Project Title: Smart Surveillance System (SSS)
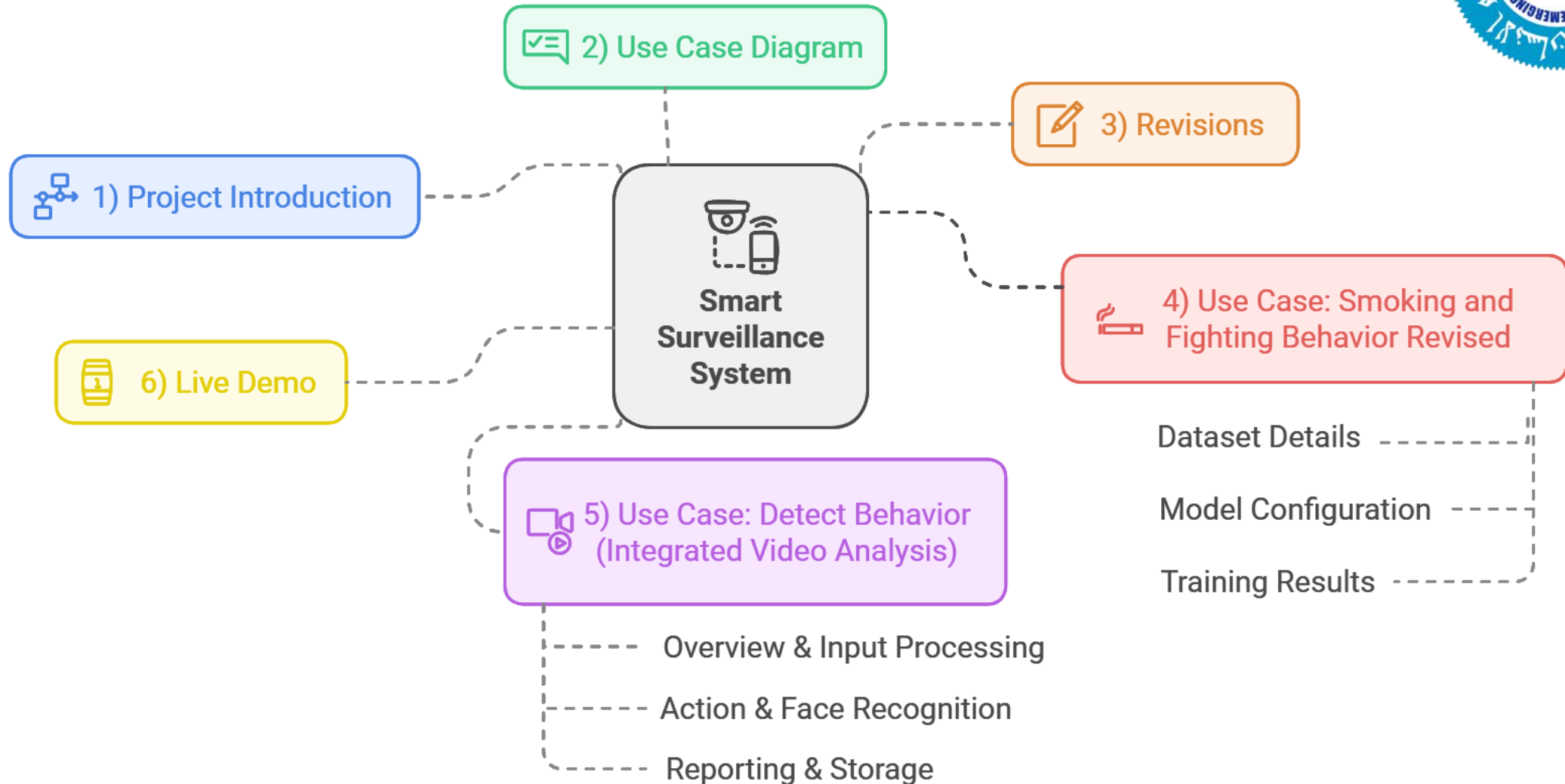
Team

