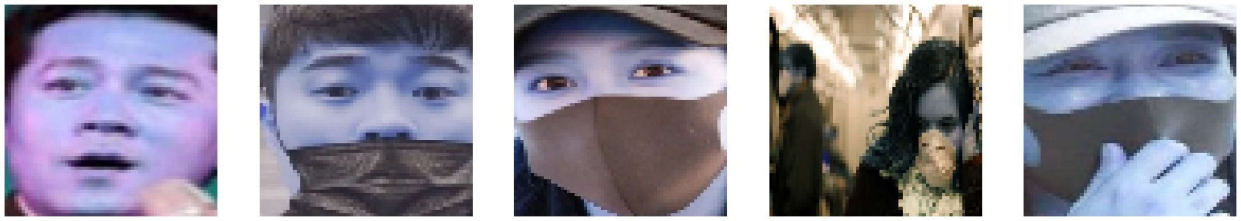
Data Preprocessing

```
import os
import cv2
import numpy as np
from tensorflow.keras.utils import to_categorical
from sklearn.model_selection import train_test_split

# Define dataset path
data_dir = "./dataset"
categories = ["with_mask", "without_mask"]

data = []
labels = []

for category in categories:
    path = os.path.join(data_dir, category)
    class_label = categories.index(category)

    for img_name in os.listdir(path):
        try:
            img_path = os.path.join(path, img_name)

            # Check if the file is an image
            if not img_path.lower().endswith((".png", ".jpg",
".jpeg")):
                print(f"Skipping non-image file: {img_name}")
                continue

            # print(f"Trying to read: {img_path}")
            img = cv2.imread(img_path)

            # if img is None:
            #     print(f"Failed to load: {img_path}")
            #     continue  # Skip unreadable images


            img = cv2.imread(img_path)

            # Check if the image was loaded successfully
            if img is None:
                print(f"Skipping unreadable image: {img_name}")
                continue

            img = cv2.resize(img, (64, 64))  # Resize to match CNN
input
            data.append(img)
            labels.append(class_label)

        except Exception as e:
```

```
            print(f"Error loading image {img_name}: {e}")

# Convert to NumPy arrays
data = np.array(data) / 255.0  # Normalize pixel values
labels = np.array(labels)

# Split dataset
X_train, X_test, y_train, y_test = train_test_split(data, labels,
test_size=0.2, random_state=42)
y_train = to_categorical(y_train, 2)
y_test = to_categorical(y_test, 2)

print("Dataset successfully loaded!")
print(f"Total images loaded: {len(data)}")
```

```
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-23 132115.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-23 132400.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 171804.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 172039.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 202509.png
Skipping unreadable image: 0 0 ≈˙◊¢ 2020-02-24 205216.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 215234.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 215615.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 220536.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 222124.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 224833.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 225329.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-24 225427.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-25 150422.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-25 150847.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-25 150921.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-25 185823.png
Skipping unreadable image: 0_0_≈˙◊¢ 2020-02-25 190026.png
Skipping unreadable image: 1_0_≈˙◊¢ 2020-02-24 202935.png
Skipping unreadable image: 1_0_≈˙◊¢ 2020-02-24 215624.png
Skipping unreadable image: 1_0_≈˙◊¢ 2020-02-24 224914.png
Skipping unreadable image: 1_0_≈˙◊¢ 2020-02-25 151918.png
Dataset successfully loaded!
Total images loaded: 3810
```

```
import matplotlib.pyplot as plt

fig, axes = plt.subplots(2, 5, figsize=(15, 10))
for i, ax in enumerate(axes.flat):
    ax.imshow(X_train[i])
    ax.axis('off')
plt.show()
```



Model Training

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten,
Dense, Dropout

# Model definition
model = Sequential([
    Conv2D(32, (3,3), activation="relu", input_shape=(64, 64, 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(2, activation="softmax")  # Two classes: With Mask / Without
Mask
])

model.compile(optimizer="adam", loss="categorical_crossentropy",
metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 62, 62, 32)        896

 max_pooling2d (MaxPooling2D  (None, 31, 31, 32)       0
 )

 conv2d_1 (Conv2D)           (None, 29, 29, 64)        18496

 max_pooling2d_1 (MaxPooling  (None, 14, 14, 64)       0
 2D)

 conv2d_2 (Conv2D)           (None, 12, 12, 128)       73856

 max_pooling2d_2 (MaxPooling  (None, 6, 6, 128)        0
 2D)

 flatten (Flatten)           (None, 4608)              0

 dense (Dense)               (None, 128)               589952

 dropout (Dropout)           (None, 128)               0

 dense_1 (Dense)             (None, 2)                 258

=================================================================
Total params: 683,458
Trainable params: 683,458
Non-trainable params: 0
_________________________________________________________________
```

```
history = model.fit(X_train, y_train, validation_data=(X_test,
y_test), epochs=10, batch_size=32)
model.save("mask_detector_model.h5")  # Save model

