Roll Number: 210701503

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:

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
```

Roll Number: 210701503

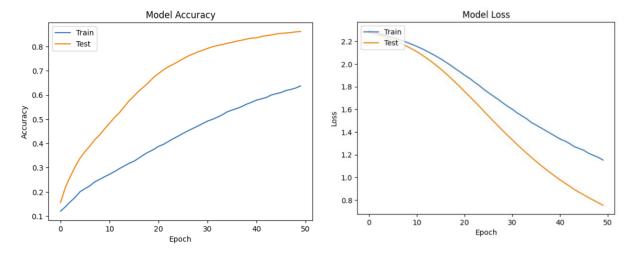
```
print('x train shape:', x train.shape)
print(x train.shape[0], 'train samples')
print(x test.shape[0], 'test samples')
batch size = 128
num classes = 10
epochs = 50
model = Sequential()
model.add(Conv2D(32, kernel size=(5, 5),activation='relu',input shape=input shape))
model.add(MaxPooling2D(pool 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(),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])
import matplotlib.pyplot as plt
plt.plot(hist.history['accuracy'])
plt.plot(hist.history['val accuracy'])
plt.title('Model Accuracy')
plt.ylabel('Accuracy')
```

Roll Number: 210701503

```
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



Result

Handwritten digit recognition with MNIST has been successfully created.