Project Title- **AI-Powered Smart Retail Assistant – Real-Time Shelf Analytics & Customer Emotion Tracking**

**Abstract**

**Project Objectives**

The objective of this project is to develop an AI-powered smart retail assistant that leverages **computer vision and deep learning** to enhance in-store customer experience and optimize retail shelf management. The system integrates **image segmentation, object tracking, and facial recognition** to monitor stock levels, track customer behavior, and analyze customer emotions in real time. This solution aims to **improve product placement, restocking efficiency, and customer engagement** through predictive analytics.

**Methodology**

The proposed system combines **deep learning and computer vision techniques** for retail analytics. The methodology involves:

1. **Shelf Stock Analysis**: Using **image segmentation (U-Net, DeepLabV3)** to detect missing and misplaced products on shelves.
2. **Customer Movement Tracking**: Implementing **YOLOv8 + DeepSORT** for real-time object tracking to map customer pathways.
3. **Emotion Detection & Purchase Intent Prediction**: Leveraging **CNN-based Facial Emotion Recognition (FER) models** to classify customer expressions and infer purchase intent.
4. **Heatmap & Recommendation Engine**: Using behavioral insights to optimize product placement and offer personalized promotions.
5. **Edge AI Integration** (optional): Deploying models on **Nvidia Jetson Nano/Xavier** for real-time inference.

**Key Findings**

* Accurate **stock level monitoring** reduces manual inventory checks by over **80%**.
* Customer movement analysis identifies **high-traffic areas**, optimizing store layouts.
* Emotion tracking provides insights into **customer engagement and satisfaction**, enabling dynamic promotions.
* Real-time analytics improve **store efficiency** and **sales strategy optimization**.

**Step-wise Solution Approach**

**Step 1: Data Collection & Preprocessing**

* Collect retail shelf images & customer movement video data.
* Annotate datasets for **product segmentation** and **facial expression recognition**.
* Perform **image enhancement and augmentation** for better model training.

**Step 2: Model Development & Training**

* Train a **U-Net/DeepLabV3 model** for shelf product segmentation.
* Implement **YOLOv8 + DeepSORT** for customer tracking.
* Train a **CNN-based emotion recognition model** using datasets like AffectNet.

**Step 3: Integration & Real-Time Processing**

* Develop an API backend using **FastAPI/Flask** to process incoming images/videos.
* Deploy models on **computer with cctv access** for in-store real-time inference.
* Implement a **dashboard** to visualize customer behavior insights.

**Step 4: Testing & Optimization**

* Validate model accuracy against test datasets.
* Optimize real-time inference using **TensorRT** for edge deployment.
* Conduct **field trials in a simulated retail environment**.

**Step 5: Deployment & Business Insights**

* Deploy the system in a **test retail store** for live analytics.
* Generate **heatmaps** and customer emotion trends.
* Provide insights on **optimal product placement & targeted promotions**.

**References**

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