

```

In [5]: # =====
# 0. Install Required Libraries (Fix)
# =====

!pip install numpy matplotlib tensorflow scikit-learn

# =====
# 1. Import Libraries
# =====

import os
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf

from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense, Dropout

# =====
# 2. Dataset Path (FIX)
# =====

dataset_path = "." # مجلد البيانات
img_size = (224,224)
batch_size = 32

# =====
# 3. Data Augmentation
# =====

train_datagen = ImageDataGenerator(
    rescale=1./255,
    rotation_range=20,
    zoom_range=0.2,
    horizontal_flip=True,
    shear_range=0.2,
    validation_split=0.2
)

validation_datagen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.2
)

# =====
# 4. Dataset Splitting
# =====

train_data = train_datagen.flow_from_directory(

```

```

        dataset_path,
        target_size=img_size,
        batch_size=batch_size,
        class_mode='categorical',
        subset='training',
        seed=42
    )

val_data = validation_datagen.flow_from_directory(
    dataset_path,
    target_size=img_size,
    batch_size=batch_size,
    class_mode='categorical',
    subset='validation',
    seed=42
)

# =====
# 5. Show Sample Images
# =====

images, labels = next(train_data)

plt.figure(figsize=(10,10))

for i in range(9):
    plt.subplot(3,3,i+1)
    plt.imshow(images[i])
    plt.axis("off")

plt.show()

# =====
# 6. Build CNN Model
# =====

model = Sequential([

    Conv2D(32,(3,3),activation='relu',input_shape=(224,224,3)),
    MaxPooling2D(2,2),

    Conv2D(64,(3,3),activation='relu'),
    MaxPooling2D(2,2),

    Conv2D(128,(3,3),activation='relu'),
    MaxPooling2D(2,2),

    Flatten(),

    Dense(128,activation='relu'),
    Dropout(0.5),

    Dense(4,activation='softmax')
])

```

```
])

# =====
# 7. Compile Model
# =====

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

model.summary()

# =====
# 8. Train Model
# =====

history = model.fit(
    train_data,
    validation_data=val_data,
    epochs=10
)

# =====
# 9. Evaluate Model
# =====

loss, accuracy = model.evaluate(val_data)
print("Validation Accuracy:", accuracy)

# =====
# 10. Plot Accuracy
# =====

plt.figure()
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title("Model Accuracy")
plt.ylabel("Accuracy")
plt.xlabel("Epoch")
plt.legend(['Train', 'Validation'])
plt.show()

# =====
# 11. Plot Loss
# =====

plt.figure()
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
```

```
plt.title("Model Loss")
plt.ylabel("Loss")
plt.xlabel("Epoch")
plt.legend(['Train', 'Validation'])
plt.show()

# =====
# 12. Save Model (Updated)
# =====

model.save("eye_disease_model.keras")
print("Model saved successfully in Keras native format.")
```

Requirement already satisfied: numpy in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (2.4.3)

Requirement already satisfied: matplotlib in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (3.10.8)

Requirement already satisfied: tensorflow in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (2.21.0)

Requirement already satisfied: scikit-learn in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (1.8.0)

Requirement already satisfied: contourpy>=1.0.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (1.3.3)

Requirement already satisfied: cyclor>=0.10 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (0.12.1)

Requirement already satisfied: fonttools>=4.22.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (4.62.1)

Requirement already satisfied: kiwisolver>=1.3.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (1.5.0)

Requirement already satisfied: packaging>=20.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (25.0)

Requirement already satisfied: pillow>=8 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (12.1.1)

Requirement already satisfied: pyparsing>=3 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (3.3.2)

Requirement already satisfied: python-dateutil>=2.7 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from matplotlib) (2.9.0.post0)

Requirement already satisfied: absl-py>=1.0.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (2.4.0)

Requirement already satisfied: astunparse>=1.6.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (1.6.3)

Requirement already satisfied: flatbuffers>=25.9.23 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (25.12.19)

Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (0.7.0)

Requirement already satisfied: google_pasta>=0.1.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (0.2.0)

Requirement already satisfied: libclang>=13.0.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (18.1.1)

Requirement already satisfied: opt_einsum>=2.3.2 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (3.4.0)

Requirement already satisfied: protobuf<8.0.0,>=6.31.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (7.34.0)

Requirement already satisfied: requests<3,>=2.21.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (2.32.5)

