```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import tensorflow as tf
from tensorflow.keras import layers, models, optimizers, callbacks
from sklearn.utils.class_weight import compute_class_weight
from sklearn.metrics import classification_report, confusion_matrix

from tensorflow.keras.applications import MobileNetV2



dataset_dir=r"C:\Users\RISHWANTH PATTAPU\Downloads\TrashType_Image_Dataset"
image_size=(124,124)
batch_size=32
seed=42


import os
import zipfile

# Replace 'archive (5).zip' with the name of your uploaded zip file
zip_file_name = 'archive (5).zip' # Use the name of the file uploaded by the user
destination_dir = '/content/' # Or any other directory you prefer in Colab

with zipfile.ZipFile(zip_file_name, 'r') as zip_ref:
    zip_ref.extractall(destination_dir)

print(f"Unzipped {zip_file_name} to {destination_dir}")

# Update dataset_dir to the unzipped directory path
# Assuming the zip file contained a folder named 'TrashType_Image_Dataset' at the top level
dataset_dir = os.path.join(destination_dir, 'TrashType_Image_Dataset')
print(f"Updated dataset_dir to: {dataset_dir}")
```

```
Unzipped archive (5).zip to /content/
Updated dataset_dir to: /content/TrashType_Image_Dataset
```

```
train_ds = tf.keras.utils.image_dataset_from_directory(
    dataset_dir,
    validation_split=0.2,
    subset="training",
    seed=seed,
    image_size=image_size,
    batch_size=batch_size
)

val_ds = tf.keras.utils.image_dataset_from_directory(
    dataset_dir,
    validation_split=0.2,
    subset="validation",
    seed=seed,
    image_size=image_size,
    batch_size=batch_size
)

class_names = train_ds.class_names
```

```
Found 2527 files belonging to 6 classes.
Using 2022 files for training.
Found 2527 files belonging to 6 classes.
Using 505 files for validation.
```

```
all_labels = []
for _, labels in train_ds:
    all_labels.extend(labels.numpy())

class_weights_array = compute_class_weight(
    class_weight='balanced',
    classes=np.arange(len(class_names)),
    y=all_labels
)

class_weights = {i: w for i, w in enumerate(class_weights_array)}



data_augmentation = tf.keras.Sequential([
    layers.RandomFlip("horizontal"),
    layers.RandomRotation(0.1),
    layers.RandomZoom(0.1),
```

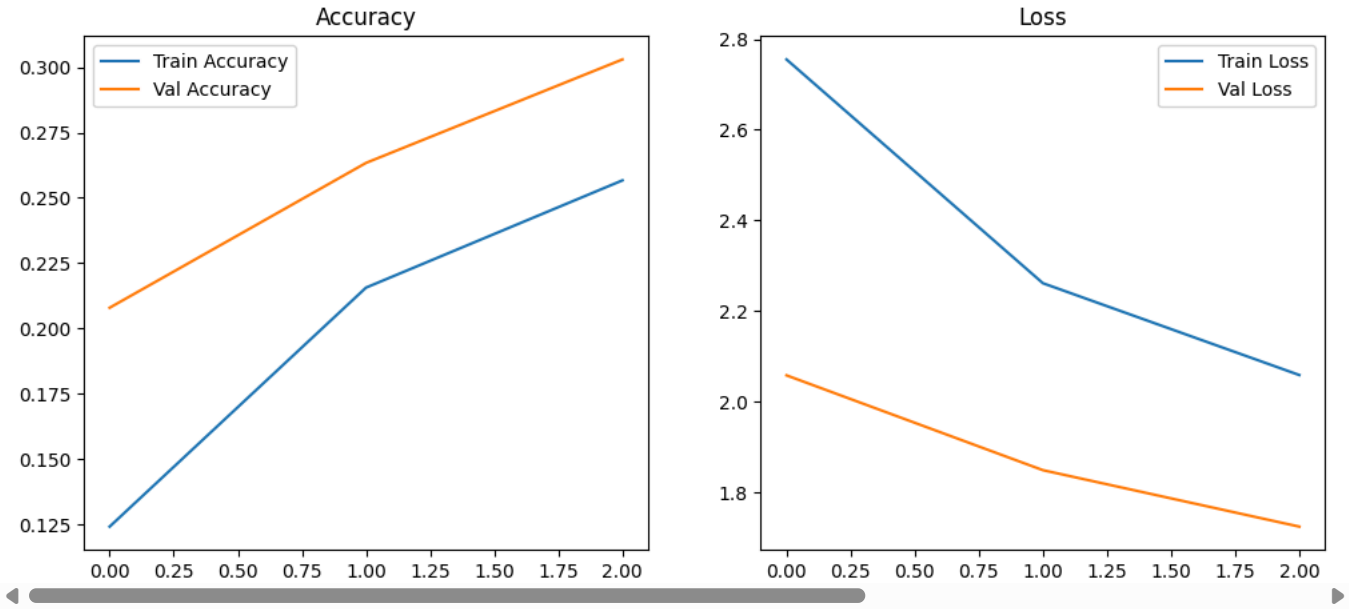
```
    layers.RandomContrast(0.1),
])



base_model = MobileNetV2(input_shape=(124, 124, 3), include_top=False, weights='imagenet')
base_model.trainable = False  # Freeze base model for now

model = models.Sequential([
    layers.Input(shape=(124, 124, 3)),
    data_augmentation,
    base_model,
    layers.GlobalAveragePooling2D(),
    layers.Dropout(0.3),
    layers.Dense(len(class_names), activation='softmax')
])

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

