EXP NO: 9	MINI PROJECT - **Image Classifier: A Deep Learning and API-Driven Framework for Visual Data Analysis**

AIM:

To design and develop an intelligent web-based system capable of recognizing handwritten digits using a Convolutional Neural Network (CNN) model trained on the MNIST dataset, and deploy it through a Flask REST API for real-time image classification.

ALGORITHM:

Step 1: Import Libraries
Import necessary libraries such as TensorFlow/Keras, NumPy, Flask, and OpenCV for model building, preprocessing, and deployment.

Step 2: Load Dataset
Load the **MNIST dataset**, which contains images of handwritten digits (0–9).

Step 3: Data Preprocessing

- Normalize the image pixel values to the range [0,1].
- Reshape images to the required input shape (28×28×1).
- Split the dataset into training and testing sets.

Step 4: Build the CNN Model

- Create a sequential CNN architecture with layers such as:
    - Convolution layer
    - ReLU activation
    - Max pooling
    - Flatten layer
    - Fully connected (dense) layer
    - Softmax output layer

Step 5: Compile the Model

- Use an optimizer (e.g., Adam) and a loss function (e.g., categorical crossentropy).
- Set accuracy as the performance metric.

Step 6: Train the Model
Train the CNN model using the training dataset and validate it with the testing dataset.

Step 7: Evaluate the Model
Calculate accuracy and loss on the test dataset to assess model performance.

Step 8: Save the Model

Save the trained model in `.h5` format for later use during deployment.

Step 9: Develop Flask API

Create a Flask-based REST API that accepts image uploads, loads the trained model, and returns the predicted digit.

Step 10: Test the Application

Run the Flask server and test it by uploading handwritten digit images to verify correct predictions.

CODE:

Index.html

```html
<!DOCTYPE html>
<html>
<head>
 <meta charset="UTF-8">
 <title>Stock Price Predictor Web App</title>
 <link href='https://fonts.googleapis.com/css?family=Pacifico' rel='stylesheet'>
 <link href='https://fonts.googleapis.com/css?family=Arimo' rel='stylesheet'>
 <link href='https://fonts.googleapis.com/css?family=Hind:300' rel='stylesheet'>
     <link     href='https://fonts.googleapis.com/css?family=Open+Sans+Condensed:300'
rel='stylesheet'>
                                <link                            rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/css/bootstrap.min.css">
 <style>
  body {
    font-family: 'Arimo', sans-serif;
    background-color: #f0f8ff;
    padding: 50px;
  }
  .login {
    max-width: 500px;
    margin: auto;
    background: white;
    padding: 30px;
    border-radius: 10px;
    box-shadow: 0px 0px 10px 0px gray;
  }
  h1, h2 {
    color: #1e81b0;
  }
```

```html
    .footer-dark {
      text-align: center;
      margin-top: 40px;
      padding: 20px;
      background-color: #1e81b0;
      color: white;
     }
  </style>
</head>
<body style="background-color: greenyellow; font-family: cursive ;">

<div class="login" style="background-color: aqua">
 <h1 style="color: black;">Stock Price Predictor</h1>
 <h2 style="color: black;">Welcome, {{ username }}!</h2>

 <form action="{{ url_for('dashboard') }}" method="post">
   <input type="number" name="Open" placeholder="Opening Price" class="form-control
mb-3" required>
   <input type="number" name="High" placeholder="Highest Price" class="form-control
mb-3" required>
    <input type="number" name="Low" placeholder="Lowest Price" class="form-control
mb-3" required>
   <input type="number" name="Volume" placeholder="Volume" class="form-control mb-
3" required>
   <button type="submit" class="btn btn-primary w-100" style= "background-color: green;
color: black;">Predict</button>
 </form>

 <br>
   <h4   class="text-success"   style="background-color:   white;   color:   black;">{{
prediction_text }}</h4>
</div>

<div class="footer-dark">
 <footer>
  <div class="container">
   <p class="copyright">Stock Price Predictor © 2025</p>
  </div>
 </footer>
</div>
```

```
<script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/js/bootstrap.bundle.min.js"></script
>
</body>
</html>
```

