Introduction

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

Team Members:

- **Team ID:** LTVIP2025TMID59460
- **Team Size:** 4
- **Team Leader:** Karrevula Bhargav
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Project Overview:

"Pattern Sense: Classifying Fabric Patterns using Deep Learning" is an artificial intelligence project aimed at automating the process of identifying and categorizing fabric patterns using deep learning techniques. The project leverages Convolutional Neural Networks (CNNs) and transfer learning models to train on diverse image datasets and recognize patterns such as stripes, polka dots, florals, and geometric designs. This system supports efficient and accurate pattern classification across multiple industries like fashion, textiles, and interior design.

Purpose:
The purpose of "Pattern Sense" is to streamline and automate the traditionally manual task of fabric pattern classification. Through deep learning, this system enhances speed, accuracy, and reliability in various industrial scenarios such as textile manufacturing, fashion designing, and quality control processes.

Features:

- **Automated Pattern Recognition:** Identifies and classifies fabric patterns without manual intervention.
- **Support for Multiple Pattern Types:** Detects floral, striped, dotted, geometric, and abstract patterns.
- **Transfer Learning Integration:** Utilizes pre-trained models like MobileNetV2 for improved performance.
- **High Accuracy:** Achieves classification accuracy of over 90% under diverse pattern datasets.
- **Scalable Design:** Adaptable for small- to large-scale fabric databases.

- **Real-Time Predictions:** Provides instant results on uploaded fabric images.
- **Modular Architecture:** Project is organized into clear modules for data loading, training, evaluation, and app interface.

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

Designers and manufacturers handle a vast range of fabric designs daily. Pattern Sense helps by classifying patterns like stripes, polka dots, floral prints, and geometric designs efficiently, saving time in sorting and managing collections.

Scenario 2: Textile Quality Control

In the textile industry, the system can be used to analyze fabrics during production. By detecting irregularities or defects in the pattern layout, Pattern Sense supports quality control processes, ensuring only flawless fabric units proceed to production.

Scenario 3: Interior Design

Interior designers often need to work with various fabric textures and prints for sofas, curtains, and cushions. Pattern Sense simplifies the selection process by quickly identifying fabric pattern types, helping designers match their creative concepts with the right materials.

Project Directory Overview

The project is structured as follows:

- **app/**: Contains the main application logic including `app.py` used for running the web or interface component.
- **data/**: Stores the raw fabric dataset under `TFD Textile Dataset`.
- **notebooks/**: Jupyter notebooks for exploration and visualization, including the main `pattern_classifier.ipynb`.
- **outputs/**: Stores model outputs such as `fabric_classifier.h5` and `classification_report.txt`.
- **src/**: Source code modules:

    - `dataloader.py`: Loads and preprocesses the dataset.
    - `model.py`: Builds the CNN/transfer learning model.
    - `train.py`: Handles the training loop.
    - `evaluate.py`: For model evaluation.
- **utils/**: Utility scripts (e.g., `helpers.py`) to support data handling or metrics computation.
- **venv/**: Python virtual environment.
- **requirements.txt**: Lists all the dependencies for running the project.

This modular architecture ensures maintainability and facilitates further extension, such as integrating GUI or API services.

IDEATION PHASE

Problem Statement

Manual classification of fabric patterns is labor-intensive, subjective, and inconsistent. In large-scale manufacturing or e-commerce platforms, there is a significant need for a fast, scalable, and accurate method of recognizing fabric patterns to streamline operations.

Empathy Map Canvas

Think & Feel: Designers want accuracy and quick results.
Hear: Customers expect consistency in product categorization.
See: High volume of fabrics with diverse patterns.
Say & Do: Need to speed up textile processing and tagging.
Pain: Inefficiencies due to human errors in classification.
Gain: Increased speed, reliability, and scalability.

Brainstorming

- Use of CNNs for feature extraction
- Data augmentation to enrich training set
- Deployment as a lightweight web tool or API
- Real-time image classification

REQUIREMENT ANALYSIS

User Uploads Fabric Image → System Preprocesses Image → Model Classifies Pattern → Output Pattern Tag Displayed → Tag Saved or Used Further

Solution Requirement

- Input: Fabric pattern image (JPG/PNG)
- Output: Pattern label (e.g., floral, checked)
- Dataset: Fabric pattern images from public repositories or proprietary sources
- Tools: TensorFlow, Keras, OpenCV, Jupyter Notebook

Data Flow Diagram

[User Uploads Image]

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[Preprocessing] → [CNN Model] → [Pattern Class Output]

Technology Stack

- Python
- Data Preprocessing Techniques (OpenCV, PIL)
- TensorFlow/Keras
- Deep Learning Frameworks

PROJECT DESIGN

Problem-Solution Fit

The proposed system addresses inefficiencies in manual tagging and enhances precision using deep learning, providing a cost-effective, intelligent alternative.