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Outline

Smart Surveillance System

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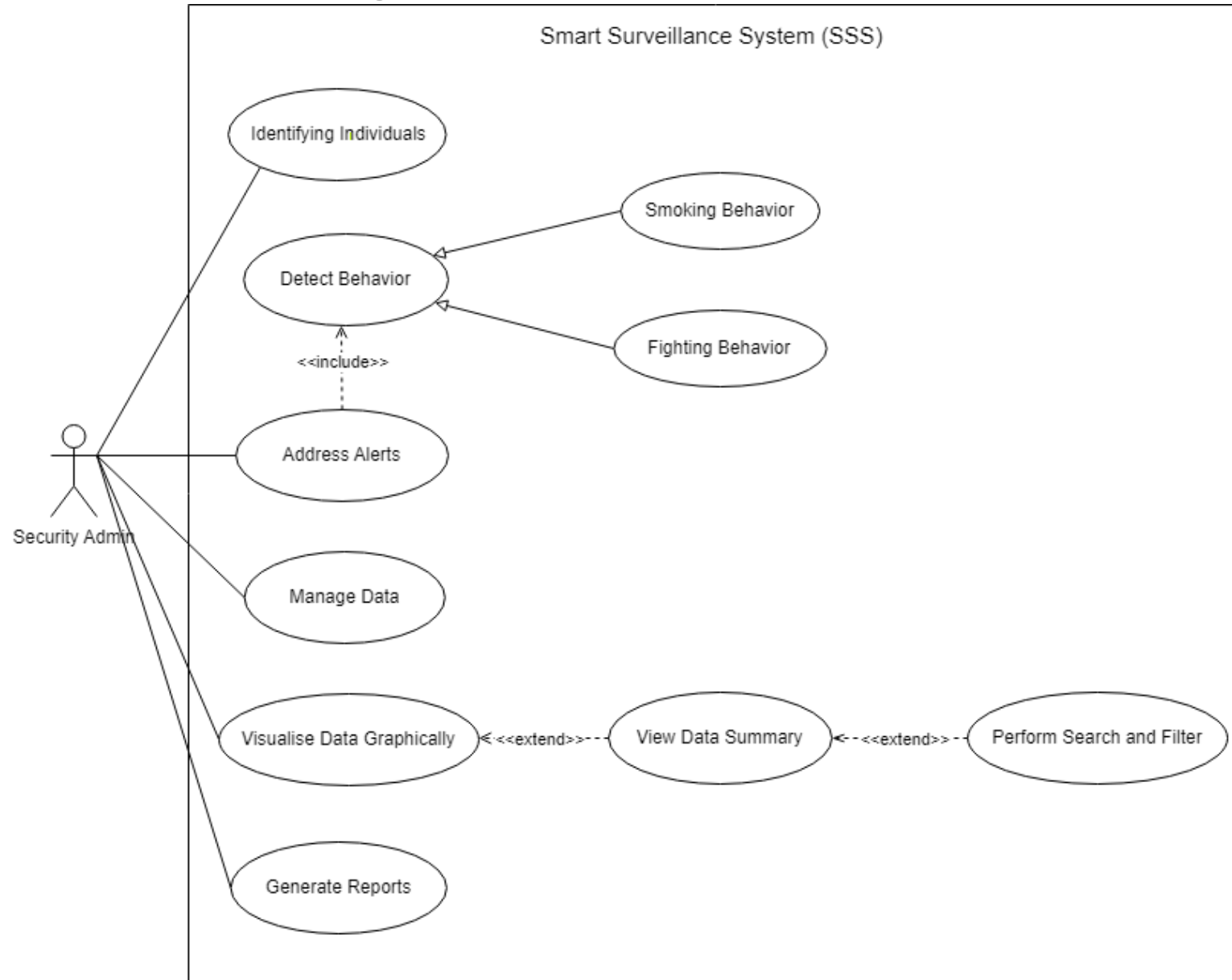- Reporting & Storage

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Project Introduction

SSS is a pioneering solution **addressing surveillance gaps** in university CCTV systems. It integrates **facial recognition**, computer vision, and behavior analysis for comprehensive monitoring. By proactively identifying and tracking specific behaviors, such as **smoking or fighting**, it overcomes human limitations in overseeing multiple cameras, ensuring continuous monitoring and precise risk management.

Use Case Diagram

Smart Surveillance System (SSS)

- Identifying Individuals
- Smoking Behavior
- Detect Behavior
- Fighting Behavior
- <<include>>
- Address Alerts
- Security Admin
- Manage Data
- Visualise Data Graphically <-<<extend>>-> View Data Summary <-<<extend>>-> Perform Search and Filter
- Generate Reports

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Revisions

- **New Detection Model:**

  - **Problem:**

    1- Old model cannot be converted to real time application

    2- After action detection, facial recognition module could not identify the actual person of interest.

  - **Solution:** Spatio Temporal Action Detection model that introduces bounding boxes around individuals performing specific behaviors.

- **Dataset:** Balanced dataset with 54 videos for Smoking and 54 for Fighting.

- **Evaluation Metric:** Mean Average Precision (mAP)

Use Case: Smoking and Fighting Behavior Revised

Dataset Details

- Created a dataset of 2 classes: **Custom Smoking** and Fighting (108 Videos, 54 Each)

- Data split into training (90 videos, 45 each) and validation (18 videos, 9 each) sets for model training.

- All Data consisted of CCTV footages.