Home.html

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Stock Price Prediction</title>
                                        <link                    rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/animate.css/4.1.1/animate.min.css"/>
            <link     rel="stylesheet"     href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/6.4.2/css/all.min.css">
    <style>
      .head {
        color: #1e81b0;
      }
      .bt {
        background-color: #1e81b0;
      }
      html {
        scroll-behavior: smooth;
      }
    </style>
      <link   href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/css/bootstrap.min.css"
rel="stylesheet">
</head>
<body style="background-color: greenyellow; font-family: cursive;">

  <!-- Header Section -->
  <div class="container">
    <header class="d-flex flex-wrap justify-content-center py-3 mb-4 border-bottom">
        <a href="/" class="d-flex align-items-center mb-3 mb-md-0 me-md-auto link-body-
emphasis text-decoration-none">
                  <img  src="/static/image/stock_icon.png"  width="50px"  height="50px"
class="rounded shadow-lg" alt="">
```

```html
            <span class="fs-3 m-3 fw-bold head" style="color: red"><i class="fas fa-chart-
line"></i> Stock Price Prediction</span>
        </a>

        <ul class="nav nav-pills">
            <li class="nav-item"><a href="{{ url_for('home') }}" class="nav-link link-light"
style="background-color: red">Home</a></li>
                    <li class="nav-item"><a href="#features" class="nav-link"
style="color:red">Features</a></li>
                        <li class="nav-item"><a href="#about" class="nav-link"
style="color:red">About</a></li>
                <li class="nav-item"><a href="{{ url_for('register') }}" class="nav-link"
style="color:red">Register</a></li>
                    <li class="nav-item"><a href="{{ url_for('login') }}" class="nav-link"
style="color:red">Login</a></li>
            <li class="nav-item"><a href="{{ url_for('login') }}" class="btn btn-lg text-light
fw-bold" style="background-color: green">Get Started</a></li>
        </ul>
    </header>
  </div>

  <!-- Hero Section -->
  <div class="container col-xxl-8">
    <div class="row flex-lg-row-reverse align-items-center g-5 py-5">
      <div class="col-10 col-sm-8 col-lg-6 animate__animated animate__zoomIn">
            <img src="/static/image/stock.png" class="d-block mx-lg-auto img-fluid"
alt="Stock Market" width="700" height="500" loading="lazy">
      </div>
        <div class="col-lg-6 animate__animated animate__slideInLeft" style="color:
black;">
            <h1 class="display-5 fw-bold lh-1 mb-3" style="color: red">Stock Price
Prediction</h1>
            <p class="lead">Stock Price Prediction estimates stock values using machine
learning models based on features like opening price, highest price, lowest price, volume,
and market trends.</p>
        <div class="d-grid gap-2 d-md-flex justify-content-md-start">
            <a href="/login"><button type="button" class="btn btn-lg px-4 me-md-2 text-
light fw-bold" style="background-color:green">Get Started</button></a>
        </div>
        </div>
```

```
            </div>
        </div>

        <!-- Features Section -->
        <div class="container py-5" id="features">
            <h2 class="text-center head animate__animated animate__fadeInDown" style="color:
red;">Features</h2>
            <div class="row text-center">
                <div class="col-md-4 animate__animated animate__zoomIn">
                        <h4 style="color: blueviolet"><i class="fas fa-chart-line"></i> Accurate
Predictions</h4>
                    <p>Our model uses advanced machine learning algorithms to estimate stock prices
with high accuracy.</p>
                </div>
                <div class="col-md-4 animate__animated animate__zoomIn">
                    <h4 style="color: blueviolet;"><i class="fas fa-clock"></i> Real-Time Data</h4>
                    <p>Stay updated with real-time stock market trends and price changes.</p>
                </div>
                <div class="col-md-4 animate__animated animate__zoomIn">
                    <h4 style="color: blueviolet;"><i class="fas fa-user"></i> User-Friendly</h4>
                    <p>Easy-to-use interface for investors, traders, and analysts.</p>
                </div>
            </div>
        </div>