```
/tmp/ipython-input-8-238186400.py:1: UserWarning: `input_shape` is undefined or non-square, or `rows` is not in [96, 128, 160, 192,
  base_model = MobileNetV2(input_shape=(124, 124, 3), include_top=False, weights='imagenet')
```

```
early_stop = callbacks.EarlyStopping(monitor='val_loss', patience=3, restore_best_weights=True)

history = model.fit(
    train_ds,
    validation_data=val_ds,
    epochs=3,
    class_weight=class_weights,
    callbacks=[early_stop]
)
```

```
Epoch 1/3
64/64 ━━━━━━━━━━━━━━━━━━━━ 28s 379ms/step - accuracy: 0.0940 - loss: 3.1443 - val_accuracy: 0.2079 - val_loss: 2.0582
Epoch 2/3
64/64 ━━━━━━━━━━━━━━━━━━━━ 23s 360ms/step - accuracy: 0.2070 - loss: 2.3112 - val_accuracy: 0.2634 - val_loss: 1.8491
Epoch 3/3
64/64 ━━━━━━━━━━━━━━━━━━━━ 39s 336ms/step - accuracy: 0.2537 - loss: 2.1054 - val_accuracy: 0.3030 - val_loss: 1.7246
```

```
acc = history.history['accuracy']
val_acc = history.history['val_accuracy']
loss = history.history['loss']
val_loss = history.history['val_loss']
epochs_range = range(len(acc))

plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.plot(epochs_range, acc, label='Train Accuracy')
plt.plot(epochs_range, val_acc, label='Val Accuracy')
plt.title('Accuracy')
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(epochs_range, loss, label='Train Loss')
plt.plot(epochs_range, val_loss, label='Val Loss')
plt.title('Loss')
plt.legend()
plt.show()
```

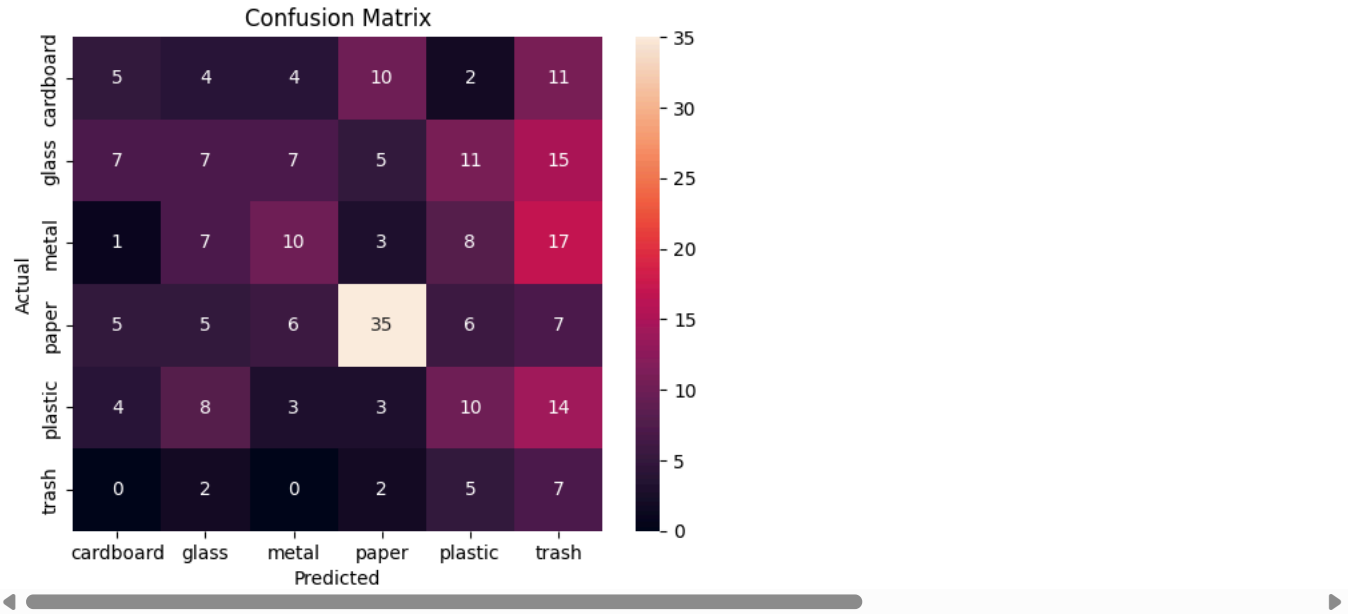