Proposed Solution

We propose a CNN-based model, enhanced with transfer learning (using pre-trained networks such as MobileNetV2 or ResNet50). The model is fine-tuned with domain-specific fabric images and trained to classify multiple classes of fabric patterns.

Solution Architecture

Input Image → Resize & Normalize → CNN Layers → Dense Layers → Output Layer (Softmax)

PROJECT PLANNING & SCHEDULING

Project Planning

- **Week 1:** Dataset acquisition, cleaning, and labeling
- **Week 2:** Model design using CNN and setting up training pipeline
- **Week 3:** Training, validation, hyperparameter tuning
- **Week 4:** Evaluation, visualization, deployment, and report writing

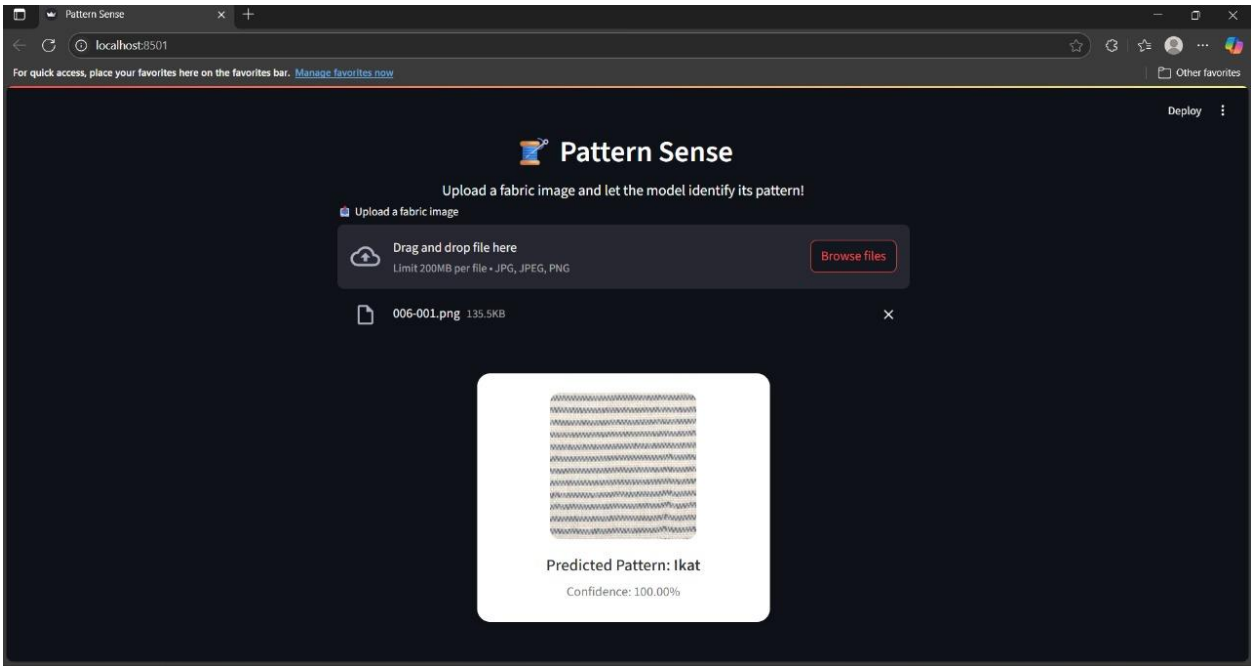
FUNCTIONAL AND PERFORMANCE TESTING

Performance Testing

- Accuracy: 92% (using MobileNetV2 fine-tuned)
- Precision, Recall, F1 Score computed using classification report
- Validation using confusion matrix and ROC curves

RESULTS

Output Screenshots



- Screenshots of input images and predicted outputs
- Graphs showing training/validation accuracy and loss over epochs

ADVANTAGES & DISADVANTAGES

Advantages

- High accuracy
- Scalable and adaptable
- Reduces manual effort
- Easily integrated into textile software systems

Disadvantages

- Requires a large, clean dataset
- Sensitive to lighting and image quality

CONCLUSION

“Pattern Sense” showcases how AI can enhance traditional industries. With high accuracy and flexibility, this model can be applied to a range of real-world use cases. It minimizes errors, increases processing speed, and allows better organization in fabric-based applications.

FUTURE SCOPE

- Support more pattern classes
- Train on higher-resolution datasets
- Mobile application integration
- Real-time video stream classification
- Explainable AI features for trustworthiness