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VITAL EXTRACTION CHALLENGE

Inter IIT Tech Meet 11.0

PRESENTED BY
Team 55

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Model Overview

Our proposed model has 3 main steps:

- **Step 1:** Segmentation
- **Step 2:** Detection
- **Step 3:** Character Recognition.

Inference time (on CPU): 0.6 - 1.0 s

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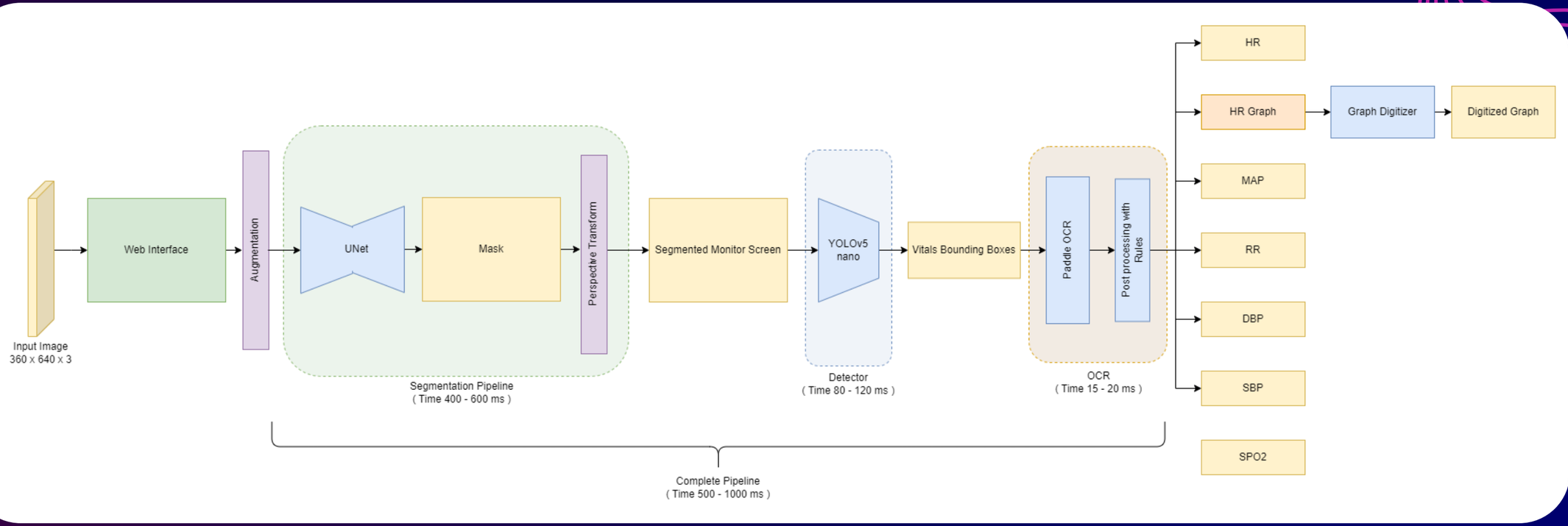
Proposed Model Pipeline



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Step 1: Segmentation

- Segmentation based **U-Net architecture** (initialized with **IMAGENET weights**)
- **Semi-Supervised(SS) Semantic Segmentation Approach.**
- Novel additions: **LR scheduler**, **Augmentations variations** (randAugment - a type of novel augmentation technique)

