PRESENTATION TITLE

PROJECT

VIDEO BASED MOBILITY MONITORING OF ELDERLY PEOPLE IN SMART HOME

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MOTIVATION

•**Critical Health Issue**
•Falls are the leading cause of injury-related deaths among elderly people.
•1/3 of people aged 65+ fall each year, leading to severe injuries.

•**Growing Need**
•The aging population increases the demand for effective fall detection systems.

•**Limitations of Existing Solutions**
•Many current systems do not provide real-time monitoring, causing delays in assistance.-Wearable devices

•**Leveraging Technological Advancements**.
•Immediate alerts ensure quick response times, reducing the severity of injuries.
•Offer higher accuracy and real-time capabilities

•**Impact on Society**
•Enhances the quality of life and independence for elderly individuals. -Provides peace of mind .

ABOUT PROJECT

PROBLEM STATEMENT AND OBJECTIVES

Problem Statement

- **High Risk of Falls**: 1 in 3 elderly people (65+) fall each year, leading to severe injuries and increased mortality rates..
- **Inadequate Existing Solutions**: Current systems (wearables, periodic monitoring) are uncomfortable, inconsistent, and often inaccurate..
- **Delayed Medical Assistance**: Many elderly individuals live alone, resulting in delayed help and worsened health outcomes..
- **Periodic Monitoring:** Delayed detection, slower response times..
- **Project Objective**: Develop a real-time, highly accurate fall detection system ,ensuring immediate alerts and reliable performance.

Objectives

- **Leverage YOLOv8 for Enhanced Accuracy**:

  -Utilize state-of-the-art object detection to achieve 99% accuracy in fall detection.

- **Provide Continuous Real-Time Monitoring**:

  -Ensure immediate detection of falls to prevent delays in assistance.

- **Implement an Efficient Alert System**:

  -Use SMTP and threading to send prompt email alerts to guardians or caregivers.

- **Improve Elderly Safety and Independence**:

  -Enhance the quality of life and provide peace of mind to families members.

LITERATURE SURVEY

Survey	Video-Based Mobility Monitoring (2023)	FallDetectNet (2021)	Fall Detection using YOLOv4 & LSTM (2022)	Fall Detection with Machine Learning (2020)	Research Trends in Fall Detection (2021)
Objective	Assess elderly mobility skills	Enhance precision-recall	Improve detection	Minimize false alarms	Critique ML algorithms
Approach	BiLSTM classification	Transfer learning, data augmentation	YOLOv4 for posture, LSTM for sequence analysis	Wearable sensor, decision tree	Statistical data
Note	Larger datasets needed	Improve accuracy/reliability	Analyze posture & movement	Enhance accuracy	Highlight improvements & trends

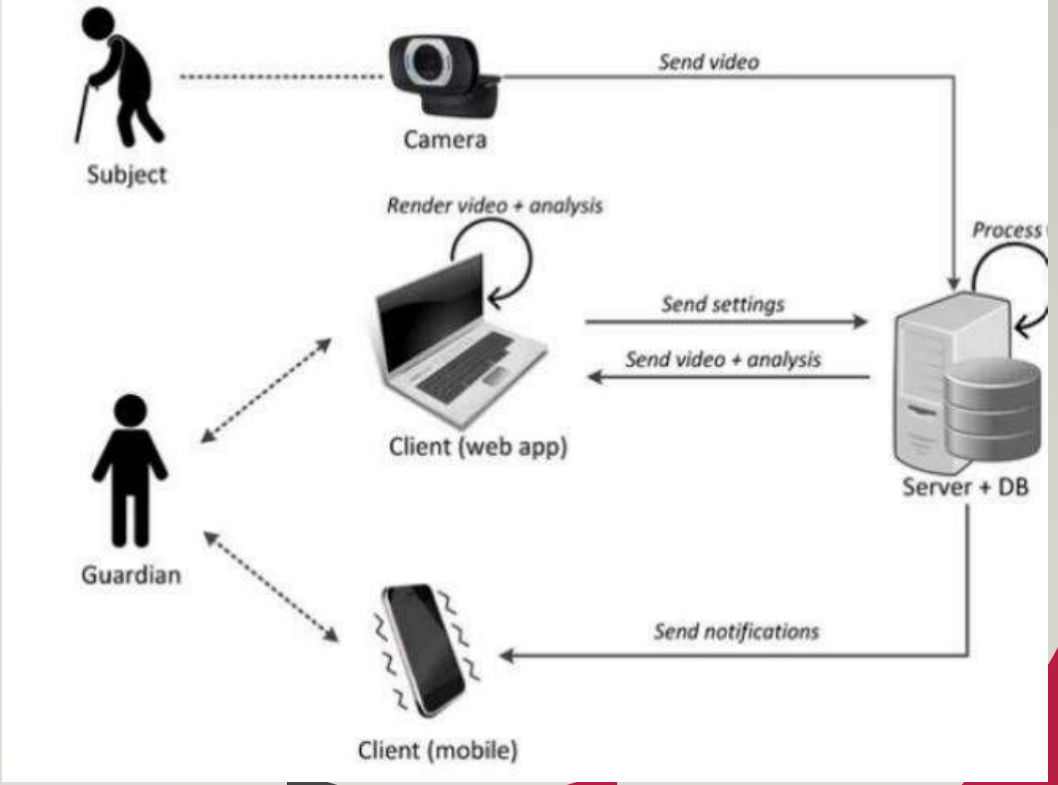
8 OUR APPROACH

•**Real-Time Video Monitoring:** real-time monitoring ensures that any fall event is promptly identified and responded to, minimizing the delay in assistance.

•**Introduction to YOLO Models for Object Detection:** YOLO (You Only Look Once) models are renowned for their efficiency in real-time applications, capable of detecting and localizing multiple objects in a single pass through the network .

•**Why YOLOv8 was Chosen Over Other Models:** due to its improved accuracy, speed, and robustness. This model excels in complex environments,

•where accurate and timely detection of falls is critical.



❑ **Initial Use of OpenCV:**

- Utilized for video capture, frame extraction, motion detection, and initial video preprocessing.

•Provided foundational functionalities for early stages of the project.