Requirement already satisfied: setuptools in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (80.10.2)

Requirement already satisfied: six>=1.12.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (1.17.0)

Requirement already satisfied: termcolor>=1.1.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (3.3.0)

Requirement already satisfied: typing_extensions>=3.6.6 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (4.15.0)

Requirement already satisfied: wrapt>=1.11.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (2.1.2)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (1.78.0)

Requirement already satisfied: keras>=3.12.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (3.13.2)

Requirement already satisfied: h5py<3.15.0,>=3.11.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (3.14.0)

Requirement already satisfied: ml_dtypes<1.0.0,>=0.5.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from tensorflow) (0.5.4)

Requirement already satisfied: charset_normalizer<4,>=2 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from requests<3,>=2.21.0->tensorflow) (3.4.4)

Requirement already satisfied: idna<4,>=2.5 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from requests<3,>=2.21.0->tensorflow) (3.11)

Requirement already satisfied: urllib3<3,>=1.21.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from requests<3,>=2.21.0->tensorflow) (2.6.3)

Requirement already satisfied: certifi>=2017.4.17 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from requests<3,>=2.21.0->tensorflow) (2026.1.4)

Requirement already satisfied: scipy>=1.10.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from scikit-learn) (1.17.1)

Requirement already satisfied: joblib>=1.3.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from scikit-learn) (1.5.3)

Requirement already satisfied: threadpoolctl>=3.2.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from scikit-learn) (3.6.0)

Requirement already satisfied: wheel<1.0,>=0.23.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from astunparse>=1.6.0->tensorflow) (0.46.3)

Requirement already satisfied: rich in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from keras>=3.12.0->tensorflow) (14.3.3)

Requirement already satisfied: namex in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from keras>=3.12.0->tensorflow) (0.1.0)

Requirement already satisfied: optree in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from keras>=3.12.0->tensorflow) (0.19.0)

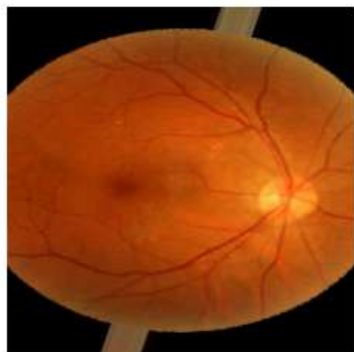
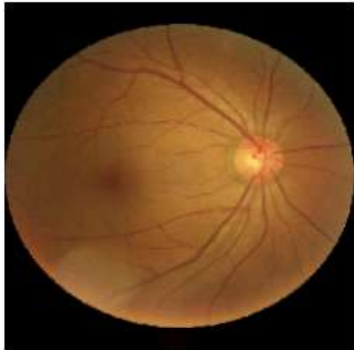
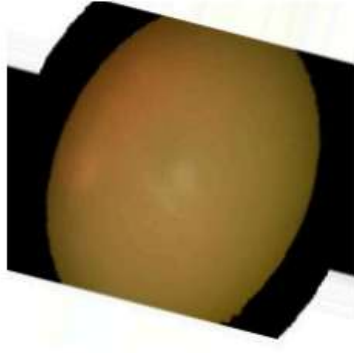
Requirement already satisfied: markdown-it-py>=2.2.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from rich->keras>=3.12.0->tensorflow) (4.0.0)

Requirement already satisfied: pygments<3.0.0,>=2.13.0 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from rich->keras>=3.12.0->tensorflow) (2.19.2)

Requirement already satisfied: mdurl~=0.1 in C:\Users\shahad\anaconda3\envs\Shahad\Lib\site-packages (from markdown-it-py>=2.2.0->rich->keras>=3.12.0->tensorflow) (0.1.2)

Found 3376 images belonging to 4 classes.

Found 841 images belonging to 4 classes.