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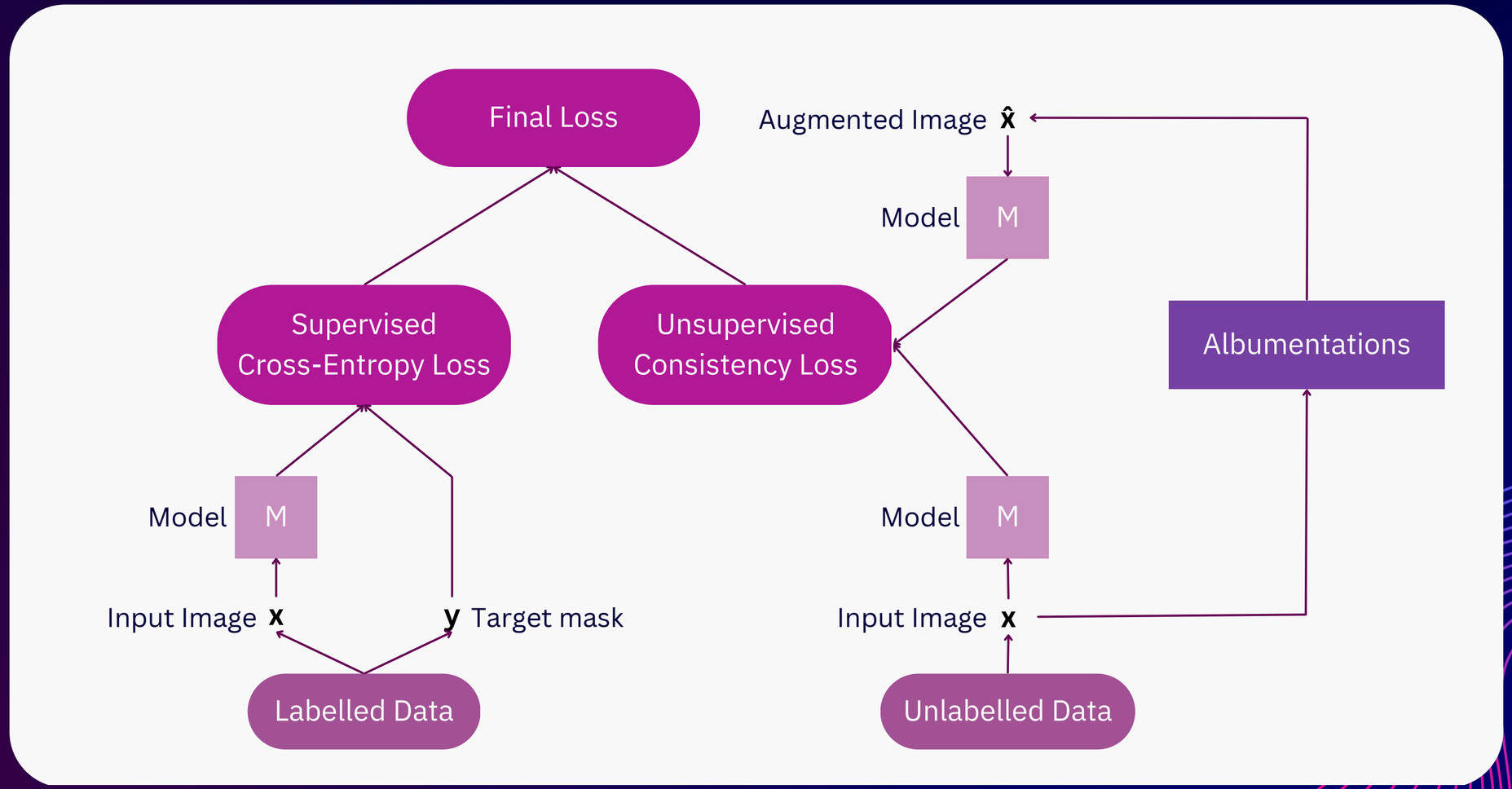
Semi-Supervised Segmentation



