Before downloading the dataset, make sure you have installed the Kaggle API and configured your API key.

```
!pip install kaggle
```

```
Requirement already satisfied: kaggle in /usr/local/lib/python3.11/dist-packages
Requirement already satisfied: bleach in /usr/local/lib/python3.11/dist-packages
Requirement already satisfied: certifi>=14.05.14 in /usr/local/lib/python3.11/di
Requirement already satisfied: charset-normalizer in /usr/local/lib/python3.11/d
Requirement already satisfied: idna in /usr/local/lib/python3.11/dist-packages (
Requirement already satisfied: protobuf in /usr/local/lib/python3.11/dist-packag
Requirement already satisfied: python-dateutil>=2.5.3 in /usr/local/lib/python3.
Requirement already satisfied: python-slugify in /usr/local/lib/python3.11/dist-
Requirement already satisfied: requests in /usr/local/lib/python3.11/dist-packag
Requirement already satisfied: setuptools>=21.0.0 in /usr/local/lib/python3.11/d
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.11/dist-packa
Requirement already satisfied: text-unidecode in /usr/local/lib/python3.11/dist-
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages (
Requirement already satisfied: urllib3>=1.15.1 in /usr/local/lib/python3.11/dist
Requirement already satisfied: webencodings in /usr/local/lib/python3.11/dist-pa
```

Now, you can download the dataset from Kaggle.

```
!kaggle datasets download -d gti-upm/leapgestrecog -p /tmp/ --unzip
```

```
Traceback (most recent call last):
  File "/usr/local/bin/kaggle", line 10, in <module>
    sys.exit(main())
             ^^^^^^
  File "/usr/local/lib/python3.11/dist-packages/kaggle/cli.py", line 68, in main
    out = args.func(**command_args)
          ^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.11/dist-packages/kaggle/api/kaggle_api_extended.p
    with self.build_kaggle_client() as kaggle:
         ^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.11/dist-packages/kaggle/api/kaggle_api_extended.p
    username=self.config_values['username'],
             ~~~~~~~~~~~~~~~~~~^^^^^^^^^^^^
KeyError: 'username'
```

After downloading and unzipping, the `leapGestRecog_dataset.csv` file should be available in the `/tmp/` directory. Now you can load it into a pandas DataFrame.

```
!mkdir -p ~/.kaggle
!mv kaggle.json ~/.kaggle/
!chmod 600 ~/.kaggle/kaggle.json
```

```
mv: cannot stat 'kaggle.json': No such file or directory
chmod: cannot access '/root/.kaggle/kaggle.json': No such file or directory
```

```
!pip install opendatasets --quite
```

```
Usage:
  pip3 install [options] <requirement specifier> [package-index-options] ...
  pip3 install [options] -r <requirements file> [package-index-options] ...
  pip3 install [options] [-e] <vcs project url> ...
  pip3 install [options] [-e] <local project path> ...
  pip3 install [options] <archive url/path> ...

no such option: --quite
```

```
!pip install opendatasets
```

```
Collecting opendatasets
  Downloading opendatasets-0.1.22-py3-none-any.whl.metadata (9.2 kB)
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages (
Requirement already satisfied: kaggle in /usr/local/lib/python3.11/dist-packages
Requirement already satisfied: click in /usr/local/lib/python3.11/dist-packages
Requirement already satisfied: bleach in /usr/local/lib/python3.11/dist-packages
Requirement already satisfied: certifi>=14.05.14 in /usr/local/lib/python3.11/di
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Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.11/dist-packa
Requirement already satisfied: text-unidecode in /usr/local/lib/python3.11/dist-
Requirement already satisfied: urllib3>=1.15.1 in /usr/local/lib/python3.11/dist
Requirement already satisfied: webencodings in /usr/local/lib/python3.11/dist-pa
Downloading opendatasets-0.1.22-py3-none-any.whl (15 kB)
Installing collected packages: opendatasets
Successfully installed opendatasets-0.1.22
```

```
import opendatasets as od
```

```
od.download("https://www.kaggle.com/datasets/gti-upm/leapgestrecog")
```

```
Please provide your Kaggle credentials to download this dataset. Learn more: htt
Your Kaggle username: shivaniddeshmukh
Your Kaggle Key: ·····
Dataset URL: https://www.kaggle.com/datasets/gti-upm/leapgestrecog
Downloading leapgestrecog.zip to ./leapgestrecog
100%|██████████| 2.13G/2.13G [00:24<00:00, 92.3MB/s]
```

```
import os
import cv2
import numpy as np

def load_data_simple(data_dir):
    data = []
    labels = []
    categories = sorted(os.listdir(data_dir))

    for label, category in enumerate(categories):
        category_path = os.path.join(data_dir, category)
        if not os.path.isdir(category_path):
            continue

        for img_name in os.listdir(category_path):
            if img_name.endswith('.png'):
                img_path = os.path.join(category_path, img_name)
                img = cv2.imread(img_path, cv2.IMREAD_GRAYSCALE)
                if img is not None:
                    img = cv2.resize(img, (64, 64))
                    data.append(img)
                    labels.append(label)

    data = np.array(data).reshape(-1, 64, 64, 1) / 255.0
    labels = np.array(labels)
    return data, labels, categories

# Example usage:
data_dir = './leapgestrecog/leapGestRecog/00'  # Point to one subject folder with gestures
data, labels, categories = load_data_simple(data_dir)

print(f"Loaded {len(data)} images from {len(categories)} categories.")
```

```
Loaded 2000 images from 10 categories.
```