❑ **Transition to YOLOv5 and Finally YOLOv8:**

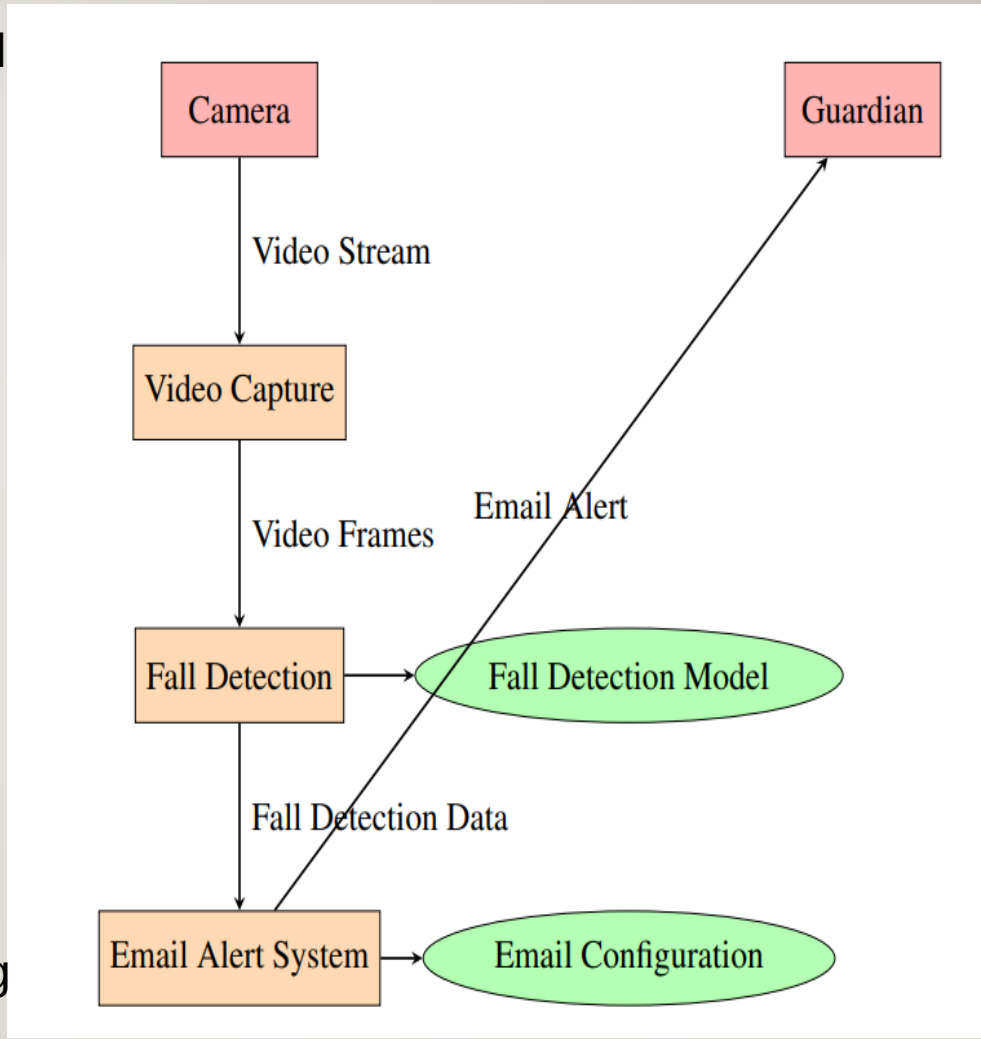
•Integrated ***YOLOv5*** for improved speed and accuracy in real-time object detection.

•Upgraded to ***YOLOv8*** for enhanced capabilities in handling complex scenes and achieving superior detection performance.

❑ **Use Email Alerts:**

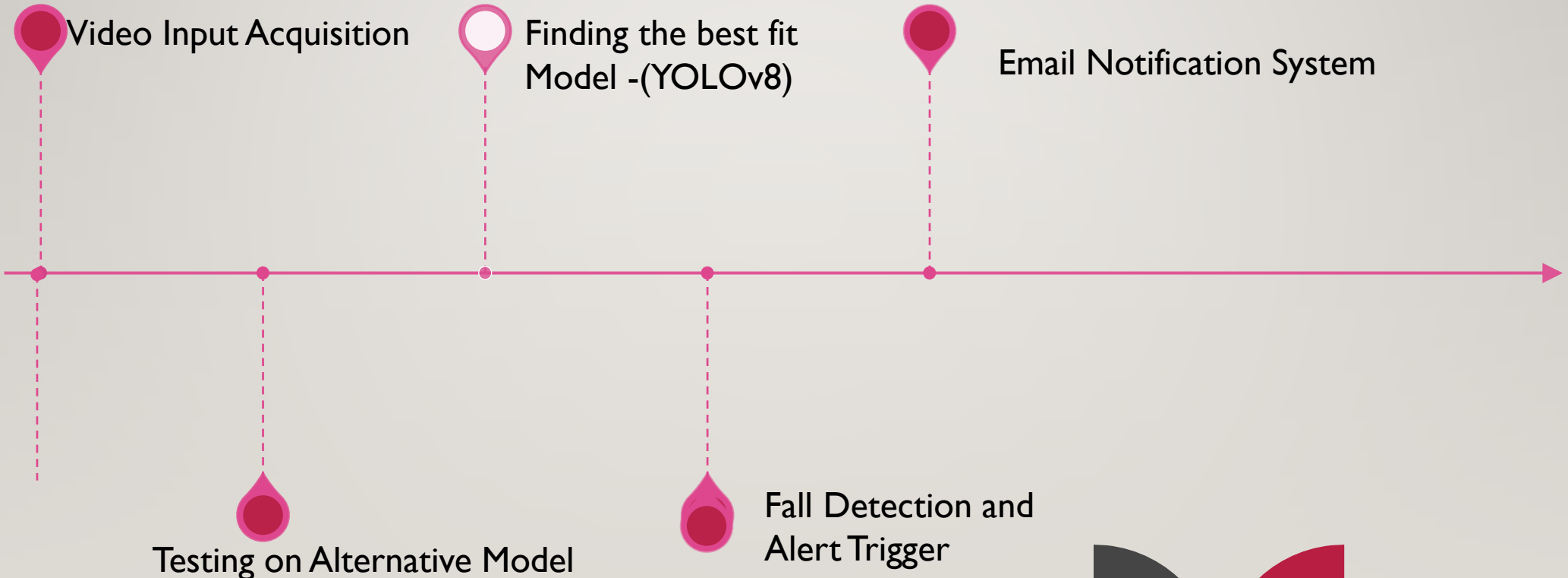
- **smtplib:** Integrated for email notification functionality, enabling immediate alerts upon fall detection.
- **Threading:** Implemented threading for concurrent execution, ensuring that email alerts are sent promptly without affecting real-time monitoring.

•**Benefits:** Enhances system responsiveness by separating email sending from main processing, maintaining continuous monitoring efficiency.



Data flow of Fall Detection Model

10 FLOW OF THE PROJECT



11 ABOUT DATASET

(INSIGHTS OF THE DATASET)

1. Fall Detection Computer Vision Project

- The dataset includes 3 classes: fall, no fall, and other.
- Train Set: 70% of the dataset, consisting of 6901 images , Validation Set: 20% of the dataset, consisting of 1972 images , Test Set: 10% of the dataset, consisting of 985 images

2. Fall Dataset

- The dataset includes 3 classes: fall, no fall, and other.
- Train Set: Consisting of 374 images • Validation Set: Consisting of 111 images Image Size: The images are typically of size 720x480 pixels.

