0
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.62.1)
Requirement already satisfied: tensorboard<2.16,>=2.15 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.15.2)
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Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboar
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.1
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.16
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.16
Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1->tensorboard<2.16,>=2.
Requirement already satisfied: pyasn1<0.7.0,>=0.4.6 in /usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1->google-auth<
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-auth-oa
```

```
!pip install tf-keras-vis
```

```
Collecting tf-keras-vis
  Downloading tf_keras_vis-0.8.7-py3-none-any.whl (52 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 52.5/52.5 kB 1.4 MB/s eta 0:00:00
Requirement already satisfied: scipy in /usr/local/lib/python3.10/dist-packages (from tf-keras-vis) (1.11.4)
Requirement already satisfied: pillow in /usr/local/lib/python3.10/dist-packages (from tf-keras-vis) (9.4.0)
Collecting deprecated (from tf-keras-vis)
  Downloading Deprecated-1.2.14-py2.py3-none-any.whl (9.6 kB)
Requirement already satisfied: imageio in /usr/local/lib/python3.10/dist-packages (from tf-keras-vis) (2.31.6)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tf-keras-vis) (24.0)
Requirement already satisfied: wrapt<2,>=1.10 in /usr/local/lib/python3.10/dist-packages (from deprecated->tf-keras-vis) (1.14.1)
Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages (from imageio->tf-keras-vis) (1.25.2)
Installing collected packages: deprecated, tf-keras-vis
Successfully installed deprecated-1.2.14 tf-keras-vis-0.8.7
```

```
import tensorflow as tf
import keras
from tf_keras_vis.gradcam import Gradcam
from tf_keras_vis.utils import normalize
import matplotlib.pyplot as plt
```

```
print(type(model.output))
```

```
<class 'keras.src.engine.keras_tensor.KerasTensor'>
```

```
import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Model
from matplotlib import pyplot as plt
import cv2

# Define the function to create the Grad-CAM heatmap
def make_gradcam_heatmap(img_array, model, last_conv_layer_name):
    # First, create a model that maps the input image to the activations
    # of the last conv layer as well as the output predictions
    grad_model = Model(
        [model.inputs],
        [model.get_layer(last_conv_layer_name).output, model.output]
    )

    # Then, compute the gradient of the top predicted class for our input image
    # with respect to the activations of the last conv layer
    with tf.GradientTape() as tape:
        last_conv_layer_output, preds = grad_model(img_array)
        pred_index = tf.argmax(preds[0])
        class_channel = preds[:, pred_index]

    # This is the gradient of the output neuron (top predicted or chosen)
    # with respect to the output feature map of the last conv layer
    grads = tape.gradient(class_channel, last_conv_layer_output)

    # This is a vector where each entry is the mean intensity of the gradient
    # over a specific feature map channel
    pooled_grads = tf.reduce_mean(grads, axis=(0, 1, 2))

    # We multiply each channel in the feature map array
    # by "how important this channel is" with regard to the top predicted class
    # then sum all the channels to obtain the heatmap class activation
    last_conv_layer_output = last_conv_layer_output[0]
```

```
    last_conv_layer_output = last_conv_layer_output[0]
    heatmap = last_conv_layer_output @ pooled_grads[..., tf.newaxis]
    heatmap = tf.squeeze(heatmap)

    # For visualization purpose, we will also normalize the heatmap between 0 & 1
    heatmap = tf.maximum(heatmap, 0) / tf.math.reduce_max(heatmap)
    return heatmap.numpy()

# Assume test_img is loaded in its raw form (e.g., using cv2.imread)
test_img = cv2.imread('/content/dog01.JPG')  # Replace with the actual path of your image
test_img = cv2.cvtColor(test_img, cv2.COLOR_BGR2RGB)  # Convert color channels
test_img_resized = cv2.resize(test_img, (256, 256))  # Resize image
test_img_batch = np.expand_dims(test_img_resized.astype('float32') / 255.0, axis=0)  # Normalize and add batch dimension

# Generate the Grad-CAM heatmap
last_conv_layer_name = 'conv2d_2'  # The name of the last conv layer in your model
heatmap = make_gradcam_heatmap(test_img_batch, model, last_conv_layer_name)

# Resize heatmap to match the size of the original image
heatmap_resized = cv2.resize(heatmap, (test_img.shape[1], test_img.shape[0]))

# Convert heatmap to RGB
heatmap_resized = np.uint8(255 * heatmap_resized)
heatmap_resized = cv2.applyColorMap(heatmap_resized, cv2.COLORMAP_JET)  # Apply color map

# Superimpose the heatmap on the original image
superimposed_img = heatmap_resized * 0.4 + test_img

# Display the image
plt.figure(figsize=(6, 6))
plt.imshow(superimposed_img / 255.0)
plt.axis('off')
plt.show()
```

```
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
```