        <!-- About Section -->
        <div class="container py-5" id="about">
            <h2 class="text-center head animate__animated animate__fadeInLeft" style="color:
red;">About Us</h2>
            <div class="row align-items-center">
                <div class="col-md-6">
                    <p>Stock Price Prediction is a tool that utilizes machine learning to estimate stock
values based on key features like historical data, market trends, and economic indicators.
Our goal is to provide reliable and insightful predictions to help investors make informed
decisions.</p>
                </div>
                <div class="col-md-6 animate__animated animate__fadeInRight">
                    <img src="/static/image/stock_llllll.avif" class="img-fluid rounded " alt="About
Us">
                </div>
```

```html
        </div>
    </div>

    <!-- Footer Section -->
    <div class="container">
      <footer class="py-3 my-4">
        <p class="text-center text-body-secondary">&copy; 2025 Company, Inc</p>
      </footer>
    </div>

                                                            <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/js/bootstrap.bundle.min.js"></script
>
</body>
</html>
```

Login.html

```html
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Login</title>
    <link   href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/css/bootstrap.min.css"
rel="stylesheet">
  <style>
    body {
      height: 100vh;
      display: flex;
      align-items: center;
      justify-content: center;
    }
    .login-container {
      border-radius: 10px;
      overflow: hidden;
    }
  </style>
</head>
<body style="background-color: greenyellow;">
  <div class="container">
    <div class="row login-container" >
```

```html
        <!-- Left Side Image -->
        <div class="col-md-6" style="margin-top: 50px;" >
          <img src="/static/image/reg.jpg" class="w-100">
        </div>

        <!-- Right Side Form -->
        <div class="col-md-6 p-5" >
            <div class="shadow-lg p-5 m-5 bordered rounded" style="background-color:
aqua;">
              <h2 class="text-center mb-4" style="font-family: cursive;">Login</h2>
              <form action="/login" method="post">
                <div class="mb-3">
                  <label for="username" class="form-label" style="color: blue; font-family:
cursive;">Username</label>
                  <input type="text" class="form-control" name="username" id="username"
placeholder="Enter your username" required>
                </div>
                <div class="mb-3">
                  <label for="password" class="form-label" style="color: blue; font-family:
cursive;">Password</label>
                       <input type="password" class="form-control" name="password"
id="password" placeholder="Enter your password" required>
                </div>
                <div class="d-grid">
                  <button type="submit" class="btn" style="background-color: green; font-
family: cursive;">Login</button>
                </div>
                <div class="text-center mt-3" style="font-family: cursive;">
                  <p>Don't have an account? <a href="Register.html" class="text-primary"
>Register</a></p>
                </div>
              </form>
            </div>
          </div>
      </div>
    </div>

                                                                     <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/js/bootstrap.bundle.min.js"></script
```

```
>
</body>
</html>
```

Register.html

```html
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Register</title>
    <link   href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/css/bootstrap.min.css"
rel="stylesheet">
  <style>
    body {
       height: 100vh;
       display: flex;
       align-items: center;
       justify-content: center;

    }
    .register-container {

       border-radius: 10px;
       overflow: hidden;

    }

  </style>
</head>
<body style="background-color: greenyellow; font-family: cursive;">
  <div class="container">
    <div class="row register-container">
      <!-- Left Side Image -->
      <div class="col-md-6" style="margin-top: 150px;">
        <img src="/static/image/reg.jpg" class="w-100" >
      </div>

      <!-- Right Side Form -->
      <div class="col-md-6 p-5 " >
          <div class="shadow-lg p-5 m-5 bordered rounded" style="background-color:
```