TECHNOLOGY USED

YOLOv8

YOLOv5

OpenCV

13 YOLOv8

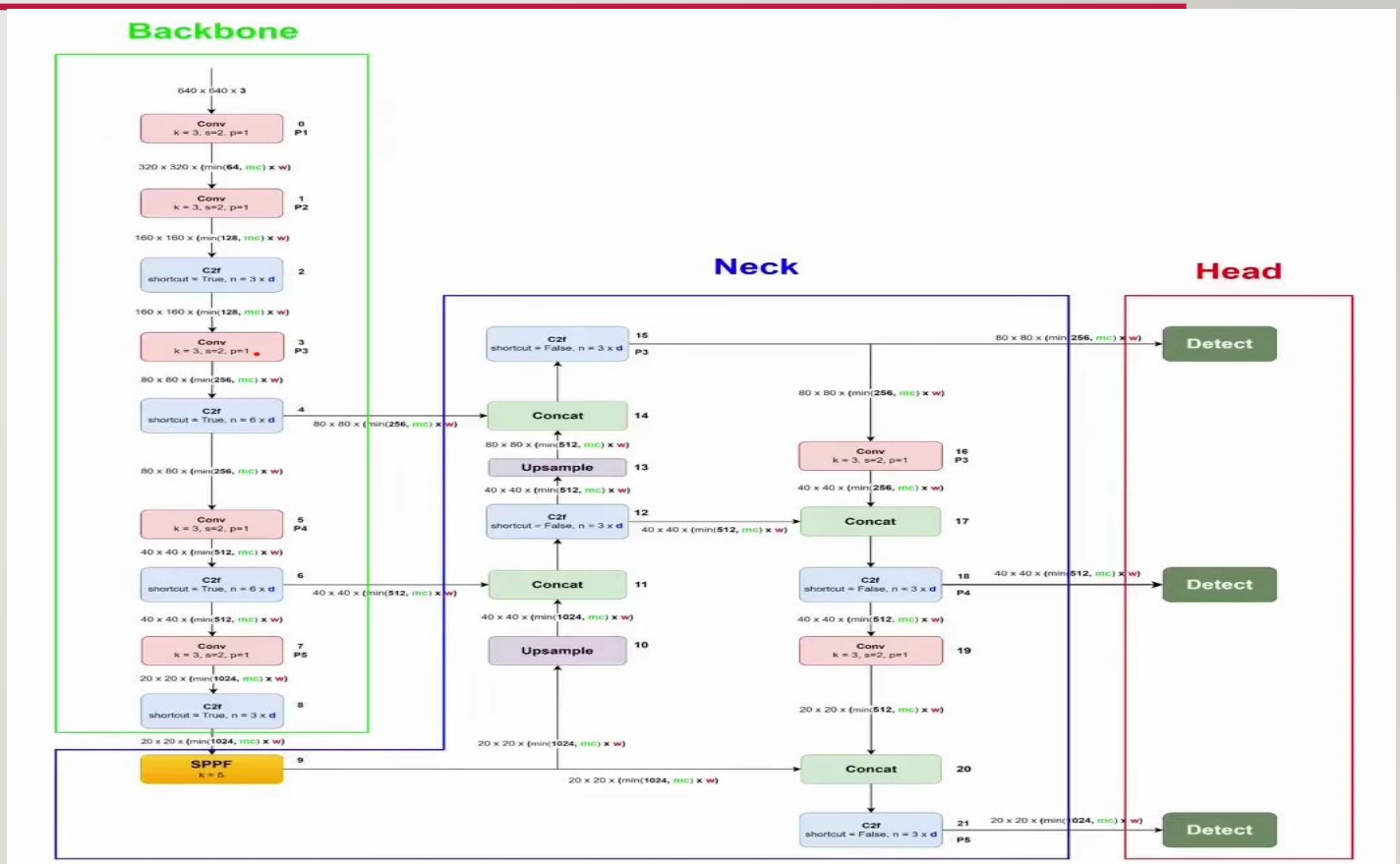
The YOLOv8 architecture follows the one-stage object detection paradigm, where the entire process of object localization and classificationis performed in a single pass through the neural network. This design allows YOLOv8 to achieve real-time inference speeds while maintaining high accuracy.

Key Features ofYOLOv8 :-

- Backbone Network : Utilizes powerful CNNs like Darknet or CSPDarknet for strong feature extraction..
- Detection Head: Predicts bounding boxes and class probabilities directly from feature maps for efficiency and speed.
- Anchor Boxes: Uses predefined boxes to enhance object localization accuracy.
- Training Strategy: Employs data augmentation, transfer learning, and optimization algorithms for improved performance.
- Post-processing: Applies techniques like non-maximum suppression(NMS) to refine predictions.

14 ARCHITECTURE YOLOv8

- Object detection, which YOLOv8 was designed for, involves creating features from input images. These features are then passed through a prediction system to draw boxes around objects and predict their classes
- The YOLOv8 network consists of three main pieces:
- • Backbone: A convolutional neural network that aggregates and extracts image features at different granularities.
- • Neck: A series of layers designed to mix and combine the image features extracted by the backbone. These layers prepare the features for the final prediction steps.
- • Head: The head of the network consumes the features from the neck and performs the final steps of box and class predictions based on these features.



15 YOLOv5

YOLOv5 (You Only Look Once version 5) is a state-of-the-art object detection model developed by Ultralytics. It stands out for its balance of speed and accuracy, making it ideal for real-time detection tasks across various domains.

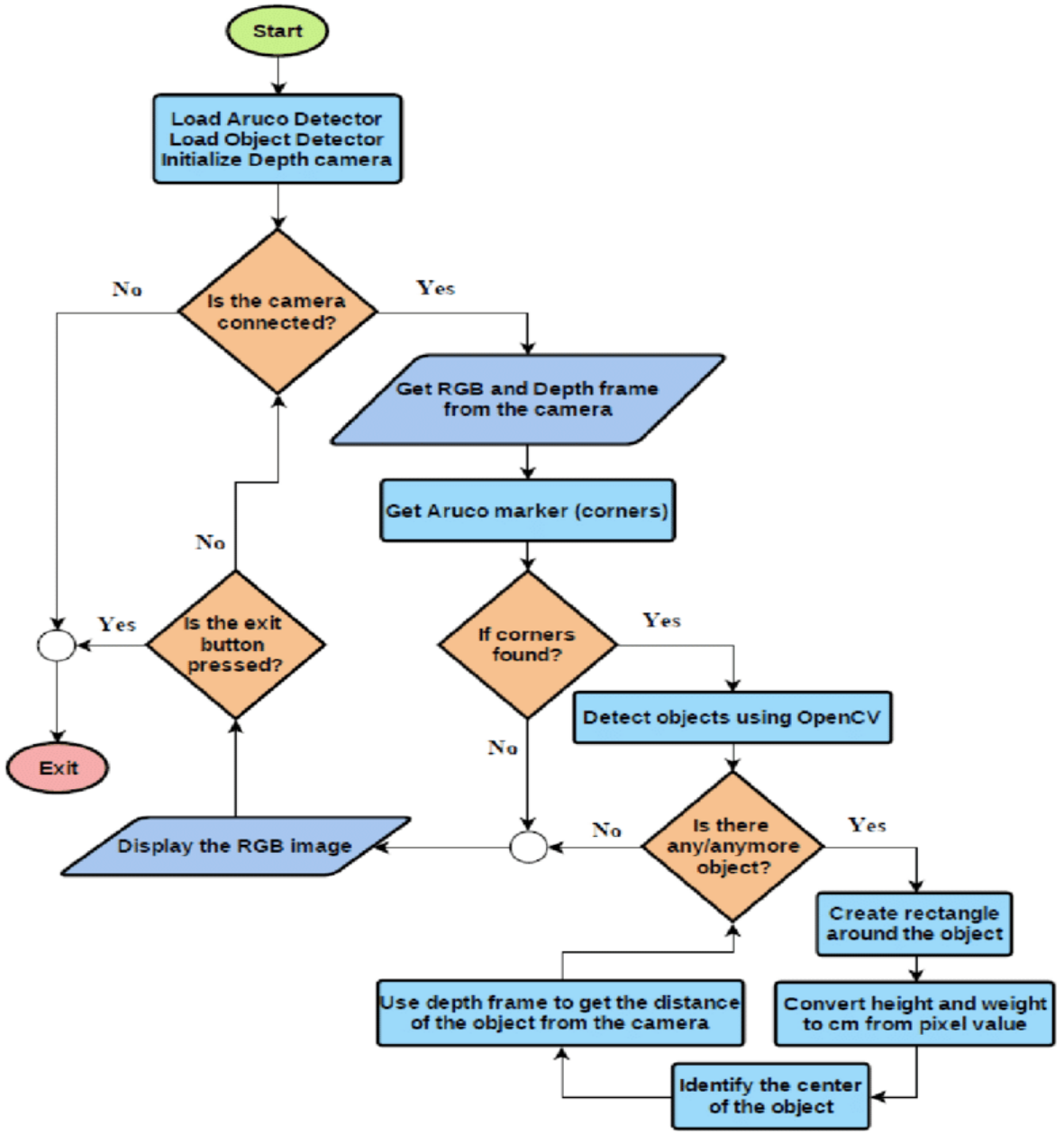
- **Key Features**

1. **High Speed**: YOLOv5 is designed for real-time applications, capable of processing images quickly.
2. **High Accuracy**: It achieves high precision and recall, making it reliable for various detection tasks.
3. **Model Sizes**: YOLOv5 comes in different sizes (s, m, l, x) to balance speed and accuracy according to specific needs.
4. **Ease of Use**: It is user-friendly with a straightforward training and inference process.
5. **Pre-trained Models**: Pre-trained on the COCO dataset, YOLOv5 can be fine-tuned for specific tasks, reducing training time.
6. **Flexible Integration**: Compatible with popular frameworks like PyTorch, facilitating integration into various applications.