```
# Split val_ds again for testing
val_batches = tf.data.experimental.cardinality(val_ds)
test_ds = val_ds.take(val_batches // 2)
val_ds = val_ds.skip(val_batches // 2)
test_ds_eval = test_ds.cache().prefetch(tf.data.AUTOTUNE)

loss, accuracy = model.evaluate(test_ds_eval)
print(f"Test Accuracy: {accuracy:.4f}, Test Loss: {loss:.4f}")
```

```
8/8 ━━━━━━━━━━━━━━━━━━━━ 2s 216ms/step - accuracy: 0.2828 - loss: 1.7725
Test Accuracy: 0.2891, Test Loss: 1.7660
```

```
y_true = np.concatenate([y.numpy() for x, y in test_ds_eval])
y_pred_probs = model.predict(test_ds_eval)
y_pred = np.argmax(y_pred_probs, axis=1)

print(confusion_matrix(y_true, y_pred))
print(classification_report(y_true, y_pred, target_names=class_names))

# Optional heatmap
sns.heatmap(confusion_matrix(y_true, y_pred), annot=True, fmt='d', xticklabels=class_names, yticklabels=class_names)
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix")
plt.show()
```

```
8/8 ━━━━━━━━━━━━━━━━━━━━ 2s 197ms/step
[[ 5  4  4 10  2 11]
 [ 7  7  7  5 11 15]
 [ 1  7 10  3  8 17]
 [ 5  5  6 35  6  7]
 [ 4  8  3  3 10 14]
 [ 0  2  0  2  5  7]]
              precision    recall  f1-score   support

   cardboard       0.23      0.14      0.17        36
       glass       0.21      0.13      0.16        52
       metal       0.33      0.22      0.26        46
       paper       0.60      0.55      0.57        64
     plastic       0.24      0.24      0.24        42
       trash       0.10      0.44      0.16        16

    accuracy                           0.29       256
   macro avg       0.29      0.29      0.26       256
weighted avg       0.33      0.29      0.30       256
```




```
model.save('mobilenet_trash_classifier.keras')
```

```
!pip install gradio
```

```
Requirement already satisfied: gradio in /usr/local/lib/python3.11/dist-packages (5.31.0)
Requirement already satisfied: aiofiles<25.0,>=22.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (24.1.0)
Requirement already satisfied: anyio<5.0,>=3.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (4.9.0)
Requirement already satisfied: fastapi<1.0,>=0.115.2 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.115.13)
Requirement already satisfied: ffmpy in /usr/local/lib/python3.11/dist-packages (from gradio) (0.6.0)
Requirement already satisfied: gradio-client==1.10.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (1.10.1)
Requirement already satisfied: groovy~=0.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.1.2)
Requirement already satisfied: httpx>=0.24.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.28.1)
Requirement already satisfied: huggingface-hub>=0.28.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.33.0)
Requirement already satisfied: jinja2<4.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.1.6)
Requirement already satisfied: markupsafe<4.0,>=2.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.0.2)
Requirement already satisfied: numpy<3.0,>=1.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (2.0.2)
Requirement already satisfied: orjson~=3.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.10.18)
Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-packages (from gradio) (24.2)
Requirement already satisfied: pandas<3.0,>=1.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (2.2.2)
Requirement already satisfied: pillow<12.0,>=8.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (11.2.1)
Requirement already satisfied: pydantic<2.12,>=2.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (2.11.7)
Requirement already satisfied: pydub in /usr/local/lib/python3.11/dist-packages (from gradio) (0.25.1)
Requirement already satisfied: python-multipart>=0.0.18 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.0.20)
Requirement already satisfied: pyyaml<7.0,>=5.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (6.0.2)
Requirement already satisfied: ruff>=0.9.3 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.12.0)
Requirement already satisfied: safehttpx<0.2.0,>=0.1.6 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.1.6)
Requirement already satisfied: semantic-version~=2.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (2.10.0)
Requirement already satisfied: starlette<1.0,>=0.40.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.46.2)
Requirement already satisfied: tomlkit<0.14.0,>=0.12.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.13.3)
Requirement already satisfied: typer<1.0,>=0.12 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.16.0)
Requirement already satisfied: typing-extensions~=4.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (4.14.0)
Requirement already satisfied: uvicorn>=0.14.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.34.3)
Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.1->gradio) (2025.3.2)
Requirement already satisfied: websockets<16.0,>=10.0 in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.1->gradio
Requirement already satisfied: idna>=2.8 in /usr/local/lib/python3.11/dist-packages (from anyio<5.0,>=3.0->gradio) (3.10)
Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.11/dist-packages (from anyio<5.0,>=3.0->gradio) (1.3.1)
Requirement already satisfied: certifi in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (2025.6.15)
Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (1.0.9)
```