- Annotated using CVAT

Model Configuration

- **FastRCNN withResNet3dSlowFast backbone**, optimized for spatiotemporal action detection in videos on custom dataset.

- **Froze the first two layers** to focus on task specific features and maintain general patterns.

- Dataset based on **AVADATASET** format, provided by Google.

- Training Pipeline includes multiple **data augmentation** techniques such as Random Rescaling, Cropping, Color Jitter, and Fixed Resize.

- Used AdamW as optimizer, with weight decay (0.05), and layer-specific learning rates. Loss Function used is Cross Entropy.

- Evaluator based on **AVAMetric:** Mean Average Precision mAP score.

- **Initial Learning Rate:** 0.00001

- **Warm-Up Phase:** Gradual increase to 0.0001 over 5 epochs.

- **Cosine Annealing Decay:** Begins at epoch 5, gradually decays towards 0.000001

Training Results

Best Epoch 7 Results

Smoking AP: 0.5708

Fighting AP: 0.7058

Overall mAP: 0.6383
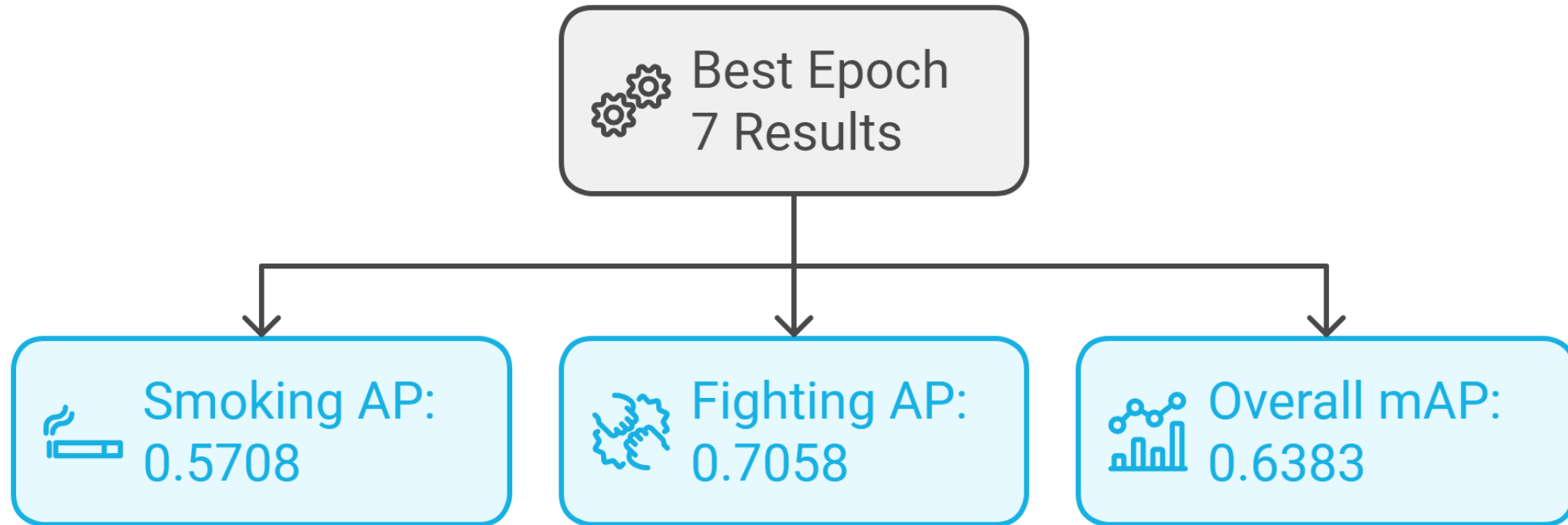
Use Case: Detect Behavior

Integrated Video Analysis – Action & Face Detection

Overview & Input Processing

- Reads a video stream, extracting frames in sequence.

- A human detector (Pre-trained Faster R-CNN by MMdetection) finds people per frame

- Frames are buffered to provide temporal context for action detection.

- Each person detected gets assigned a unique ID and tracked across frames.

Integrated Video Analysis – Action & Face Detection

Action & Face Recognition

- Fine-tuned model classifies actions (smoking and fighting) based on buffered frames.

- When a high-confidence action is found for a certain temporal window, we start gathering that person's

  frames.

- Cropped face regions based upon bounding boxes are analyzed with face recognition to identify known

  individuals or label them "Unknown."

Integrated Video Analysis – Action & Face Detection

Reporting & Storage

- Once an action sequence is confirmed, evidence (cropped images) are saved locally.

- System sends results and image to a Smart Surveillance Web App server.

Surveillance Pipeline Process

Detect Individual

Detect Action

Identify Individual

Report Event

Live Demo

Thank You