```html
aqua;">
        <h2 class="text-center mb-4" style="color: black">Register</h2>
      <form action="/Register" method="post">
        <div class="mb-3" >
          <label for="name" class="form-label" style="color: blue;">Name</label>
              <input type="text" class="form-control" name="username" id="name"
placeholder="Enter your name" required>
        </div>
        <div class="mb-3">
          <label for="gender" class="form-label" style="color: blue;">Gender</label>
          <select class="form-control" name="gender" id="gender" required>
            <option value="">Select Gender</option>
            <option value="Male">Male</option>
            <option value="Female">Female</option>
            <option value="Other">Other</option>
          </select>
        </div>
        <div class="mb-3">
          <label for="age" class="form-label" style="color: blue;">Age</label>
              <input type="number" class="form-control" name="age" id="age"
placeholder="Enter your age" required>
        </div>
        <div class="mb-3">
                      <label for="password" class="form-label" style="color:
blue;">Password</label>
                    <input type="password" class="form-control" name="password"
id="password" placeholder="Enter password" required>
        </div>
        <div class="d-grid">
                    <button type="submit" class="btn" style="background-color:
green;">Register</button>
        </div>
        <div class="text-center mt-3">
            <p>Already have an account? <a href="/login" class="text-primary">Sign
In</a></p>
        </div>
      </form>
      </div>
    </div>
    </div>
```

```
    </div>

                                                                    <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.3.3/dist/js/bootstrap.bundle.min.js"></script
>
</body>
</html>
```

Style.css

```
@import url(https://fonts.googleapis.com/css?family=Open+Sans);
.btn { display: inline-block; *display: inline; *zoom: 1; padding: 4px 10px 4px; margin-
bottom: 0; font-size: 13px; line-height: 18px; color: #333333; text-align: center;text-shadow:
0 1px 1px rgba(255, 255, 255, 0.75); vertical-align: middle; background-color: #f5f5f5;
background-image: -moz-linear-gradient(top, #ffffff, #e6e6e6); background-image: -ms-
linear-gradient(top, #ffffff, #e6e6e6); background-image: -webkit-gradient(linear, 0 0, 0
100%, from(#ffffff), to(#e6e6e6)); background-image: -webkit-linear-gradient(top, #ffffff,
#e6e6e6); background-image: -o-linear-gradient(top, #ffffff, #e6e6e6); background-image:
linear-gradient(top,     #ffffff,     #e6e6e6);     background-repeat:     repeat-x;     filter:
progid:dximagetransform.microsoft.gradient(startColorstr=#ffffff,     endColorstr=#e6e6e6,
GradientType=0); border-color: #e6e6e6 #e6e6e6 #e6e6e6; border-color: rgba(0, 0, 0, 0.1)
rgba(0, 0, 0, 0.1) rgba(0, 0, 0, 0.25); border: 1px solid #e6e6e6; -webkit-border-radius: 4px;
-moz-border-radius: 4px; border-radius: 4px; -webkit-box-shadow: inset 0 1px 0 rgba(255,
255, 255, 0.2), 0 1px 2px rgba(0, 0, 0, 0.05); -moz-box-shadow: inset 0 1px 0 rgba(255, 255,
255, 0.2), 0 1px 2px rgba(0, 0, 0, 0.05); box-shadow: inset 0 1px 0 rgba(255, 255, 255, 0.2),
0 1px 2px rgba(0, 0, 0, 0.05); cursor: pointer; *margin-left: .3em; }
.btn:hover, .btn:active, .btn.active, .btn.disabled, .btn[disabled] { background-color:
#e6e6e6; }
.btn-large { padding: 9px 14px; font-size: 15px; line-height: normal; -webkit-border-radius:
5px; -moz-border-radius: 5px; border-radius: 5px; }
.btn:hover { color: #333333; text-decoration: none; background-color: #e6e6e6;
background-position: 0 -15px; -webkit-transition: background-position 0.1s linear; -moz-
transition: background-position 0.1s linear; -ms-transition: background-position 0.1s linear;
-o-transition: background-position 0.1s linear; transition: background-position 0.1s linear; }
.btn-primary, .btn-primary:hover { text-shadow: 0 -1px 0 rgba(0, 0, 0, 0.25); color: #ffffff; }
.btn-primary.active { color: rgba(255, 255, 255, 0.75); }
.btn-primary { background-color: #4a77d4; background-image: -moz-linear-gradient(top,
#6eb6de, #4a77d4); background-image: -ms-linear-gradient(top, #6eb6de, #4a77d4);
background-image: -webkit-gradient(linear, 0 0, 0 100%, from(#6eb6de), to(#4a77d4));
background-image: -webkit-linear-gradient(top, #6eb6de, #4a77d4); background-image: -o-
linear-gradient(top, #6eb6de, #4a77d4); background-image: linear-gradient(top, #6eb6de,
#4a77d4);          background-repeat:          repeat-x;          filter:
```