16 OpenCV

OpenCV, short for Open Source Computer Vision Library, works by providing a set of tools and functions that developers can use to process visual data. It's like a toolbox full of algorithms and techniques designed to work with images and videos.

For example, it can help detect objects, recognize faces, track movements, and much more. At its core, OpenCV uses ***mathematical operations*** to manipulate pixels and analyze patterns in images.. OpenCV is popular because it's open-source, meaning anyone can use it and contribute to its development, making it a versatile and powerful tool for ***computer vision*** applications across various industries.



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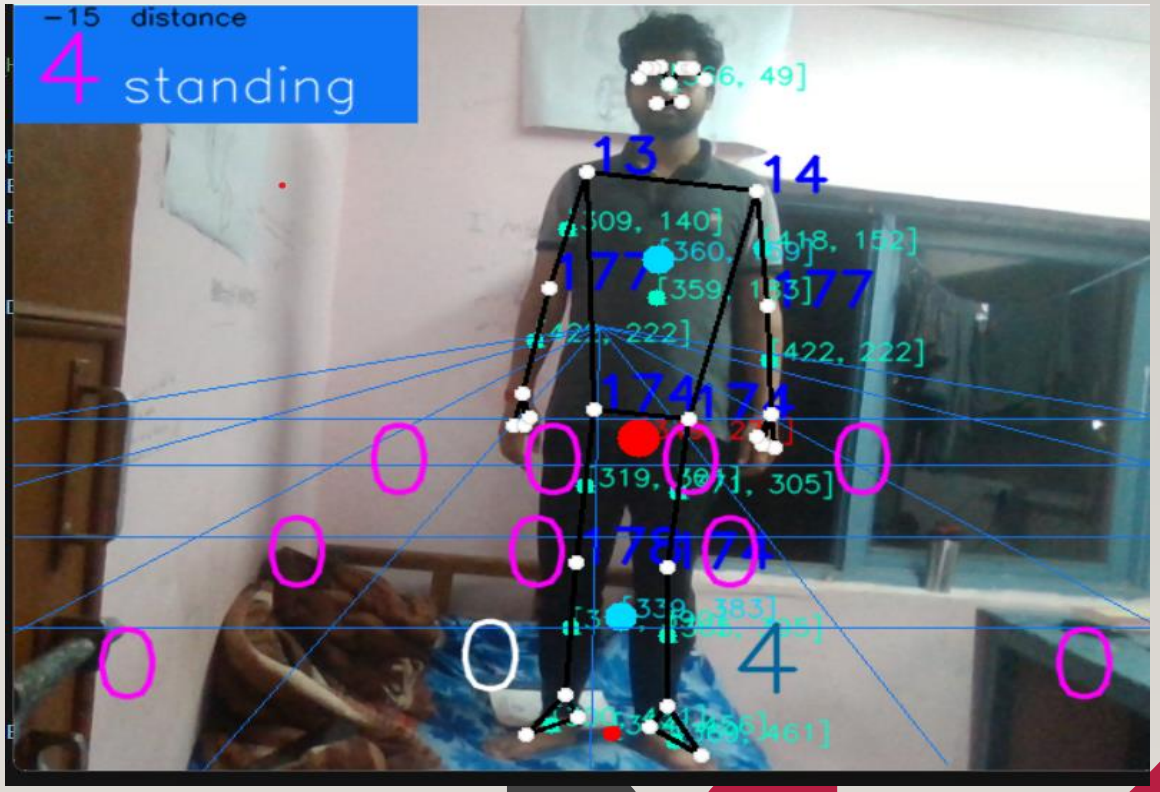
IMPLEMENTATION

IMPLEMENTATION USING OPENCV

Key Points

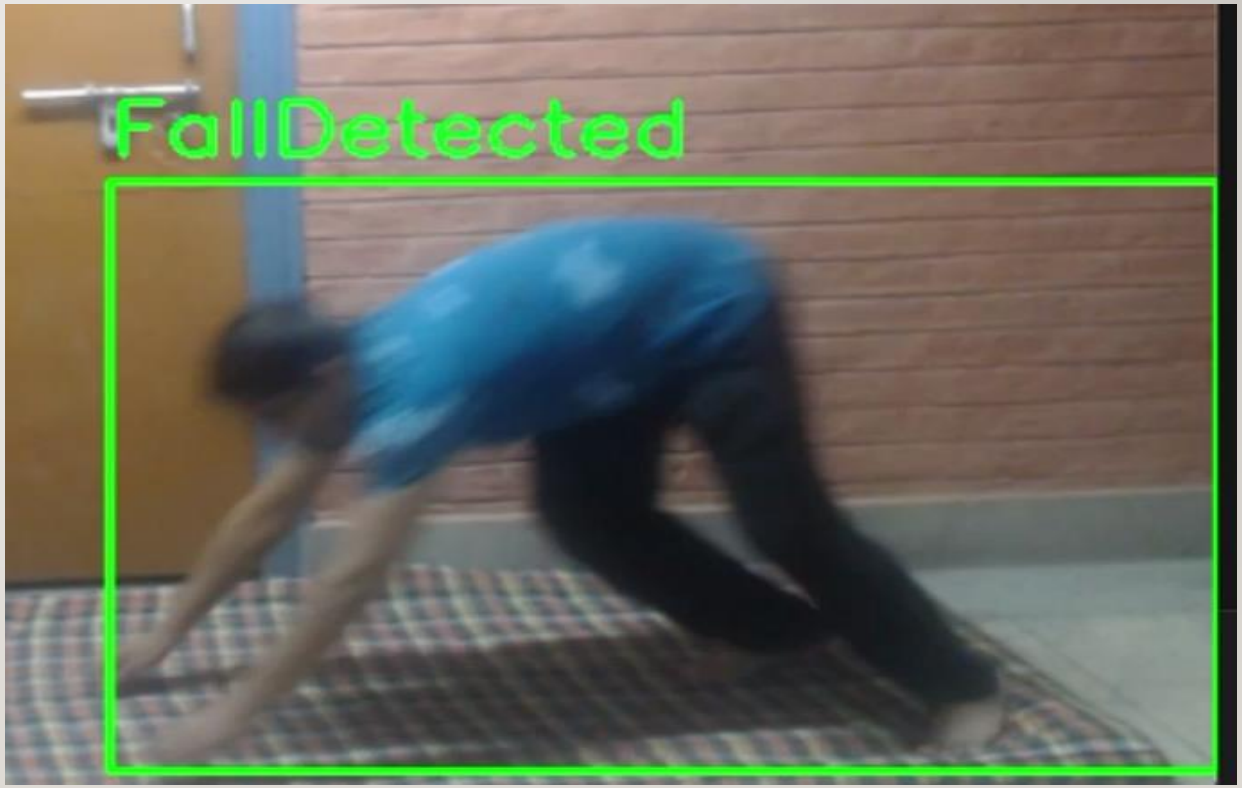
- Importing Libraries Mediapipe , Numpy, OpenCV
- Setting Up the Video Capture
- Function to Calculate Angles
- Main Loop to Process Video Frames
- Extracting Key Points
- Calculating Angles for Key Points
- Visualizing the Key Points and Angles
- Calculate midpoints
- Fall Detection Logic