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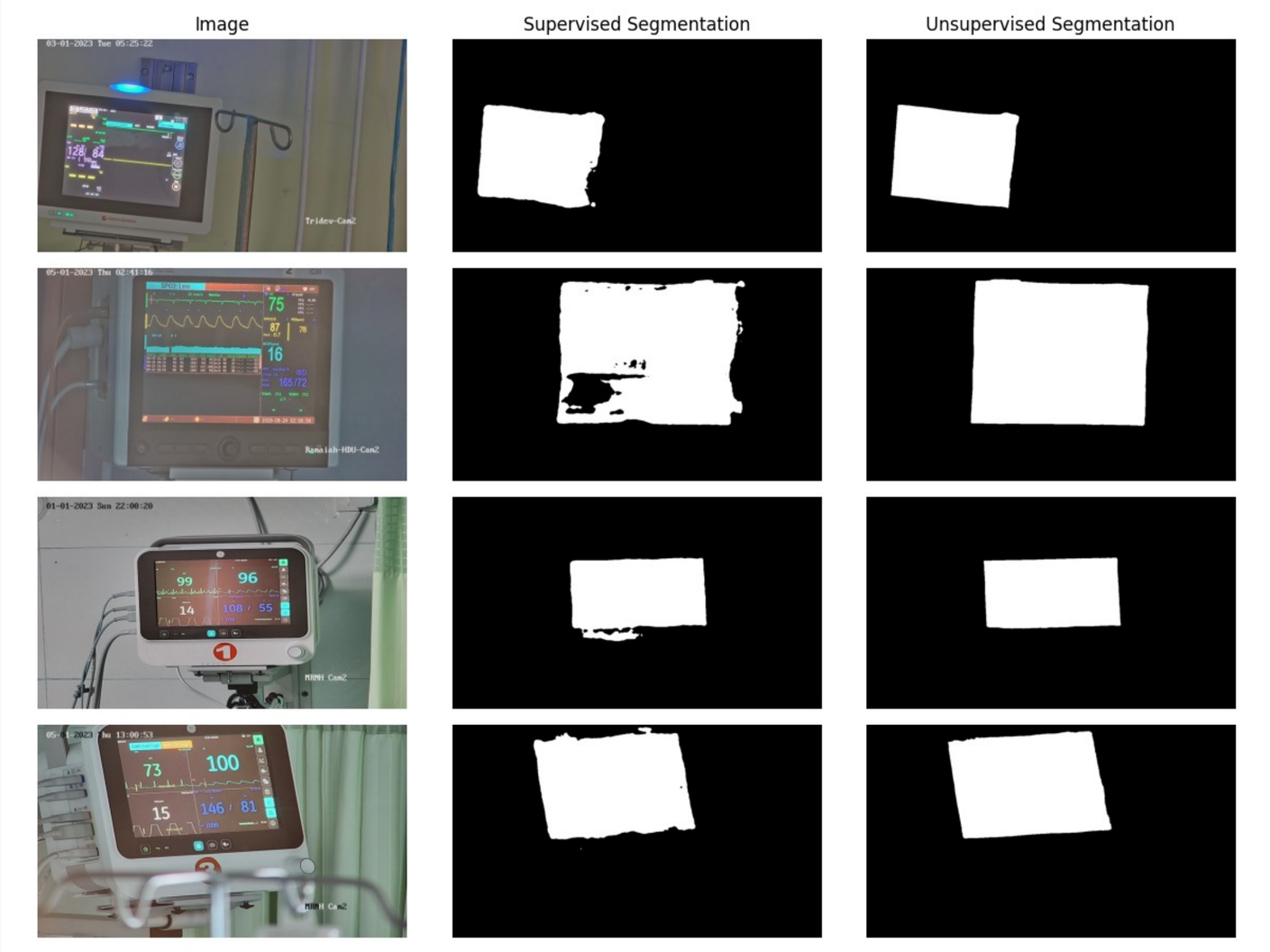
Why choose Semi-Supervised Segmentation model?

- monitor positions are not always rectangular
- detection model will not give good accuracy
- pixel level segmentation will perform better.