```
progid:dximagetransform.microsoft.gradient(startColorstr=#6eb6de, endColorstr=#4a77d4,
GradientType=0); border: 1px solid #3762bc; text-shadow: 1px 1px 1px rgba(0,0,0,0.4);
box-shadow: inset 0 1px 0 rgba(255, 255, 255, 0.2), 0 1px 2px rgba(0, 0, 0, 0.5); }
.btn-primary:hover, .btn-primary:active, .btn-primary.active, .btn-primary.disabled, .btn-
primary[disabled] { filter: none; background-color: #4a77d4; }
.btn-block { width: 100%; display:block; }

* { -webkit-box-sizing:border-box; -moz-box-sizing:border-box; -ms-box-sizing:border-
box; -o-box-sizing:border-box; box-sizing:border-box; }

html { width: 100%; height:100%; overflow:hidden; }

body {
   width: 100%;
   height:100%;
   font-family: 'Open Sans', sans-serif;
   background: #1e81b0;
   color: #fff;
   font-size: 18px;
   text-align:center;
   letter-spacing:1.2px;
      filter:    progid:DXImageTransform.Microsoft.gradient(    startColorstr='#3E1D6D',
endColorstr='#092756',GradientType=1 );

}
.login {
   position: absolute;
   top: 40%;
   left: 50%;
   margin: -150px 0 0 -150px;
   width:400px;
   height:400px;
}

.login h1 { color: #fff; text-shadow: 0 0 10px rgba(0,0,0,0.3); letter-spacing:1px; text-
align:center; }

input {
   width: 100%;
   margin-bottom: 10px;
```

```python
# --- Models ---
class User(UserMixin, db.Model):
    id = db.Column(db.Integer, primary_key=True)
    username = db.Column(db.String(150), unique=True, nullable=False)
    password = db.Column(db.String(150), nullable=False)


@login_manager.user_loader
def load_user(user_id):
    return User.query.get(int(user_id))


# --- Routes ---
@app.route('/')
def home():
    return render_template('home.html')


@app.route('/Register', methods=['GET', 'POST'])
def register():
    if request.method == 'POST':
        username = request.form['username']
        password = request.form['password']
        existing = User.query.filter_by(username=username).first()
        if existing:
            flash('User already exists', 'error')
            return redirect(url_for('register'))
        user = User(username=username, password=password)
        db.session.add(user)
        db.session.commit()
        flash('Registered successfully', 'success')
        return redirect(url_for('login'))
    return render_template('Register.html')


