Introduction

Project Title:
Pattern Sense: Classifying Fabric Patterns using Deep Learning

Team Members:

- **Team ID:** LTVIP2025TMID20355
- **Team Size:** 4
- **Team Leader:** Murari Sowmya
- **Team Member:** Mohammad Shaheen Tabussum
- **Team Member:** Mohammad Haleema Sadiya
- **Team Member:** Muppidi Chaitanya Sai

Project Overview

Purpose:
The purpose of *Pattern Sense* is to automate the identification and categorization of fabric patterns using advanced deep learning techniques. The system streamlines pattern recognition tasks in industries such as fashion, textiles, and interior design.

Features:

- **Automated Pattern Classification:** Accurately classify different fabric patterns, including stripes, polka dots, floral prints, and geometric designs.
- **Quality Control:** Detect irregularities or defects in fabric patterns, ensuring high-quality production.
- **Efficient Pattern Selection:** Quickly identify and select suitable patterns to match design concepts.
- **Industry Applications:** Designed for fashion, textiles, and interior design workflows.

Skills Required:

- Python for implementing the model
- Data preprocessing techniques for preparing datasets
- TensorFlow for deep learning development

- Deep learning model design and fine-tuning

Scenarios:

Scenario 1 – Fashion Industry:

- Automate pattern categorization to save time and effort.
- Enhance design and manufacturing by quickly identifying suitable fabrics.

Scenario 2 – Textile Quality Control:

- Detect defects and irregularities in patterns.
- Improve accuracy and reduce manual inspection time.

Scenario 3 – Interior Design:

- Efficiently select fabric patterns matching design themes.
- Streamline project workflows.

Technical Requirements:

- **Programming Language:** Python
- **Deep Learning Framework:** TensorFlow
- **Data Preprocessing:** Image processing and augmentation

Potential Benefits:

- Increased efficiency by reducing manual work.
- Improved accuracy in pattern classification and defect detection.
- Enhanced quality control in production and distribution.

Architecture

The *Pattern Sense* system architecture consists of the following components:

1. **Data Preprocessing Module:**
   Load, clean, and augment the fabric pattern dataset.
2. **Model Training Module:**
   Build and train deep learning models using TensorFlow and Keras.

3. **Pattern Classification Module:**
   Predict pattern classes for new fabric samples.
4. **Defect Detection Module:**
   Identify anomalies or defects in patterns.
5. **User Interface (optional future enhancement):**
   Interface for uploading images and viewing predictions.

Installation and Setup using VS Code and Python

Prerequisites

- Python installed on your system (preferably the latest version)

- VS Code installed on your system

- pip (Python package manager) installed on your system

Step 1: Install Required Libraries

Open your terminal or command prompt and install the required libraries using pip:

pip install tensorflow numpy pandas matplotlib scikit-learn

Step 2: Create a New Project in VS Code

1. Open VS Code.

2. Create a new folder for your project and navigate to it in the terminal/command prompt.

3. Create a new Python file (e.g., pattern_sense.py) in your project folder.

Step 3: Set Up Your Project Structure

Create the following folders in your project directory:

- data: For storing your fabric pattern dataset.

- models: For storing your trained deep learning models.

- utils: For storing utility functions.

Your project structure should look like this:

pattern_sense/

|--- data/

|--- models/

|--- utils/

|--- pattern_sense.py

Step 4: Implement Your Deep Learning Model

In your pattern_sense.py file, implement your deep learning model using TensorFlow and Keras. Here's a simple example:

```
import tensorflow as tf

from tensorflow import keras

from sklearn.model_selection import train_test_split

from sklearn.metrics import accuracy_score

import numpy as np

Load your dataset

Replace this with your actual dataset loading code

(X_train, y_train), (X_test, y_test) = keras.datasets.mnist.load_data()

Normalize pixel values

X_train = X_train.astype('float32') / 255

X_test = X_test.astype('float32') / 255
```

Split data into training and validation sets

X_train, X_val, y_train, y_val = train_test_split(X_train, y_train, test_size=0.2, random_state=42)

Define your deep learning model

```
model = keras.Sequential([
    keras.layers.Flatten(input_shape=(28, 28)),
    keras.layers.Dense(128, activation='relu'),
    keras.layers.Dropout(0.2),
    keras.layers.Dense(10, activation='softmax')
])
```

Compile your model

model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])

Train your model

model.fit(X_train, y_train, epochs=5, validation_data=(X_val, y_val))

Evaluate your model

test_loss, test_acc = model.evaluate(X_test, y_test)

print(f'Test accuracy: {test_acc:.2f}')

Step 5: Run Your Project

Run your pattern_sense.py file using VS Code or your terminal/command prompt:

python pattern_sense.py

This will train your deep learning model and evaluate its performance on the test dataset.