```
Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-packages (from httpcore==1.*->httpx>=0.24.1->gradio) (0.1
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.28.1->gradio) (3.18.0)
Requirement already satisfied: requests in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.28.1->gradio) (2.32.3)
Requirement already satisfied: tqdm>=4.42.1 in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.28.1->gradio) (4.67
Requirement already satisfied: hf-xet<2.0.0,>=1.1.2 in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.28.1->gradio
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2025.2)
Requirement already satisfied: annotated-types>=0.6.0 in /usr/local/lib/python3.11/dist-packages (from pydantic<2.12,>=2.0->gradio)
Requirement already satisfied: pydantic-core==2.33.2 in /usr/local/lib/python3.11/dist-packages (from pydantic<2.12,>=2.0->gradio)
Requirement already satisfied: typing-inspection>=0.4.0 in /usr/local/lib/python3.11/dist-packages (from pydantic<2.12,>=2.0->gradio
Requirement already satisfied: click>=8.0.0 in /usr/local/lib/python3.11/dist-packages (from typer<1.0,>=0.12->gradio) (8.2.1)
Requirement already satisfied: shellingham>=1.3.0 in /usr/local/lib/python3.11/dist-packages (from typer<1.0,>=0.12->gradio) (1.5.4
Requirement already satisfied: rich>=10.11.0 in /usr/local/lib/python3.11/dist-packages (from typer<1.0,>=0.12->gradio) (13.9.4)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.8.2->pandas<3.0,>=1.0->g
Requirement already satisfied: markdown-it-py>=2.2.0 in /usr/local/lib/python3.11/dist-packages (from rich>=10.11.0->typer<1.0,>=0.1
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /usr/local/lib/python3.11/dist-packages (from rich>=10.11.0->typer<1.0,>=0
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub>=
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub>=0.28.1
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-packages (from markdown-it-py>=2.2.0->rich>=10.11.0->typ
```

```
import gradio as gr
import tensorflow as tf
import numpy as np

# Load the trained MobileNetV2 model
model = tf.keras.models.load_model('mobilenet_trash_classifier.keras')

# Class names (adjust if your dataset differs)
class_names = ['cardboard', 'glass', 'metal', 'paper', 'plastic', 'trash']

# Prediction function
def classify_image(img):
    img = tf.image.resize(img, (124, 124))
    img = tf.expand_dims(img, axis=0)
    preds = model.predict(img)[0]
    return {class_names[i]: float(preds[i]) for i in range(6)}

# Gradio interface
interface = gr.Interface(
    fn=classify_image,
    inputs=gr.Image(type="numpy", label="Upload Trash Image"),
    outputs=gr.Label(num_top_classes=3),
    title="Trash Type Classifier - MobileNetV2",
    description="Upload an image of trash to classify it as cardboard, glass, metal, paper, plastic, or trash."
)

interface.launch()
```

```
It looks like you are running Gradio on a hosted a Jupyter notebook. For the Gradio app to work, sharing must be enabled. Automatica

Colab notebook detected. To show errors in colab notebook, set debug=True in launch()
* Running on public URL: https://9705d831b0d7ca27fe.gradio.live

This share link expires in 1 week. For free permanent hosting and GPU upgrades, run `gradio deploy` from the terminal in the working
```

Trash Type Classifier - MobileNetV2

Upload an image of trash to classify it as cardboard, glass, metal, paper, plastic, or trash.