Ex 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.

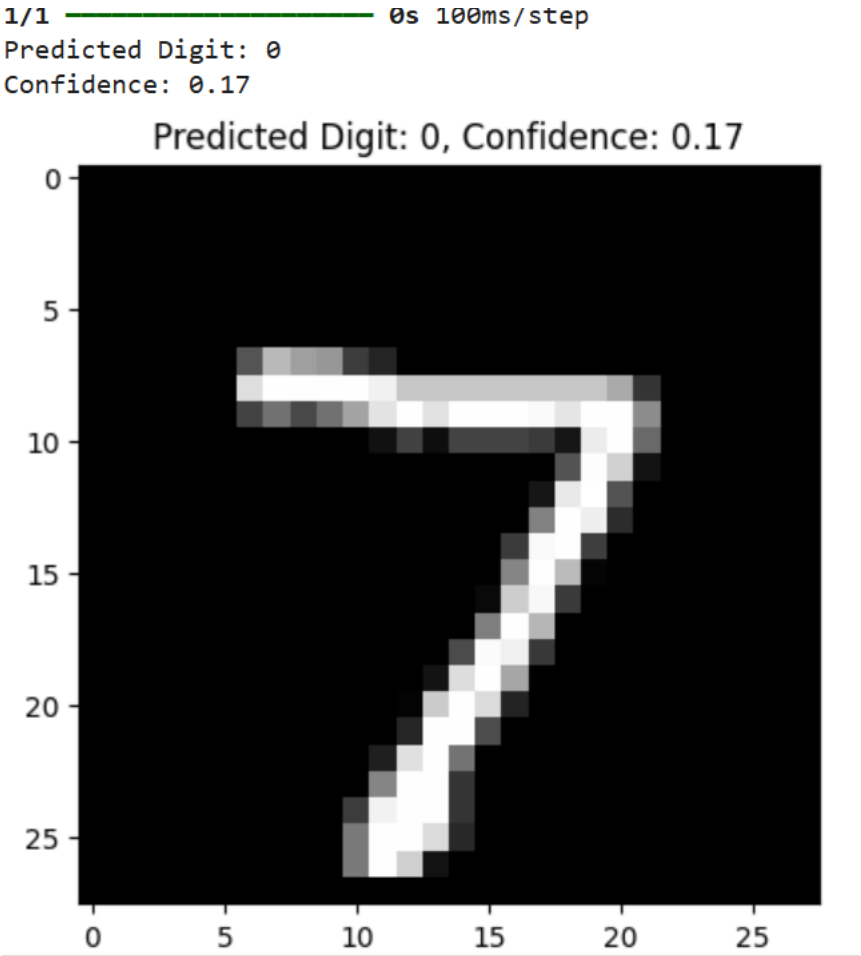
PROGRAM:

```
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 = 50

 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(),met
rics

 =['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])

import matplotlib.pyplot as plt

plt.plot(hist.history['accuracy'])

plt.plot(hist.history['val_accuracy'])

plt.title('Model Accuracy')

plt.ylabel('Accuracy')

 plt.xlabel('Epoch')

 plt.legend(['Train', 'Test'], loc='upper left')

 plt.show()

# Plot training & validation loss values

plt.plot(hist.history['loss'])

plt.plot(hist.history['val_loss'])

plt.title('Model Loss')

plt.ylabel('Loss')

plt.xlabel('Epoch')

plt.legend(['Train', 'Test'], loc='upper left')

plt.show()
```

OUTPUT:



```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 100ms/step
Predicted Digit: 0
Confidence: 0.17
```

RESULT:

A handwritten digit’s recognition with MNIST dataset is successfully build.