19 IMPLEMENTATION USING YOLOv5 & YOLOv8

Key Points :

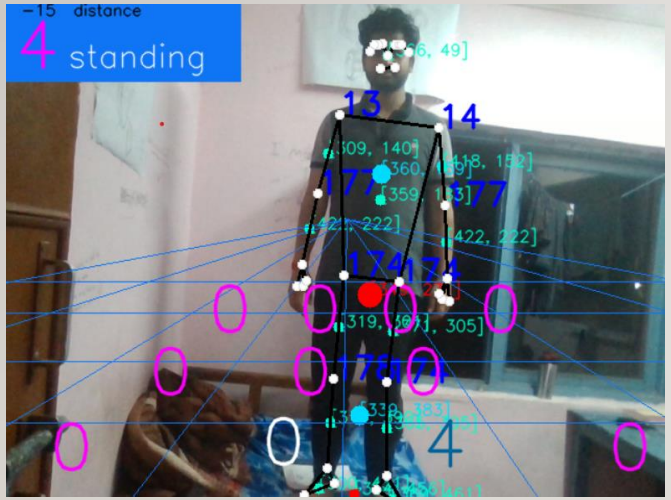
- ❑ Importing Libraries
- ❑ Checking GPU Availability
- ❑ Loading and Training the YOLO v8 Model
- ❑ Loading the Trained Model
- ❑ Defining the Email Sending Function
- ❑ Sending Email in a Separate Thread
- ❑ Dictionary to Track Alerts Sent
- ❑ Listing Available Cameras



Working demo

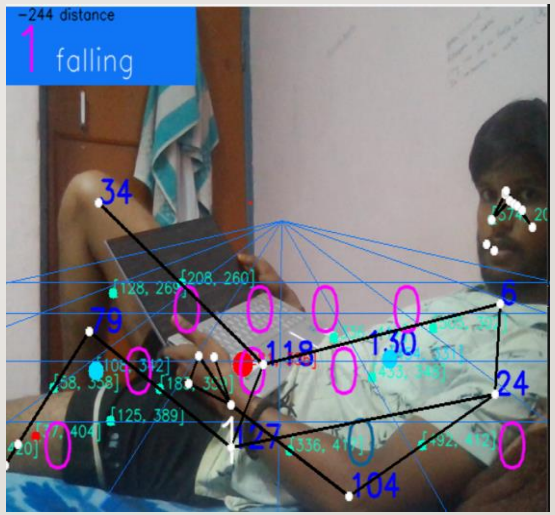
RESULTS

Result Using OpenCV

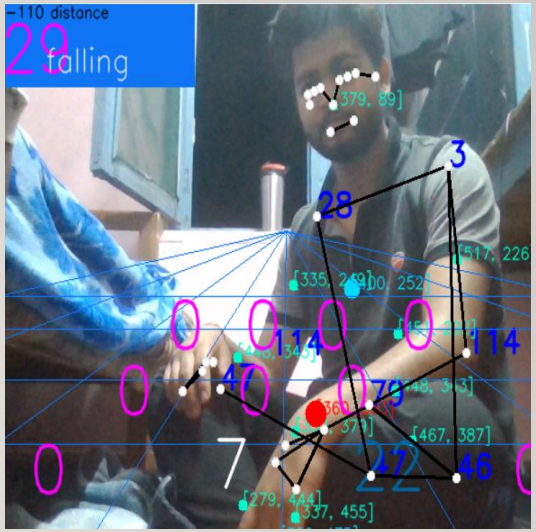


1.Standing Detected

2.Falling Detected



3.Poorly Detected

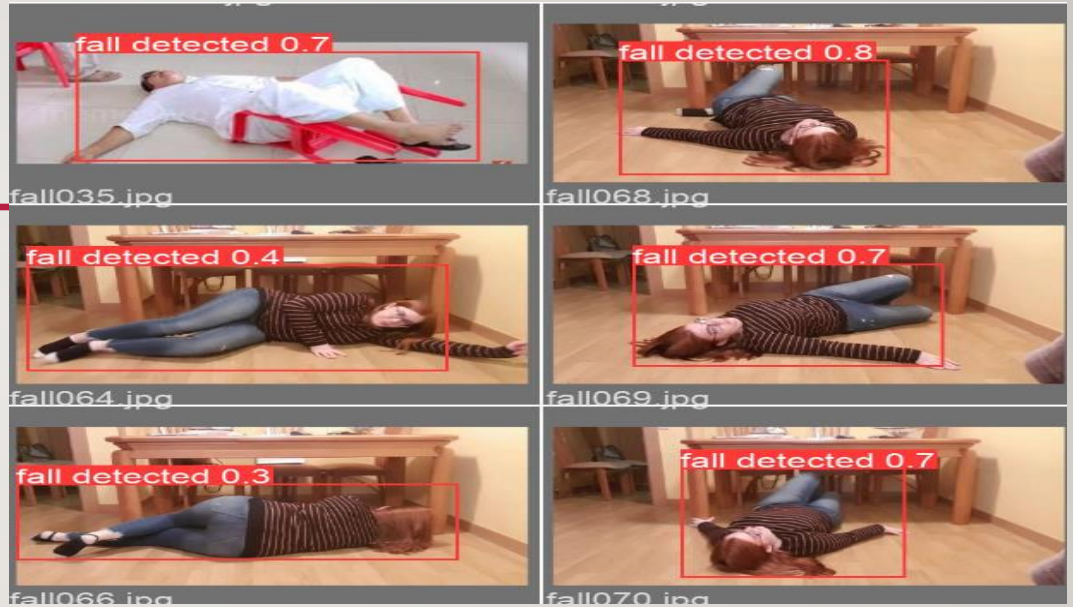


4.Poorly Detected

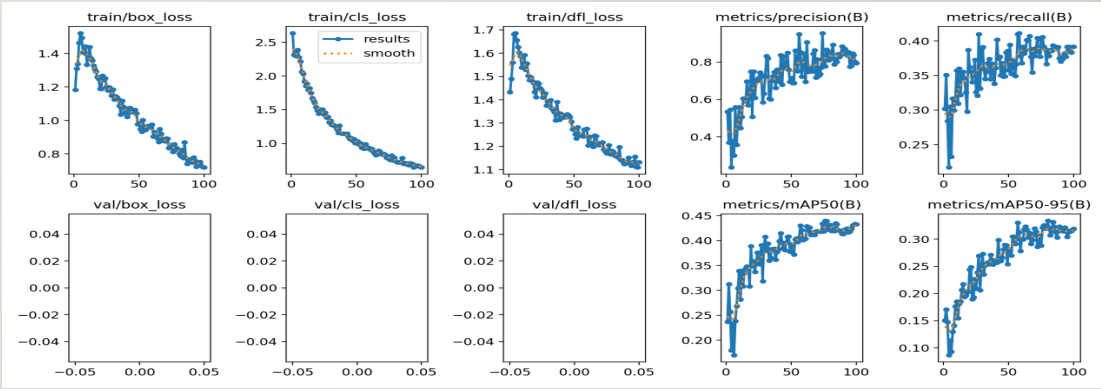
22 RESULTS USING YOLOv5

We have observed that YOLOv5 realizes an impressive mAP at 0.927 threshold whereby 92.7% objects are correctly identified and precisely located on average acrossall classes by YOLOv5 detection algorithm Additional Metrics.

