Exp No: 4 HANDWRITTEN DIGITS RECOGNITION WITH MNIST

Aim:

To build a handwritten digit's recognition with MNIST dataset.

Procedure:

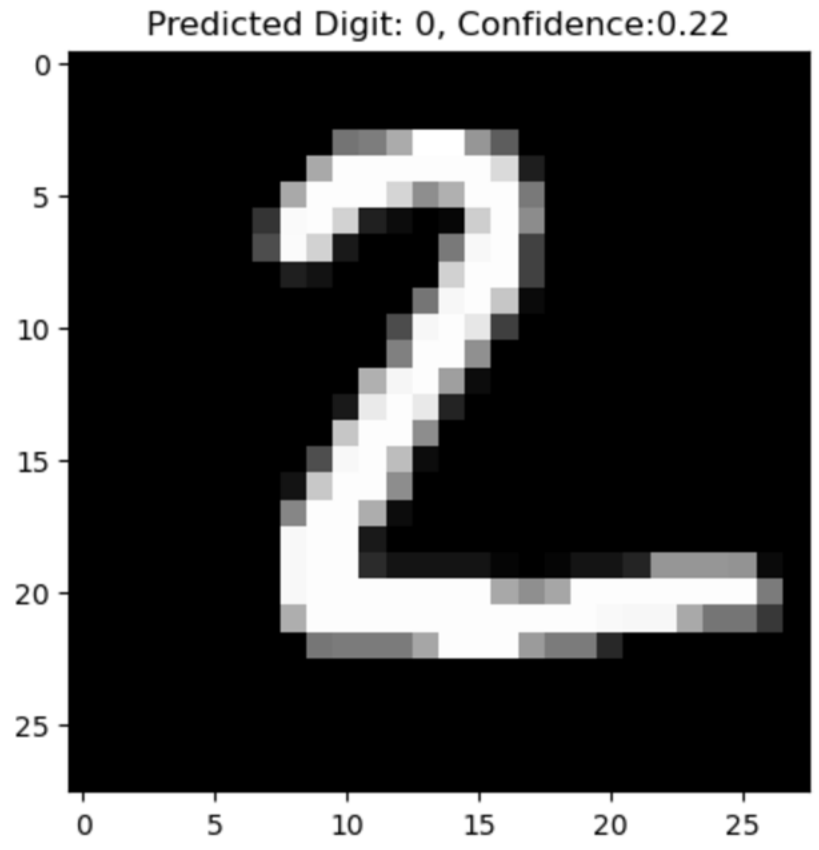
1. Download and load the MNIST dataset.
2. Perform analysis and preprocessing of the dataset.
3. Build a simple neural network model using Keras/TensorFlow.
4. Compile and fit the model.
5. Perform prediction with the test dataset.
6. Calculate performance metrics.

Program:

```
import numpy as np
from tensorflow.keras.models import load_model
from tkinter import *
import tkinter as tk
import win32gui
from PIL import ImageGrab, Image
from tensorflow import keras
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D
from tensorflow.keras import backend as k
(x_train, y_train), (x_test, y_test) = mnist.load_data()
print(x_train.shape, y_train.shape)
x_train = x_train.reshape(x_train.shape[0], 28, 28, 1)
x_test = x_test.reshape(x_test.shape[0], 28, 28, 1)
input_shape = (28, 28, 1)
y_train = keras.utils.to_categorical(y_train, 10)
y_test = keras.utils.to_categorical(y_test, 10)
x_train = x_train.astype('float32')
x_test = x_test.astype('float32')
x_train /= 255
x_test /= 255
print('x_train shape:', x_train.shape)
print(x_train.shape[0], 'train samples')
print(x_test.shape[0], 'test samples')
batch_size = 128
num_classes = 10
epochs = 15
model = Sequential()
model.add(Conv2D(32, kernel_size=(5, 5),activation='relu',input_shape=input_shape))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Conv2D(64, (3, 3), activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Flatten())
model.add(Dense(128, activation='relu'))
model.add(Dropout(0.3))
model.add(Dense(64, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(num_classes, activation='softmax'))
model.compile(loss=keras.losses.categorical_crossentropy,optimizer=keras.optimizers.Adadelta(),
metrics=['accuracy'])
hist = model.fit(x_train,
y_train,batch_size=batch_size,epochs=epochs,verbose=1,validation_data=(x_test, y_test))
print("The model has successfully trained")
score = model.evaluate(x_test, y_test, verbose=0)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
model.save('mnist.h5')
print("Saving the model as mnist.h5")
model = load_model('mnist.h5')
def predict_digit(img):
    #resize image to 28x28 pixels
    img = img.resize((28,28))
    #Convert rgb to grayscale
    img = img.convert('L')
    img = np.array(img)
    img = img.reshape(1, 28, 28, 1)
    img = img/255.0
    img = 1 - img
    #predicting
    res = model.predict([img])[0]
    return np.argmax(res), max(res)
```

```
import matplotlib.pyplot as plt

#Use an image from the MNIST test dataset
test_image_array = x_test[1] # Change the index to use different images from the test set
test_image_pil = Image.fromarray((np.squeeze(test_image_array) * 255).astype(np.uint8))

#Predict the digit in the image
predicted_digit, confidence = predict_digit(test_image_pil)

#Print the results
print(f"Predicted Digit: {predicted_digit}")
print(f"Confidence:{confidence:.2f}")

#Show the test image
plt.imshow(test_image_array.squeeze(), cmap='gray')
plt.title(f"Predicted Digit: {predicted_digit}, Confidence:{confidence:.2f}")
plt.show()
```

Output:



Result:

Therefore, haandwritten digits have been recognized using MNIST dataset.