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

model = Sequential([
    Conv2D(32, (3, 3), activation='relu', input_shape=(64, 64, 1)),
    MaxPooling2D(2, 2),
    Conv2D(64, (3, 3), activation='relu'),
    MaxPooling2D(2, 2),
    Flatten(),
    Dense(128, activation='relu'),
    Dropout(0.5),
    Dense(len(categories), activation='softmax')
])

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

```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/convolutional/base_conv
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 62, 62, 32)	320
max_pooling2d (MaxPooling2D)	(None, 31, 31, 32)	0
conv2d_1 (Conv2D)	(None, 29, 29, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
flatten (Flatten)	(None, 12544)	0
dense (Dense)	(None, 128)	1,605,760
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 10)	1,290

Total params: 1,625,866 (6.20 MB)
Trainable params: 1,625,866 (6.20 MB)
Non-trainable params: 0 (0.00 B)

```
model.fit(X_train, y_train, epochs=10, batch_size=32, validation_split=0.2)
```

```
Epoch 1/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 84s 204ms/step - accuracy: 0.6472 - loss: 1.038(
Epoch 2/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 132s 181ms/step - accuracy: 0.9790 - loss: 0.061
Epoch 3/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 82s 182ms/step - accuracy: 0.9886 - loss: 0.036
Epoch 4/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 71s 177ms/step - accuracy: 0.9897 - loss: 0.031(
Epoch 5/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 84s 182ms/step - accuracy: 0.9925 - loss: 0.019
Epoch 6/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 70s 176ms/step - accuracy: 0.9932 - loss: 0.018
Epoch 7/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 84s 182ms/step - accuracy: 0.9952 - loss: 0.015
Epoch 8/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 79s 176ms/step - accuracy: 0.9956 - loss: 0.013(
Epoch 9/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 82s 176ms/step - accuracy: 0.9975 - loss: 0.007
Epoch 10/10
400/400 ━━━━━━━━━━━━━━━━━━━━ 83s 178ms/step - accuracy: 0.9950 - loss: 0.017
<keras.src.callbacks.history.History at 0x784593abc790>
```

```
loss, accuracy = model.evaluate(X_test, y_test)
print(f"Test Accuracy: {accuracy * 100:.2f}%")
```

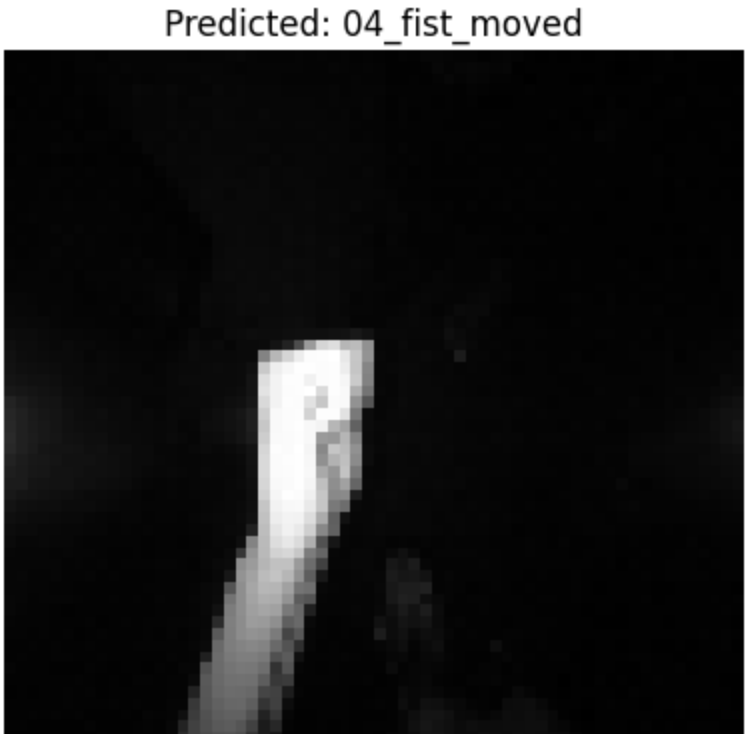
```
125/125 ━━━━━━━━━━━━━━━━━━━━ 5s 39ms/step - accuracy: 1.0000 - loss: 3.0250e-
Test Accuracy: 100.00%
```