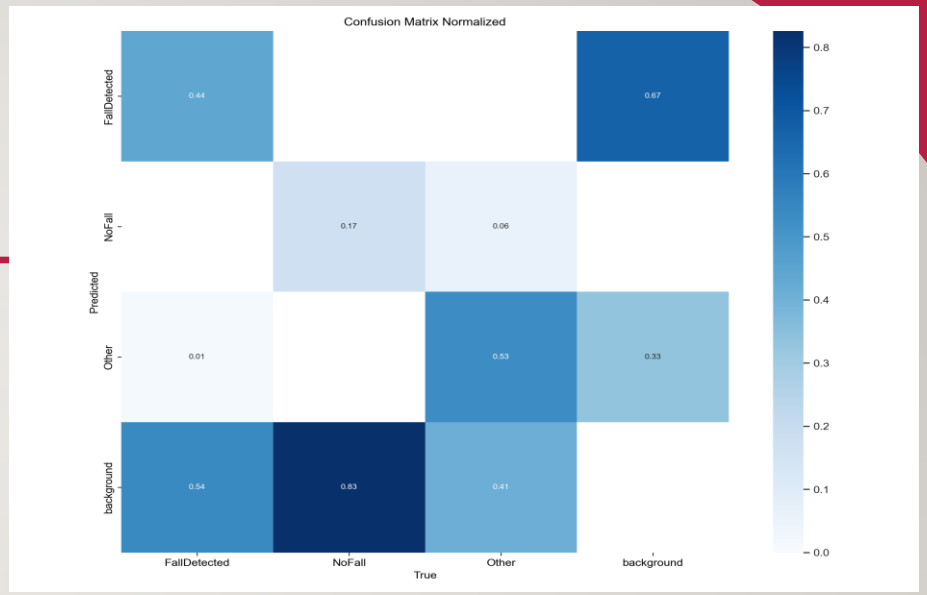
>Train/Box: 0.75
>Train/Loss: 0.50
>Train/DFF Loss: 1.2
>Metrics/Recall: 0.95
>Metrics/mAP@50-95: 0.82



Output_image from yolov5 model



23 RESULT USING YOLOv8



We have observed that YOLOv8 realizes an impressive mAP at 0.9906 objects are correctly identified and precisely located on average acrossall classes by YOLOv5 detection algorithm

Additional Metrics.