Model: "sequential_3"

Layer (type)	Output Shape	Param #
conv2d_9 (Conv2D)	(None, 222, 222, 32)	896
max_pooling2d_9 (MaxPooling2D)	(None, 111, 111, 32)	0
conv2d_10 (Conv2D)	(None, 109, 109, 64)	18,496
max_pooling2d_10 (MaxPooling2D)	(None, 54, 54, 64)	0
conv2d_11 (Conv2D)	(None, 52, 52, 128)	73,856
max_pooling2d_11 (MaxPooling2D)	(None, 26, 26, 128)	0
flatten_3 (Flatten)	(None, 86528)	0
dense_6 (Dense)	(None, 128)	11,075,712
dropout_3 (Dropout)	(None, 128)	0
dense_7 (Dense)	(None, 4)	516

Total params: 11,169,476 (42.61 MB)

Trainable params: 11,169,476 (42.61 MB)

Non-trainable params: 0 (0.00 B)

Epoch 1/10

106/106 ————— **176s** 2s/step - accuracy: 0.4526 - loss: 1.2242 - val_accuracy: 0.4697 - val_loss: 1.1850

Epoch 2/10

106/106 ————— **221s** 2s/step - accuracy: 0.5213 - loss: 1.0893 - val_accuracy: 0.5208 - val_loss: 1.0867

Epoch 3/10

106/106 ————— **4918s** 47s/step - accuracy: 0.5853 - loss: 0.9823 - val_accuracy: 0.4055 - val_loss: 2.8487

Epoch 4/10

106/106 ————— **167s** 2s/step - accuracy: 0.6561 - loss: 0.8572 - val_accuracy: 0.4328 - val_loss: 2.7857

Epoch 5/10

106/106 ————— **165s** 2s/step - accuracy: 0.6905 - loss: 0.7871 - val_accuracy: 0.4055 - val_loss: 2.0742

Epoch 6/10

106/106 ————— **244s** 2s/step - accuracy: 0.7251 - loss: 0.6974 - val_accuracy: 0.4316 - val_loss: 2.0584

Epoch 8/10

106/106 ————— **172s** 2s/step - accuracy: 0.7384 - loss: 0.6894 - val_accuracy: 0.4471 - val_loss: 2.0509

Epoch 9/10

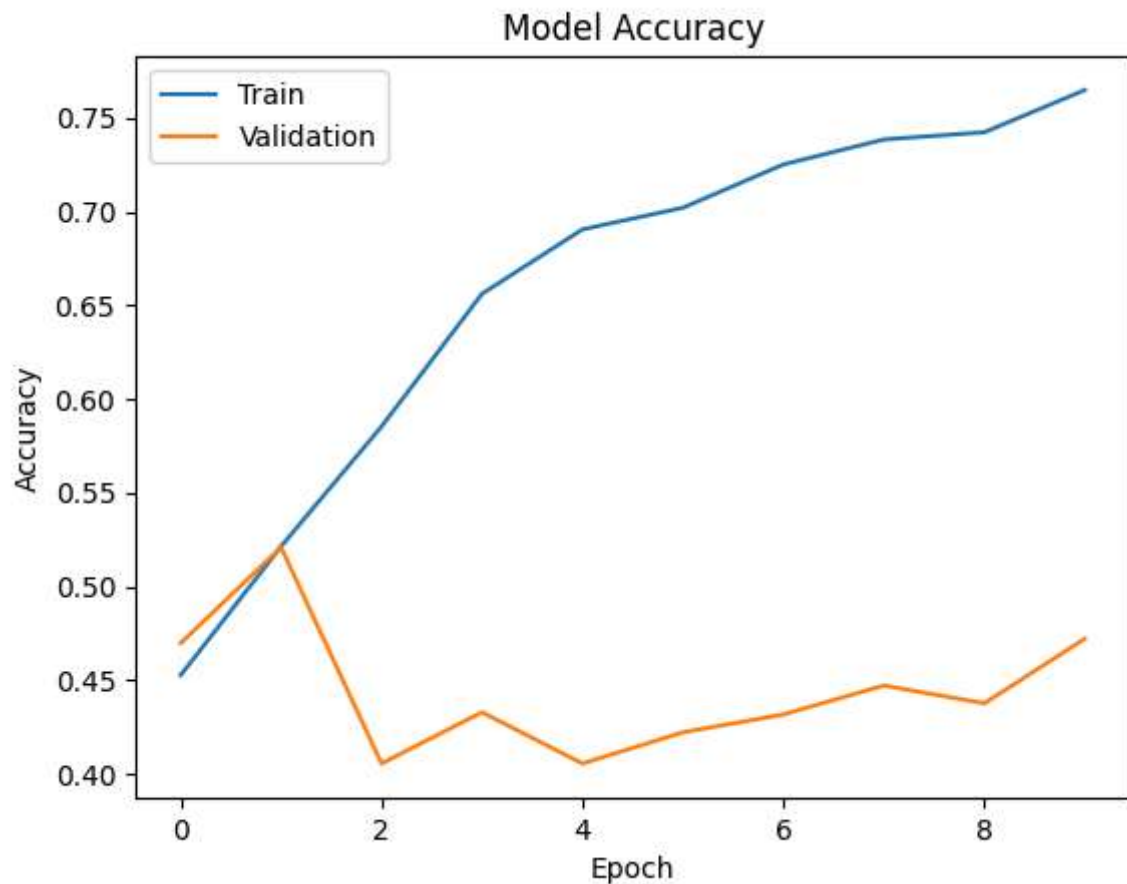
106/106 ————— **162s** 2s/step - accuracy: 0.7423 - loss: 0.6526 - val_accuracy: 0.4376 - val_loss: 1.7767