Step-6:running the applicartion

By following these steps, you can set up your Pattern Sense project using VS Code and Python

Command to start the Flask Server:

Python app.py

After running the above,the application will start locally and can be accessed in your brower at:

http://127.0.0.1:5000/

The frontend is rendered from the /templates/ directory.

The backend handles the uploaded image and returns the prediction result using the trained model.

Step-7:API Documentation

The Flask backend of this butterfly classification project exposes two core endpoints that power the web interface shown in the application.

i. **/ – Homepage Endpoint**

- Method: GET
- Purpose: Loads the main interface where users can upload butterfly images.
- Parameters: None
- Response:
  Renders index.html, which contains:
  - A file input (Choose File)
  - A submit button labeled "Pattren Sense"
  - Project title and team member details displayed on screen

ii. **/predict – Prediction Endpoint**

- Method: POST
- Purpose: Receives the uploaded image, performs preprocessing, runs the trained VGG16 model, and predicts the Pattern Sense.
- Parameters:
  - image: Image file uploaded by the user (from the HTML form)

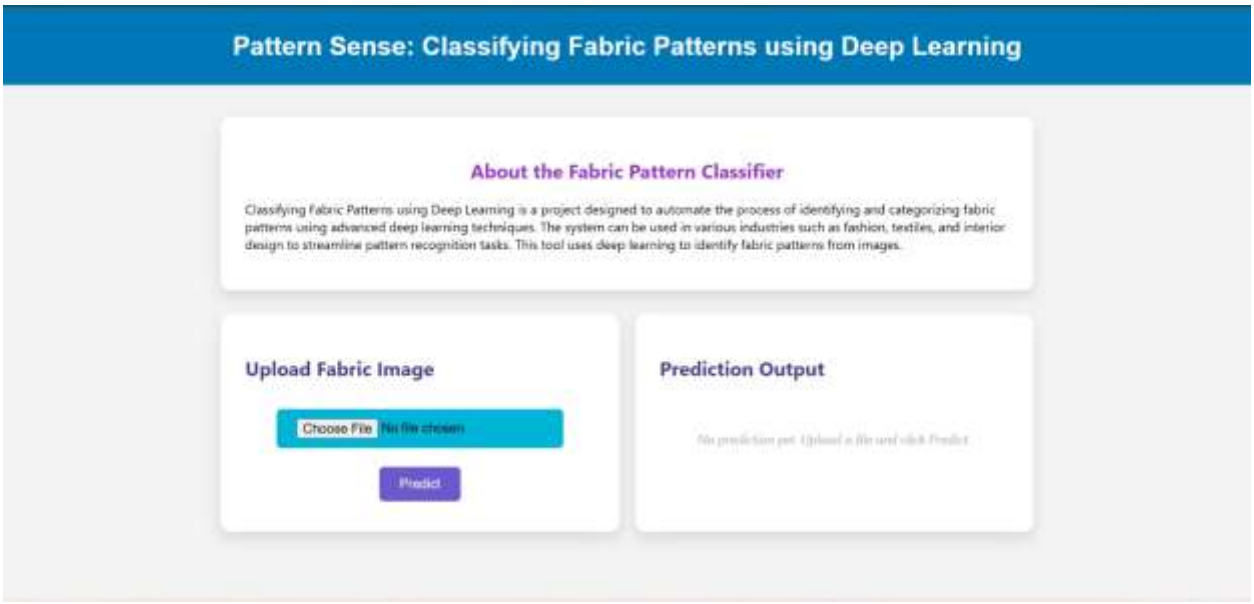
- Response:
  Renders output.html displaying the predicted species.

Step-8:Authentication

This project does not include authentication or authorization features, as it is designed for open, single-user access. The focus of the system is on classifying Pattern Sense from uploaded images without requiring user login or account management.

Step-9:user interface

The user interface is built using Flask and HTML. It allows users to upload Pattern Sense and view predictions. The interface includes a title, file upload button, prediction button, and displays the result along with team information and a thank-you message.