@app.route('/login', methods=['GET', 'POST'])
def login():
    if request.method == 'POST':
        username = request.form['username']
        password = request.form['password']
        user = User.query.filter_by(username=username, password=password).first()
        if user:
            login_user(user)
            return redirect(url_for('dashboard'))
```
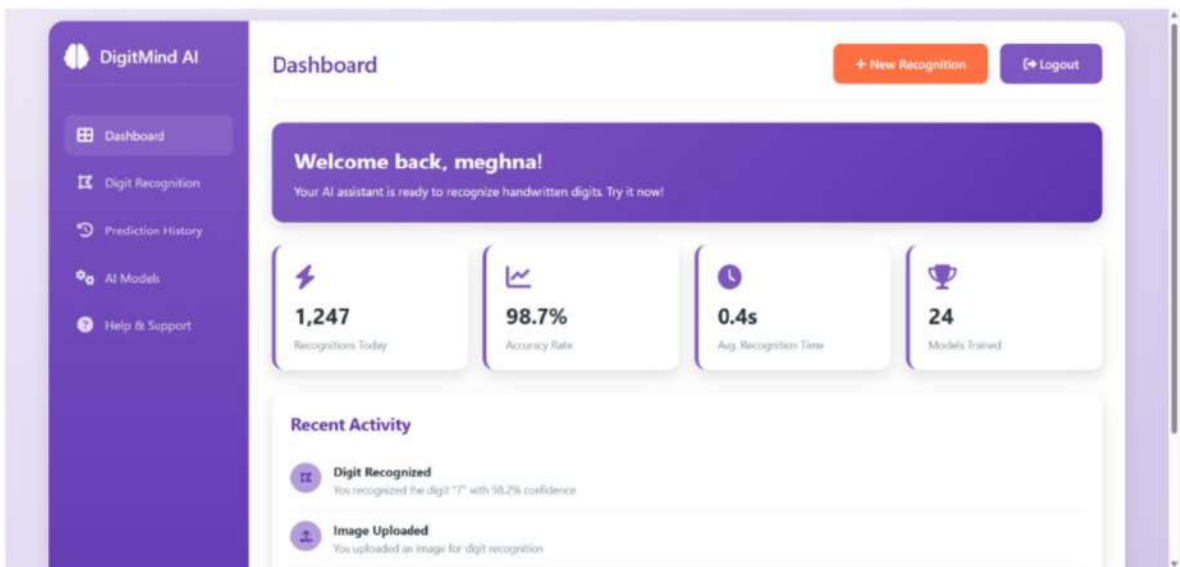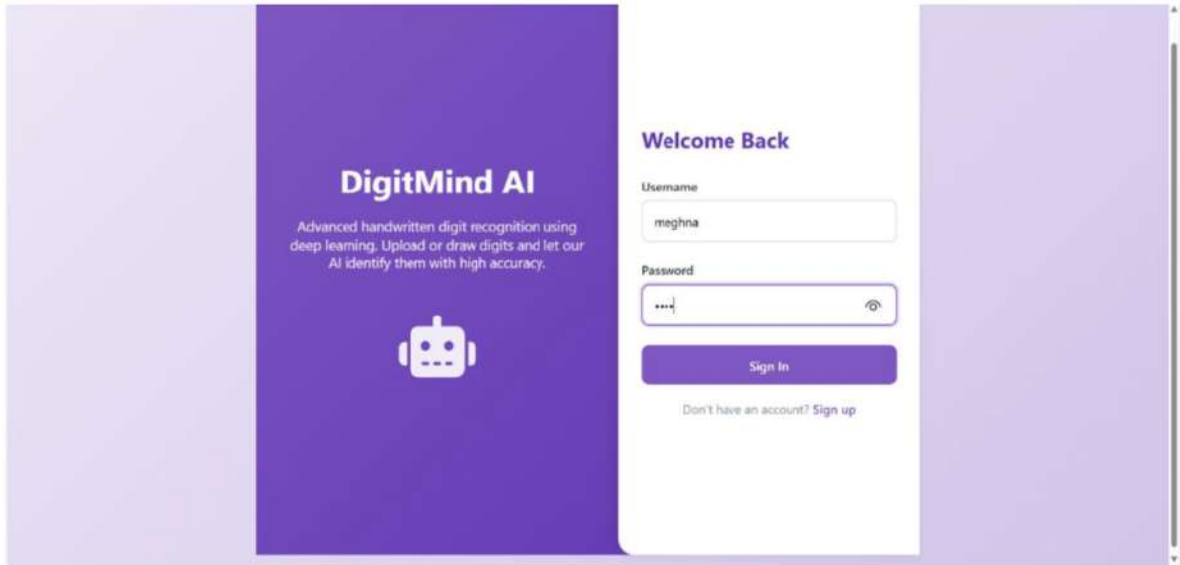
```python
      flash('Invalid credentials', 'error')
  return render_template('Login.html')