Epoch 1/10
96/96 [==============================] - 30s 277ms/step - loss: 0.3373
- accuracy: 0.8563 - val_loss: 0.1558 - val_accuracy: 0.9462
Epoch 2/10
96/96 [==============================] - 26s 271ms/step - loss: 0.2128
- accuracy: 0.9242 - val_loss: 0.1619 - val_accuracy: 0.9409
Epoch 3/10
96/96 [==============================] - 26s 271ms/step - loss: 0.1783
- accuracy: 0.9298 - val_loss: 0.1132 - val_accuracy: 0.9593
Epoch 4/10
96/96 [==============================] - 26s 266ms/step - loss: 0.1452
- accuracy: 0.9488 - val_loss: 0.1003 - val_accuracy: 0.9646
Epoch 5/10
```

```
96/96 [==============================] - 25s 265ms/step - loss: 0.1160
- accuracy: 0.9557 - val_loss: 0.0783 - val_accuracy: 0.9724
Epoch 6/10
96/96 [==============================] - 25s 265ms/step - loss: 0.1132
- accuracy: 0.9623 - val_loss: 0.1118 - val_accuracy: 0.9646
Epoch 7/10
96/96 [==============================] - 26s 269ms/step - loss: 0.0772
- accuracy: 0.9724 - val_loss: 0.0640 - val_accuracy: 0.9738
Epoch 8/10
96/96 [==============================] - 25s 263ms/step - loss: 0.0727
- accuracy: 0.9751 - val_loss: 0.1041 - val_accuracy: 0.9593
Epoch 9/10
96/96 [==============================] - 27s 286ms/step - loss: 0.0658
- accuracy: 0.9780 - val_loss: 0.0771 - val_accuracy: 0.9738
Epoch 10/10
96/96 [==============================] - 33s 344ms/step - loss: 0.0386
- accuracy: 0.9869 - val_loss: 0.0736 - val_accuracy: 0.9777
```

TESTING the model

```
import cv2
import numpy as np
from tensorflow.keras.models import load_model

# Load the trained model
model = load_model("mask_detector_model.h5")

# Load OpenCV's pre-trained face detector
face_cascade = cv2.CascadeClassifier(cv2.data.haarcascades +
"haarcascade_frontalface_default.xml")

# Open webcam (0 = default camera)
cap = cv2.VideoCapture(0)

while True:
    ret, frame = cap.read()
    if not ret:
        break

    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    faces = face_cascade.detectMultiScale(gray, scaleFactor=1.3,
minNeighbors=5)

    for (x, y, w, h) in faces:
        face = frame[y:y+h, x:x+w]
        face = cv2.resize(face, (64, 64))
        face = np.expand_dims(face, axis=0) / 255.0  # Normalize pixel
values
```

```
        prediction = model.predict(face)
        label = "Mask" if np.argmax(prediction) == 0 else "No Mask"
        color = (0, 255, 0) if label == "Mask" else (0, 0, 255)

        # Draw bounding box and label on the frame
        cv2.rectangle(frame, (x, y), (x+w, y+h), color, 2)
        cv2.putText(frame, label, (x, y-10), cv2.FONT_HERSHEY_SIMPLEX,
0.8, color, 2)

    # Show the video frame
    cv2.imshow("Mask Detection", frame)

    # Press 'q' to quit the webcam
    if cv2.waitKey(1) & 0xFF == ord("q"):
        break

# Release resources
cap.release()
cv2.destroyAllWindows()
```

```
1/1 [==============================] - 0s 191ms/step
1/1 [==============================] - 0s 73ms/step
1/1 [==============================] - 0s 71ms/step
1/1 [==============================] - 0s 61ms/step
1/1 [==============================] - 0s 65ms/step
1/1 [==============================] - 0s 72ms/step
1/1 [==============================] - 0s 71ms/step
1/1 [==============================] - 0s 76ms/step
1/1 [==============================] - 0s 72ms/step
1/1 [==============================] - 0s 72ms/step
1/1 [==============================] - 0s 70ms/step
1/1 [==============================] - 0s 64ms/step
1/1 [==============================] - 0s 71ms/step
1/1 [==============================] - 0s 83ms/step
1/1 [==============================] - 0s 70ms/step
1/1 [==============================] - 0s 69ms/step
1/1 [==============================] - 0s 71ms/step
1/1 [==============================] - 0s 68ms/step
1/1 [==============================] - 0s 83ms/step
1/1 [==============================] - 0s 72ms/step
1/1 [==============================] - 0s 62ms/step
1/1 [==============================] - 0s 122ms/step
1/1 [==============================] - 0s 64ms/step
1/1 [==============================] - 0s 69ms/step
1/1 [==============================] - 0s 62ms/step
1/1 [==============================] - 0s 82ms/step
1/1 [==============================] - 0s 72ms/step
1/1 [==============================] - 0s 74ms/step
1/1 [==============================] - 0s 72ms/step
```