

🖋️ Handwritten Digit Recognition (MNIST)

This is a **Machine Learning + Deep Learning project** that recognizes handwritten digits (0–9) using a **Convolutional Neural Network (CNN)** trained on the **MNIST dataset**.

The app is built with **Streamlit**, allowing users to:

- 🖋️ Draw digits directly in the browser canvas
- 📁 Upload single-digit images
- 📄 Upload images containing multiple handwritten digits

...and get instant predictions!

🏠 Project Overview

🎯 Objective

To identify handwritten digits from user input using a CNN model trained on the MNIST dataset.

⚙️ Technologies Used

- **Python**
- **TensorFlow / Keras**
- **Streamlit**
- **Pillow (PIL)**
- **NumPy & Pandas**
- **streamlit-drawable-canvas**

🧠 How It Works

1. **Model Training**

- A CNN is trained on MNIST dataset (60,000 training, 10,000 testing samples).
- Model achieves around **98–99% accuracy**.
- The trained model is saved as ``mnist_cnn.h5``.

2. ****Web App****

- Built using Streamlit.
- Loads the trained model.
- Supports three input modes:
 - Draw a digit
 - Upload a single digit image
 - Upload an image with multiple digits
- Automatically preprocesses input to match MNIST format (28×28 grayscale).

3. ****Prediction****

- The model outputs probabilities for digits 0–9.
- The highest probability determines the predicted digit.

🧩 Features

Feature	Description
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🖍 Draw Digit	Draw any digit 0–9 directly on screen
📷 Upload Image	Upload a single digit photo for recognition
📄 Multi-digit Support	Upload an image containing multiple digits (like “2025”)
📊 Probabilities	See confidence scores for each digit
🕒 Real-time Processing	Instant predictions through Streamlit interface

🚀 How to Run Locally

1 Clone the repository

```
```bash
```

```
git clone https://github.com/<your-username>/mnist-digit-recognition.git
```

```
cd mnist-digit-recognition
```

#### ### 2 Create a virtual environment

```
```bash
```

```
python-m venv venv
```

```
venv\Scripts\activate
```

```
### 3 Install dependencies
```

```
```bash
```

```
pip install-r requirements.txt
```

```
4 Run the Streamlit app
```

```
```bash
```

```
streamlit run app.py
```

Project Structure

mnist_digit_recognition/

|

|— app.py # Streamlit web application

|— mnist_train.py # CNN training script

|— mnist_cnn.h5 # Trained CNN model file

|— requirements.txt # Required dependencies

|— README.md # Project documentation

|— .gitignore # Ignore unnecessary files

Dependencies

streamlit

tensorflow

Pillow


numpy


pandas

streamlit-drawable-canvas

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