@app.route('/dashboard', methods=['GET', 'POST'])
@login_required
def dashboard():
  prediction_text = ""
  if request.method == 'POST':
    open_price = request.form['Open']
    high = request.form['High']
    low = request.form['Low']
    volume = request.form['Volume']
    # Dummy logic (replace with your ML model)
    predicted_price = (float(open_price) + float(high) + float(low)) / 3
    prediction_text = f"Predicted Stock Price: ₹{predicted_price:.2f}"
         return      render_template('index.html',      username=current_user.username,
prediction_text=prediction_text)


@app.route('/logout')
@login_required
def logout():
  logout_user()
  return redirect(url_for('login'))


with app.app_context():
  db.create_all()


if __name__ == '__main__':
  app.run(debug=True)
```
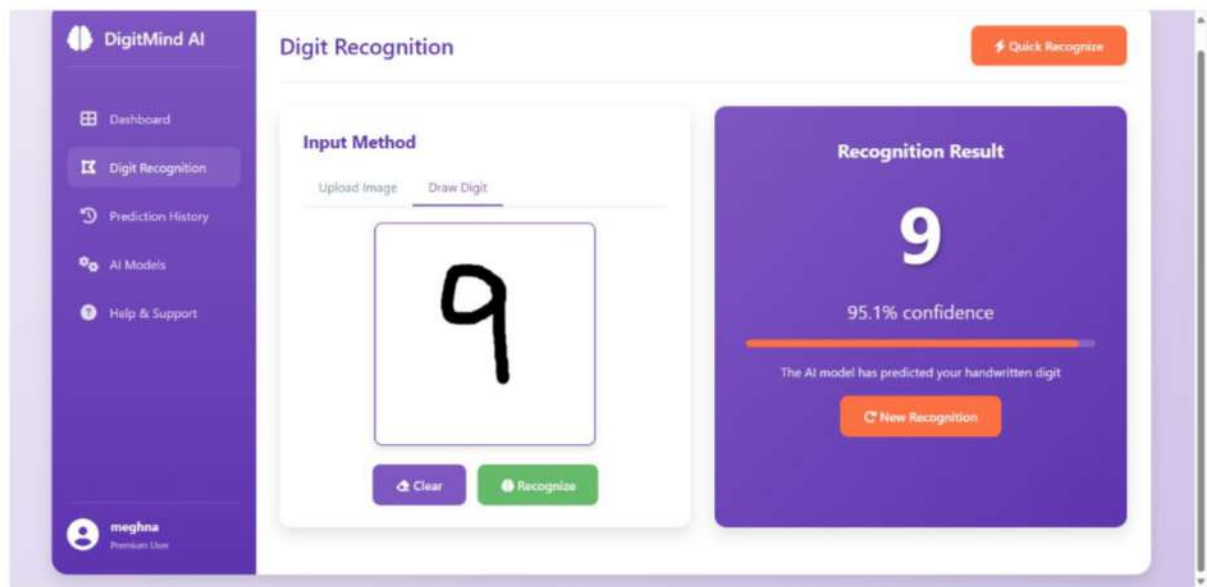
OUTPUT:

RESULT:

The developed CNN model accurately recognized handwritten digits with about **98% accuracy** on the MNIST dataset.
The model was successfully **deployed using Flask API** for real-time image prediction.
The system effectively demonstrated the **end-to-end machine learning workflow** from training to deployment.