```
import matplotlib.pyplot as plt

pred = model.predict(np.expand_dims(X_test[0], axis=0))
predicted_class = np.argmax(pred)

plt.imshow(X_test[0].reshape(64, 64), cmap='gray')
plt.title(f"Predicted: {categories[predicted_class]}")
plt.axis('off')
plt.show()
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 99ms/step
```




```
import matplotlib.pyplot as plt
import cv2
import numpy as np

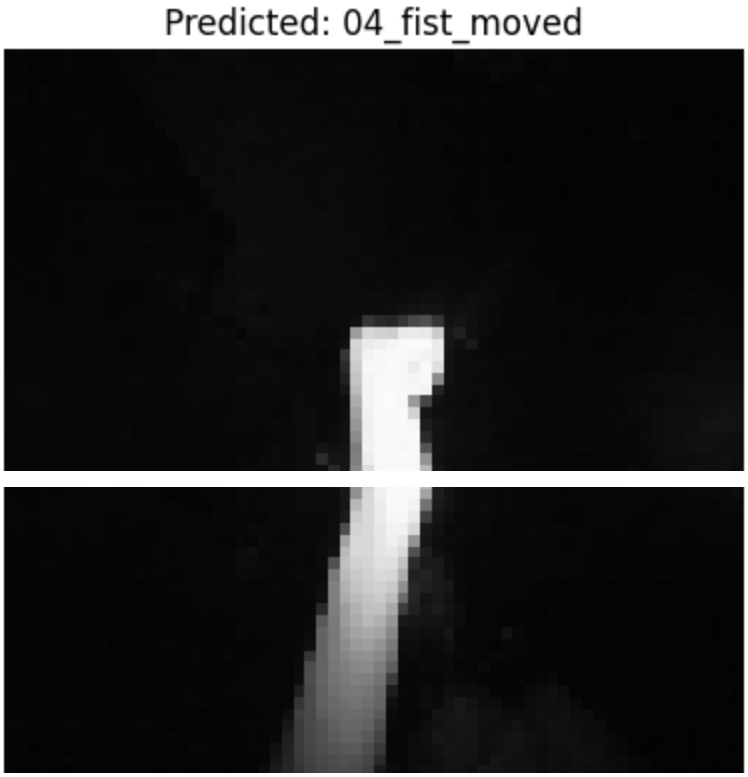
# Predict a single test image
pred = model.predict(np.expand_dims(X_test[0], axis=0))
predicted_class = np.argmax(pred)

# Convert grayscale image back to color if needed (optional)
# If your model input is grayscale but you want a colorful display:
color_img = cv2.cvtColor((X_test[0].reshape(64, 64) * 255).astype(np.uint8), cv2.COLOR_GRAY

# Display the image in color
plt.imshow(color_img)
plt.title(f"Predicted: {categories[predicted_class]}")
```

```
plt.axis('off')
plt.show()
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 106ms/step
```




```
# Install Jupyter if not already
!pip install notebook

# Convert .ipynb to PDF
!jupyter nbconvert --to pdf your_notebook.ipynb
```

```
r/local/lib/python3.11/dist-packages (6.5.7)
local/lib/python3.11/dist-packages (from notebook) (3.1.6)
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/usr/local/lib/python3.11/dist-packages (from argon2-cffi-bindings->argon2-cffi-
n /usr/local/lib/python3.11/dist-packages (from beautifulsoup4->nbconvert>=5->no
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