>Train/Box: 0.80

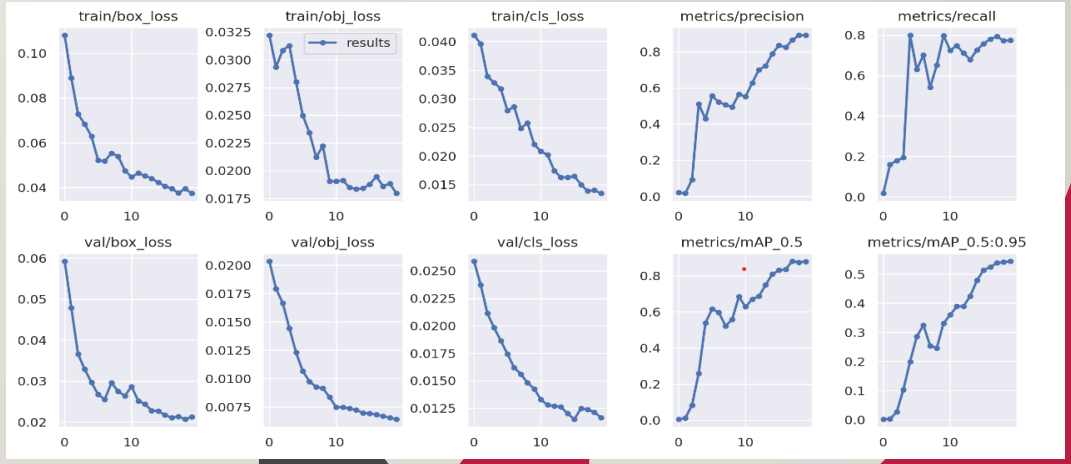
>Train/Loss:0.44

>Train/DFF Loss: 1.0047

>Metrics/Recall: 0.99

>Metrics/mAP@50: 0.9943

>Metrics/mAP@50-95: 0.8649



Results Using YOLOv8

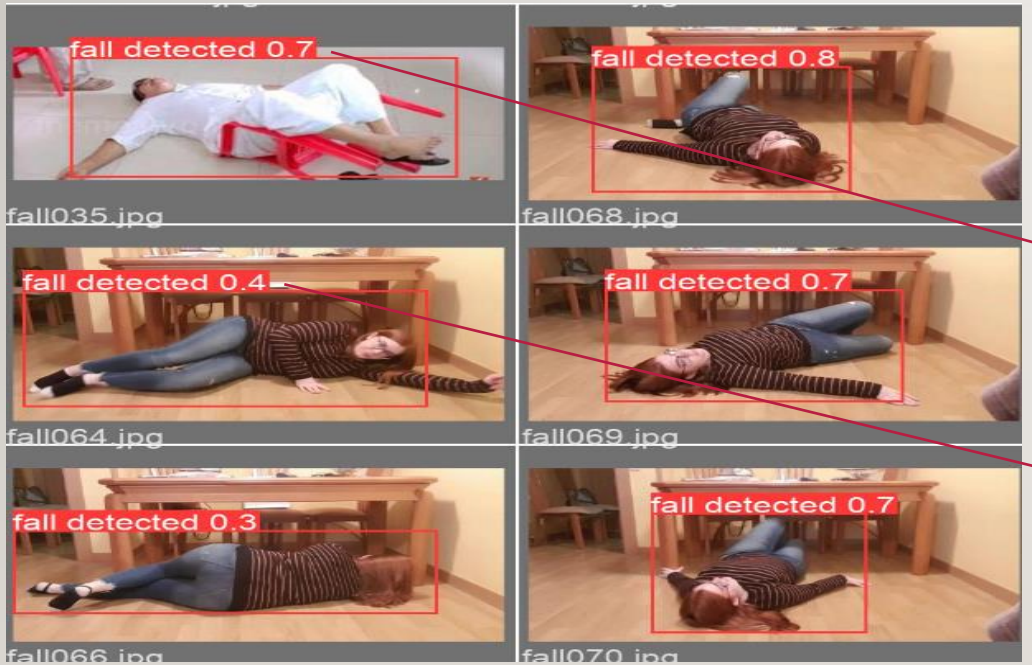
- Result-1

Result-2

Result-3

Outputs

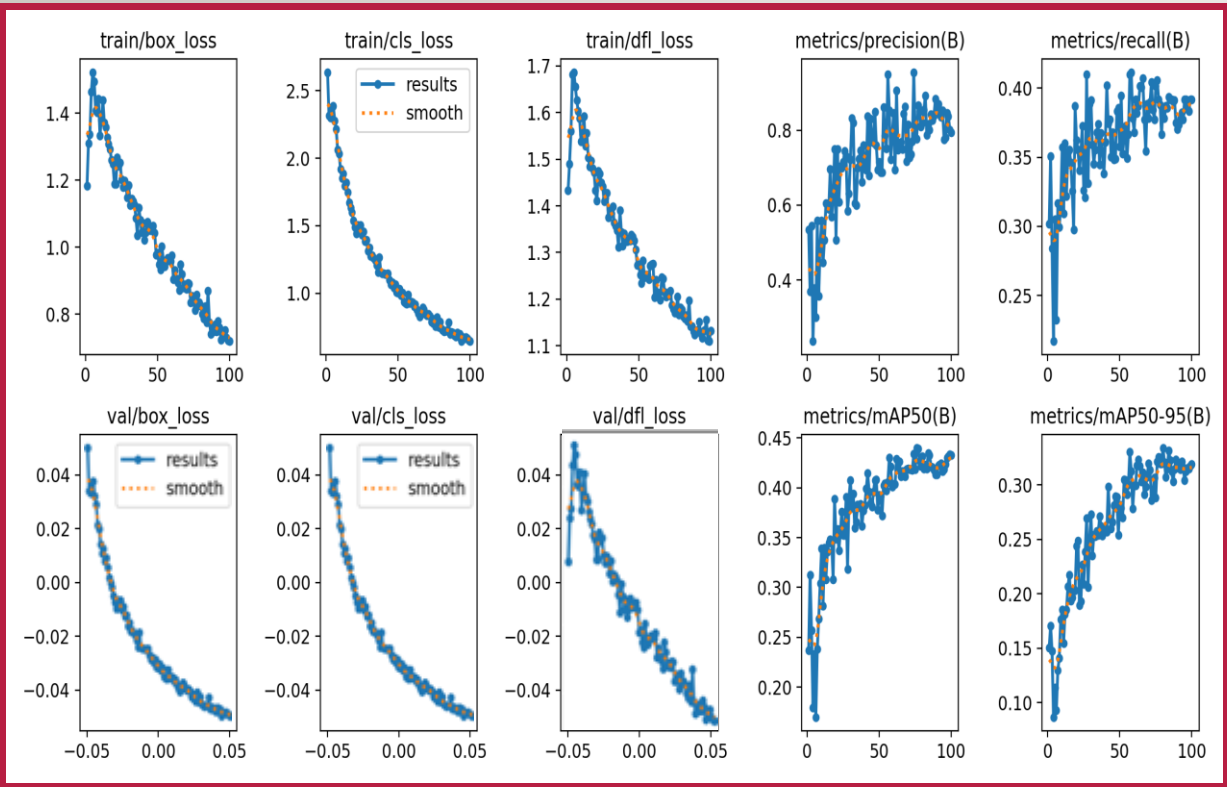
25 COMPARISION B\W YOLOv8 & YOLOv5



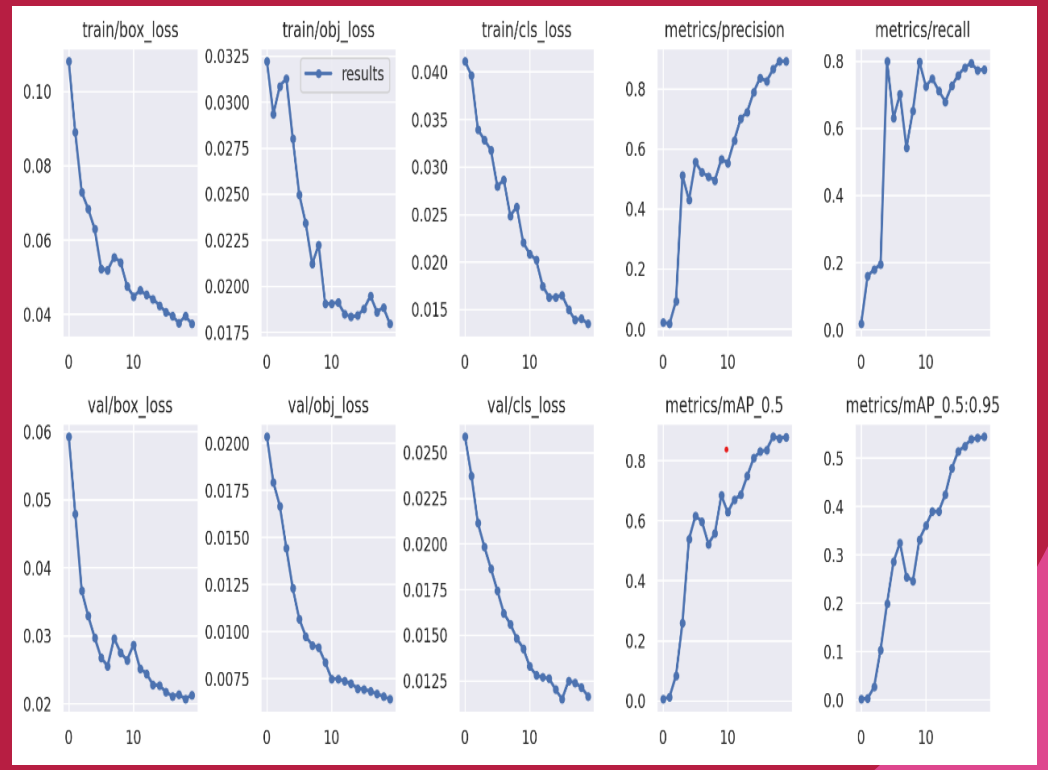
YOLOv5

YOLOv8

GRAPHICAL COMPARISION



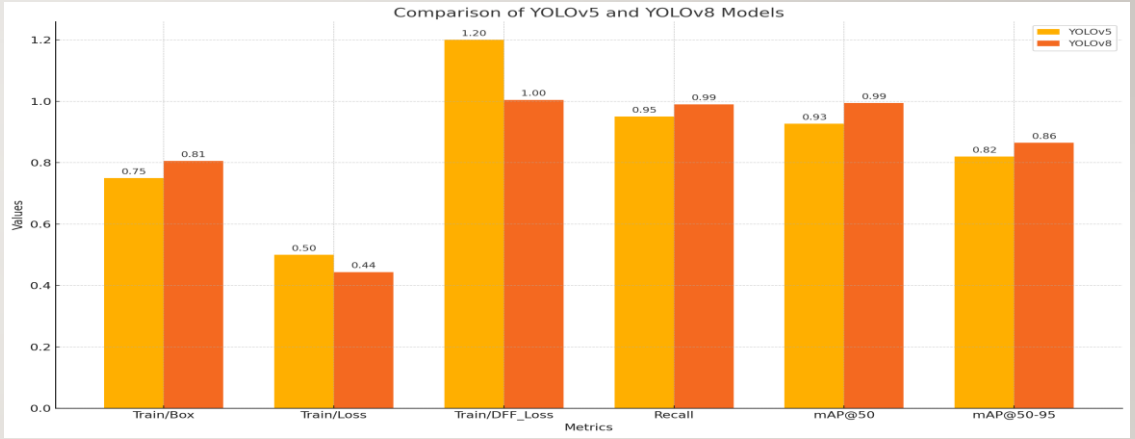
YOLOv5

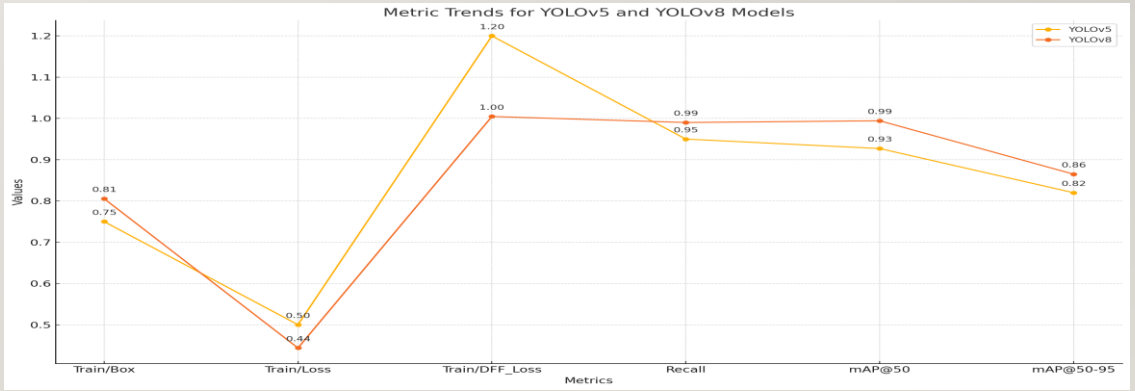


YOLOv8

COMPARISION B\W YOLOv8 & YOLOv5

❑ **Higher Accuracy**
•YOLOv8 mAP@50: 0.9943
•YOLOv5 mAP@50: 0.927
•**Result**: More precise fall detection with YOLOv8.
❑ **Improved Localization**
:YOLOv8 Train/Box: 0.80558
•YOLOv5 Train/Box: 0.75
•**Result**: Better localization of falls within video frames.
❑ **Better Feature Extraction**
•YOLOv8 Train/DFF_Loss: 1.0047
•YOLOv5 Train/DFF_Loss: 1.2
•**Result**: More effective differentiation of features in YOLOv8.
❑ **Lower Training Loss**
•YOLOv8 Train/Loss: 0.44368
•YOLOv5 Train/Loss: 0.50
•**Result**: Faster and more efficient model convergence with YOLOv8.
❑ **Higher Recall**
•YOLOv8 Recall: 0.99016
•YOLOv5 Recall: 0.95
•**Result**: YOLOv8 captures nearly all true fall instances, reducing missed detections.





ALERT SYSTEM RESULT

Real-time Notifications

SMTP

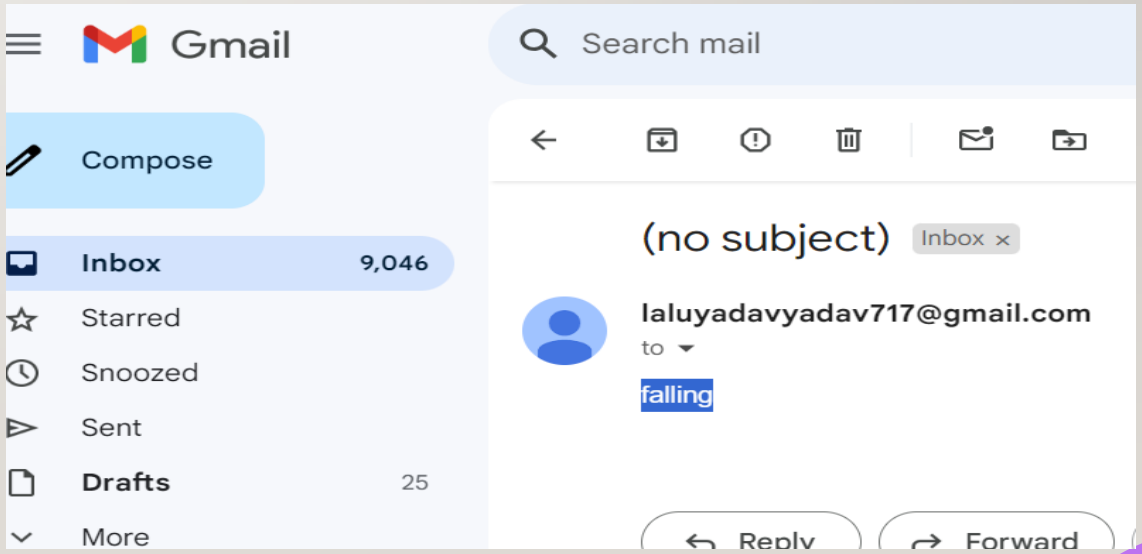
THREADING

Able to send multiple Email at same time

Prompt Alerts:

laluyadavyadav717	**(no subject)** - falling	12:03 AM
laluyadavyadav717	**(no subject)** - falling	12:00 AM

- **Optimized Efficiency:** Separates fall detection and email notification tasks into independent threads.
- **Maintained Responsiveness:** Prevents system slowdowns during peak usage, ensuring continuous monitoring capability.



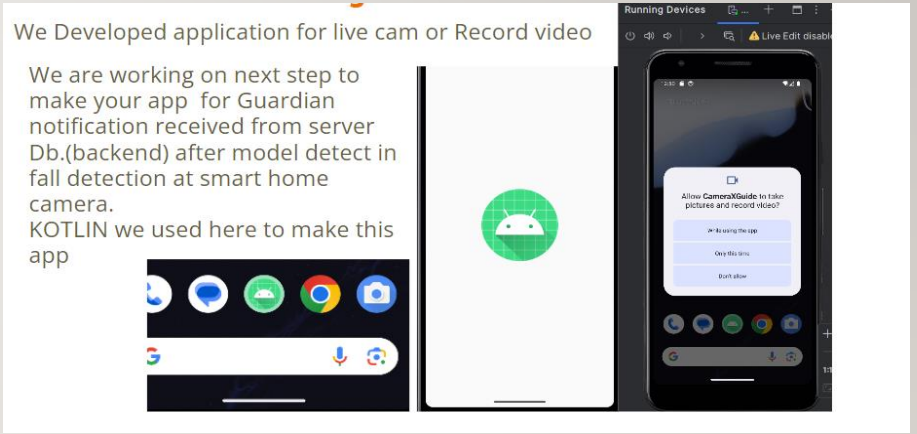
29 WHAT WE DID DIFFERENTLY?

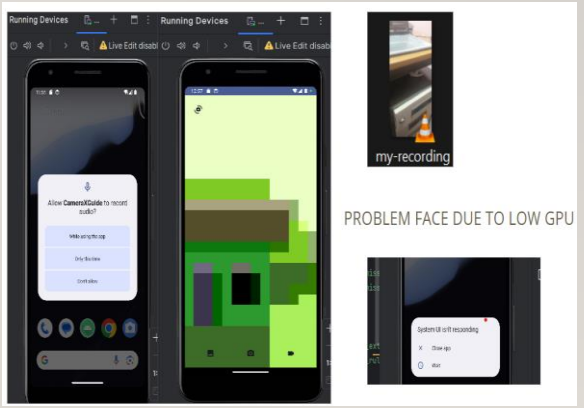
- **Higher Accuracy and Robustness:**
  Implemented YOLOv8. Achieves approximately **99%** accuracy, surpassing traditional methods.
  By using hyperparameters able to find the best confidence point at **0.78**, for alert system.
  Real-Time Monitoring:
  Provides continuous surveillance for immediate fall detection. ***Low latency***
- **Efficient Alert System:**
  Utilizes smtplib and threading for seamless email alerts to guardians.
  Integrated alert system ensures minimal delay from detection to notification.
- **Comprehensive Data Analysis:**
  Evaluation includes detailed metrics like Train/Box, Train/Loss, and mAP.
  High recall (0.99016) and mAP@50 (0.9943) ensure precise fall detection..
- **User-Friendly and Non-Intrusive:**
  Non-wearable solution provides comfort to elderly individuals.
  Easy deployment and minimal setup required in different settings..
- **Comprehensive Testing and Validation:**
  Extensive testing across varied scenarios for reliable performance.
  Continuously improving model to adapt to new data and conditions.

30 FUTURE WORK

We developed an app that captures video and provides low RGB images so that the load on the database should be low,
It increases the efficiency of the model as our model has to run 24X7.

- ❖ I will surely work on this project to ***improve it accuracy*** and ***in-app specific notification***. will ***add a frame image*** with a notification. So that it is way more accurate for Guardian to check.
- ❑ Enhanced Sensor Integration
- ❑ Multimodal Fusion for Robust Detection
- ❑ Privacy and Ethical Considerations
- ❑ On Field Testing and Validation in Diverse Settings





THANK YOU