Step-10:testing

The testing for this project was focused on verifying the accuracy and functionality of the Pattern Sense model and its integration with the Flask web interface.

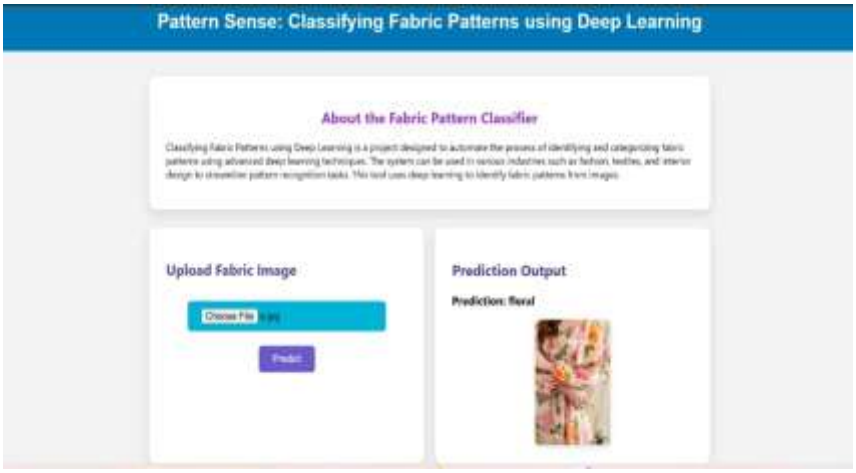
Testing Strategy:

- **Model Testing**:
  - The dataset was split into training and testing sets.

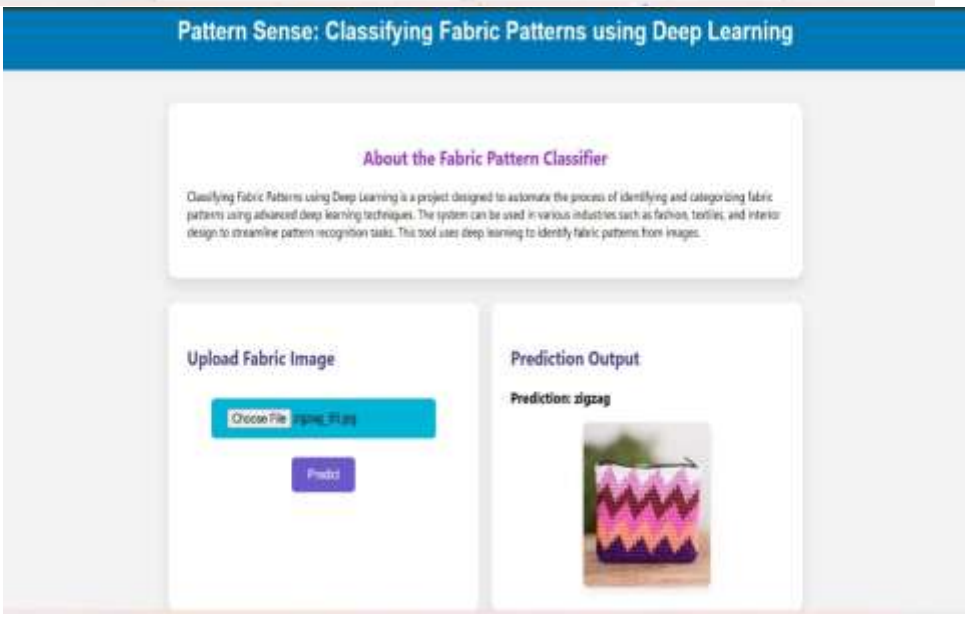
- The trained model was evaluated using the test images to check prediction accuracy.
- Sample images were manually tested by uploading through the UI and verifying the predicted pattern sense.