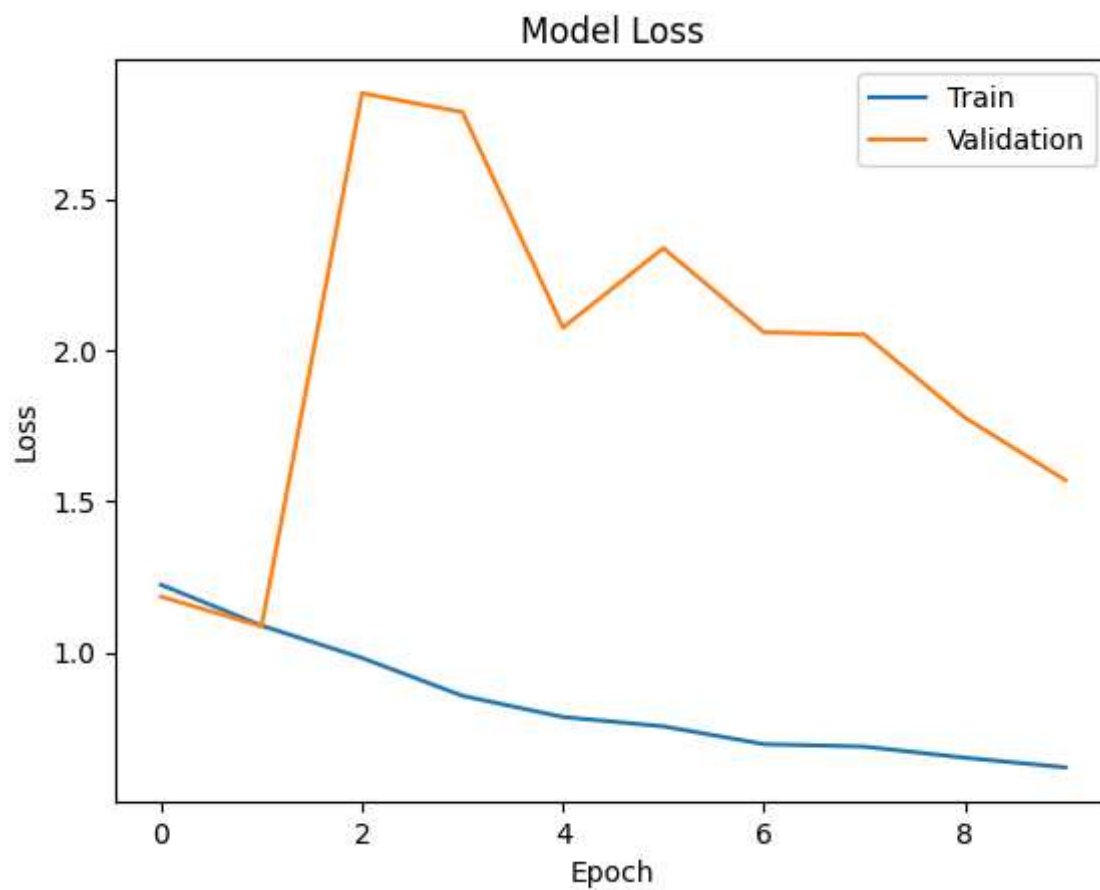
Epoch 10/10

106/106 ————— **165s** 2s/step - accuracy: 0.7648 - loss: 0.6207 - val_accuracy: 0.4721 - val_loss: 1.5699

27/27 ————— **9s** 315ms/step - accuracy: 0.4721 - loss: 1.5699

Validation Accuracy: 0.4720570743083954





Model saved successfully in Keras native format.

In []: