InsightEX

Problem Statement: *Enhancing Customer Experience with AI-Driven Insights*

Overview

In today's retail landscape, **physical stores** are under immense pressure due to the rapid rise of **online shopping**. One of the major challenges they face is delivering a **personalized and engaging customer experience**, something that online platforms have optimized well.

Our project, **InsightEX**, seeks to bridge this gap by harnessing the power of **artificial intelligence** to enhance how customers interact within physical retail spaces. Through **real-time video analysis** and **behavior tracking**, the system aims to understand **customer movement patterns**, **interactions**, and **preferences**. These insights are then used to **improve store layouts**, **optimize product placements**, and create a more **tailored in-store experience**.

Introduction

Effective people detection is crucial for **crowd control, security**, and improving **customer service** in modern **retail** and **surveillance** environments. This project focuses on building a **real-time people detection and tracking system** using **OpenVINO, YOLOv8 Pose Estimation,** and **DeepSORT tracking**.

Current Functionalities:

- **Detects individuals** using **YOLOv8 Pose Estimation** to identify people in real time.
- **Tracks movements** with **DeepSORT**, assigning **unique IDs** to each person for better monitoring.
- **Crowd detection** is implemented using a **heatmap** generated with **OpenCV** to analyze crowd density.

This system enhances **security, efficiency**, and **customer experience** by providing accurate and real-time tracking solutions.

Key Functionalities

- **Real-Time Detection**: Detects individuals instantly using **YOLOv8 Pose Estimation**
- **Advanced Tracking**: Each person is uniquely identified and tracked with **DeepSORT**
- **Crowd Analysis**: Generates **heatmaps** via **OpenCV** to identify crowded zones
- **Behavioral Insights**: Tracks **customer dwell times** and **interactions**
- **Real-Time Alerts**: Notifies managers of **anomalies** or **abnormal behaviors**

Working Model

Our system processes **real-time video** from in-store cameras to **detect and track people** efficiently. Here's how it works:

1. Video Capture & Preprocessing

- Captures **live video feeds** from store cameras.
- Prepares each frame for **detection and analysis**.

2. Detection & Pose Estimation

- Uses an **OpenVINO-optimized YOLOv8 Pose model** to detect individuals.
- Extracts **body keypoints** for better movement analysis.

3. Tracking

- **DeepSORT** assigns **unique IDs** to each detected person.
- Tracks their movements **across multiple frames**.

4. Behavior Analysis

- Creates **heatmaps** to highlight **high-traffic areas**.
- Measures **how long customers stay** in specific zones.
- Monitors **entry zones** to ensure customers are accompanied by staff.

5. Alerts & Insights

- Triggers a **real-time alert** if someone stays in one area for too long.
- Provides **visual overlays** (bounding boxes, keypoints, heatmaps).
- Logs behavior data for **further analysis** and store optimization.

This system helps improve **customer service, security, and store efficiency** by offering real-time tracking and insightful analytics.

Challenges Addressed

- **Minimal latency** for processing multiple video streams, ensuring real-time performance.
  Accurate detection even in **different lighting conditions** and **crowded environments**.
- **Efficient data handling** for **medium-scale video processing**, optimizing performance without heavy resource usage.

Future Insights

Staff and Customer Segmentation

- Differentiates between **staff and customers** for more **targeted analysis** and responses.

Entry Zone Monitoring

- Tracks **entry zones** to ensure customers are **escorted by staff** when needed, improving **safety and service**.

Store Layout Design

- Uses **movement insights** to optimize store layouts, improving **customer flow** and boosting **sales**.

Integration with Inventory Management

- Aligns **customer traffic patterns** with **sales data** to optimize **restocking and product availability**.

Dwell Time Measurement

- Monitors **how long** customers stay in specific areas to identify **potential issues or engagement opportunities**.

Behavioral Segmentation

- Groups customers based on **movement and interaction levels**, enabling **targeted marketing** and **personalized experiences**.

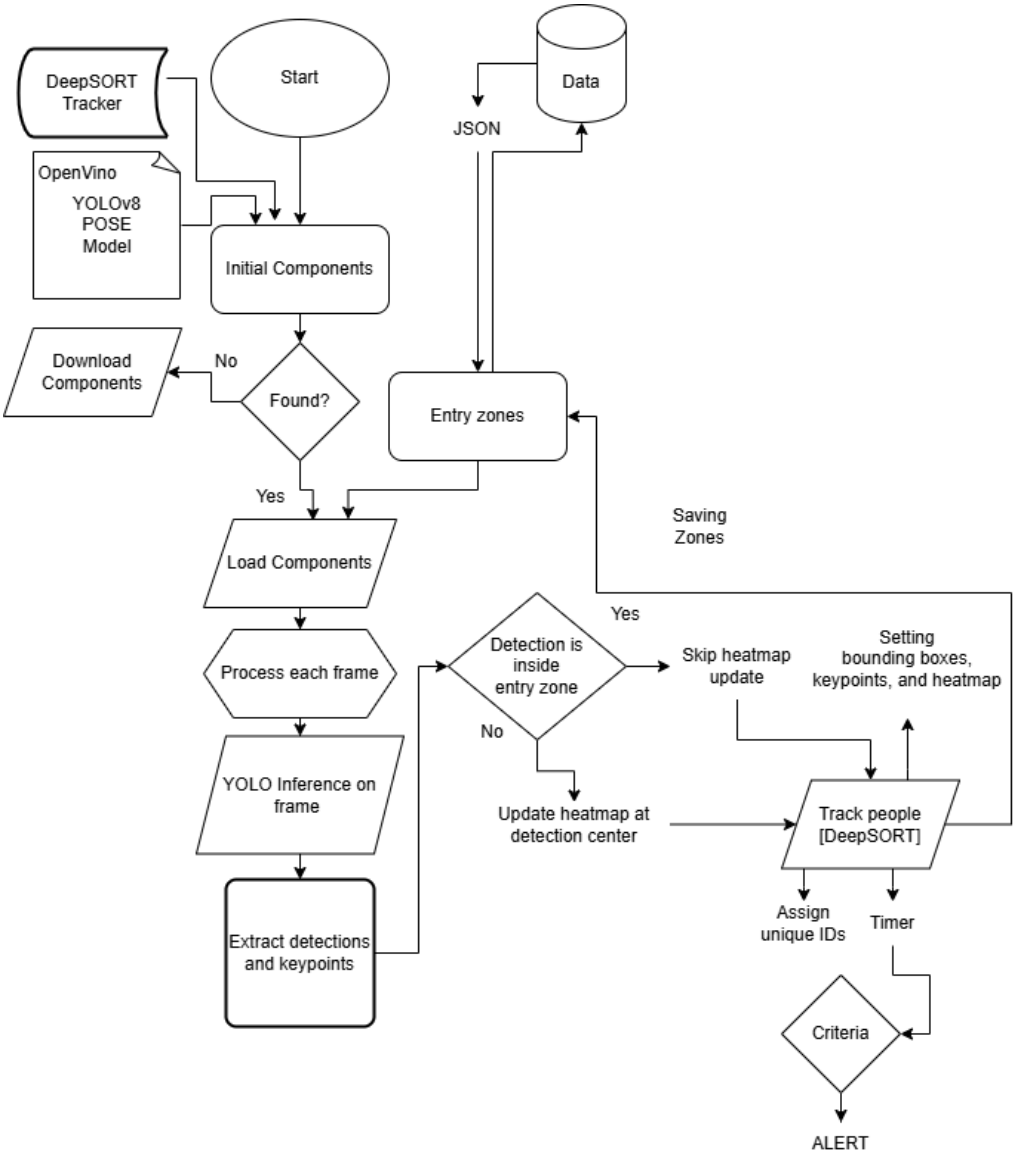
Real-Time Alerts

- Sends **instant alerts** for **abnormal situations** like **abandoned customers or congested areas**, allowing quick action.

Predictive Analytics

- Analyzes **past and real-time data** to **predict customer behavior**, helping adjust **staffing and promotions** accordingly.

Flowchart



Getting Started

1. Setup

- *Make sure **Python 3.7+** is installed.*
- *Ensure your system has the **necessary hardware** for smooth processing.*

2. Installation

- ***Download** the GitHub repository.*
- *If downloaded as a **ZIP file**, **extract** it before proceeding.*

3. Running the Setup

🔹 ***For Windows:***

- *Open **PowerShell** in the extracted directory and run:*
  - ***./setup.bat***

🔹 ***For Linux:***

- Open a **terminal** in the extracted directory and run:
  - chmod +x setup.sh
  - ./setup.sh

🔹 **Running the System**

- After setup, run the **main script** to start processing **video feeds** and analyzing **customer behavior**.

Technology Stack

- **YOLOv8 (Ultralytics)** – For **object/person detection**
- **PyTorch** – Backend for deep learning models
- **OpenCV** – Frame processing, visualizations, and heatmaps
- **OpenVINO Toolkit** – Speeds up inference and optimizes models
- **DeepSORT** – Maintains **consistent tracking IDs**

Implementation Highlights

- **OpenVINO IR** models for faster and lighter processing
- **Heatmap visualization** for popular areas
- Tracks **pose**, **movement**, and **presence**
- Detects **staff vs. customer** using pose and behavior
- Evaluates **dwell time** for service optimization

YOLOv8 (You Only Look Once)

- **What is it?**
  YOLOv8 is a fast, real-time object detection model. It scans the entire image in one go, making it ideal for quick and accurate detection.

- **How does it work?**
  It uses **Convolutional Neural Networks (CNNs)** to recognize patterns and objects in images.

- **Why are we using it?**
  To **detect and count people** in video frames.

Installation Guide

- **Clone the Repository:** Open your terminal or command prompt and run
  - git clone https://github.com/Bookinheaven/InsightEX.git
  - cd InsightEX

1. **Run the Setup Script**

- **For Windows:**
  - Using PowerShell:
    ./setup.bat
  - Using Command Prompt:
    setup.bat
- **For Linux:**
  - chmod +x setup.sh
  - ./setup.sh

Start the System

- After setup, the system should start automatically. If not, you can run it manually:
  - python InsightEX.py

Uninstallation Guide

1. **Run the Cleanup Script**

- **For Windows:**
  - Using PowerShell:
    ./clean.bat
  - Using Command Prompt:
    Clean.bat
- **For Linux:**
  - chmod +x clean.sh
  - ./clean.sh

OpenCV

- **What is it?**
  An open-source library for **computer vision** tasks like image and video processing.

- **Why are we using it?**
  To **load video frames**, **draw bounding boxes**, and **display output** such as heatmaps and tracking lines.

OpenVINO

- **Note:**
  OpenVINO currently **doesn't support Python 3.13.1**, so we're using **Python 3.10** via **pyenv**.
- **Why OpenVINO?**
  We use **OpenVINO IR models** because they are **smaller and faster**, ideal for real-time performance. (More benefits of OpenVINO)

People Detection Workflow

1. **Detect people** in video using **YOLOv8**

2. **Assign unique IDs** to each person with **DeepSORT**

3. **Track body pose** using **YOLOv8 Pose**

4. **Generate heatmaps** using **OpenCV** to find crowded areas

5. **Classify** individuals as **staff or customers**

6. **Check customer-staff interaction**

    - Criteria:
      → Customer should be in frame for at least **20 seconds (simulating 4 mins in real-time)**
      → Should be accompanied by a **staff member (Future)**