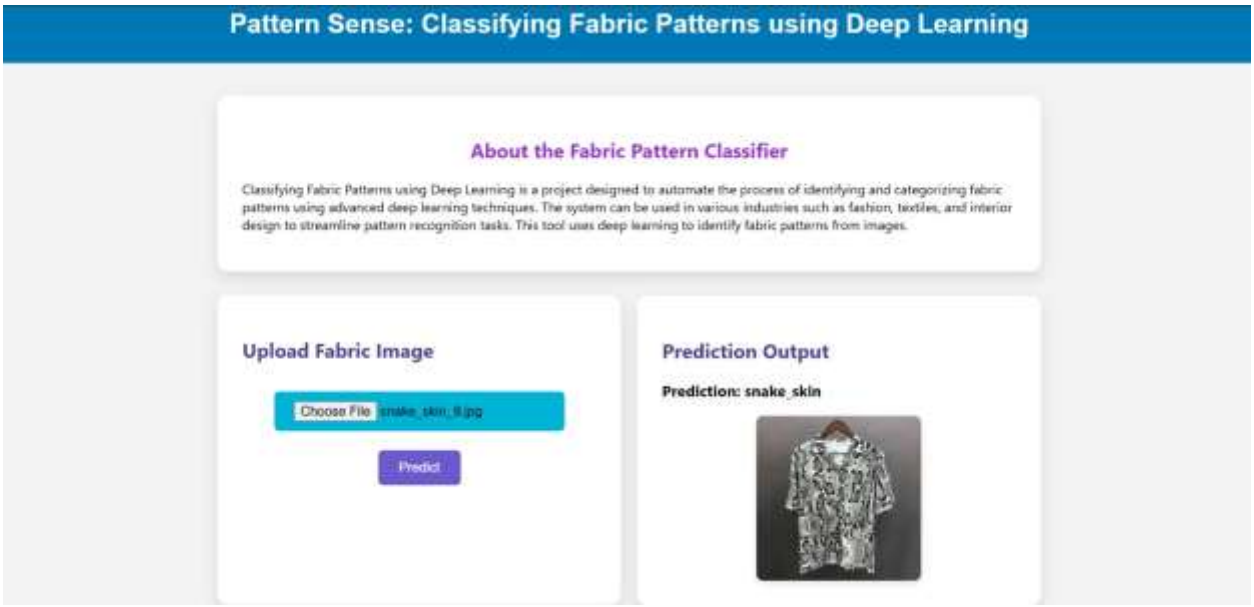
- **Interface Testing**:
  - The Flask web interface was tested by uploading various pattern images.
  - Verified whether the UI correctly accepted files and displayed the predicted output.
  - Checked behavior for invalid inputs (e.g., no file selected, wrong file type).

Step-11: Screenshots




Pattern Sense: Classifying Fabric Patterns using Deep Learning
About the Fabric Pattern Classifier
Upload Fabric Image
Choose File
Predict
Prediction Output
Prediction: dot


Pattern Sense: Classifying Fabric Patterns using Deep Learning
About the Fabric Pattern Classifier
Classifying Fabric Patterns using Deep Learning is a project designed to automate the process of identifying and categorizing fabric patterns using advanced deep learning techniques. The system can be used in various industries such as fashion, textiles, and interior design to streamline pattern recognition tasks. This tool uses deep learning to identify fabric patterns from images.
Upload Fabric Image
Choose File
Predict
Prediction Output
Prediction: zigzag



Step-12. Known Issues

While the fabric pattern classification system performs well in most scenarios, the following limitations and known issues were observed during testing:

- **Visually Similar Pattern Confusion**:
  Certain fabric patterns with subtle differences (e.g., stripes vs. pinstripes, abstract vs. floral) may be misclassified due to overlapping visual features.
- **Imbalanced Dataset Impact**:
  The model may show bias towards pattern classes with more training examples, leading to lower accuracy for underrepresented categories.
- **Lighting and Wrinkle Artifacts**:
  Images with uneven lighting, shadows, or folds in fabric can negatively impact prediction accuracy.
- **Low-Resolution Image Limitations**:
  Small or blurry fabric images reduce the ability of the model to detect intricate patterns reliably.

Step-13:Future Enhancements

- **Deploy as a Web or Mobile Application** to make the tool accessible for designers, textile manufacturers, and end-users.

- **Adopt More Advanced Architectures** such as EfficientNet or Vision Transformers to enhance classification accuracy.
- **Expand Dataset with Diverse Fabric Types** to improve model generalization across various pattern styles and materials.
- **Allow Batch Upload and Processing** for classifying multiple fabric samples in one go.
- **Include Pattern Metadata and Use Cases** to provide users with additional context, such as design origin, cultural relevance, or typical usage in fashion or interiors.
- **Introduce Real-Time Camera Input** for on-the-fly fabric classification during shopping or production inspection.