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Segmentation Pipeline

Input Image

Augmentation

U-Net

Segmentation Mask

Perspective Transformation

Segmented and Perspective Transformed Image

Inference time (on CPU): 0.4 - 0.6 s

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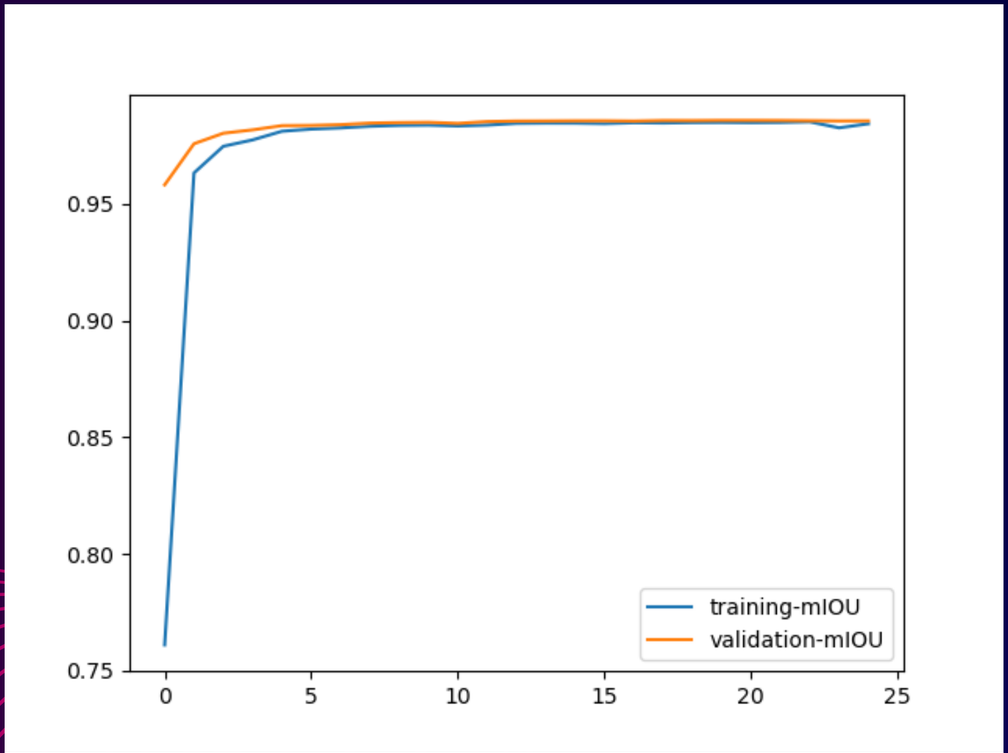
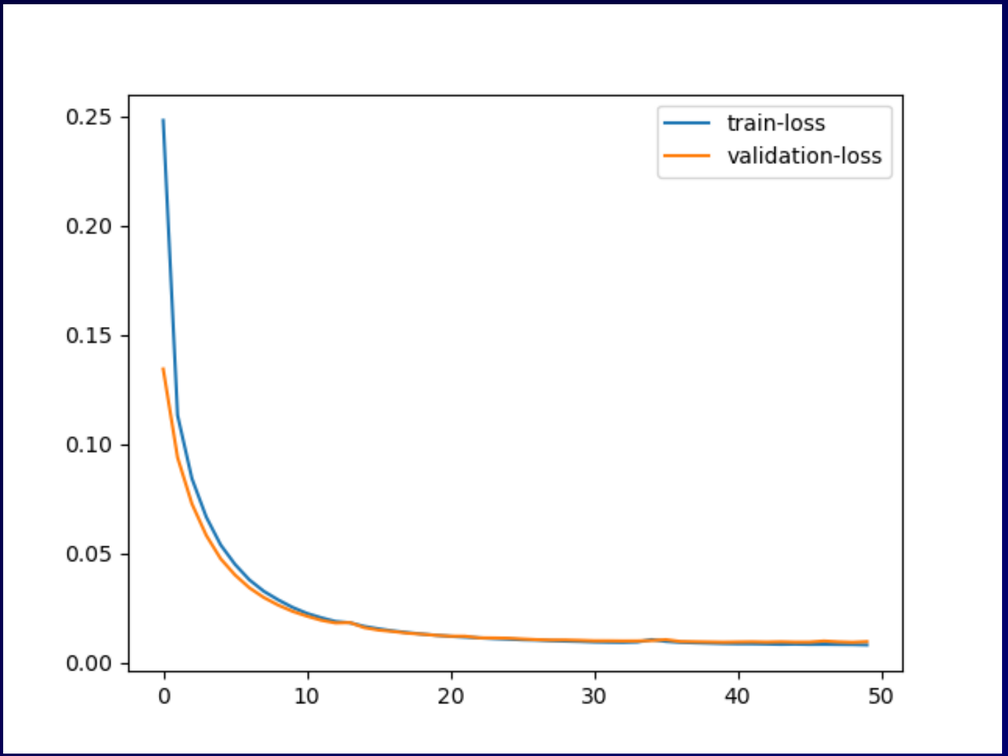
Metrics



Plot for mIOU socre



Plot for loss

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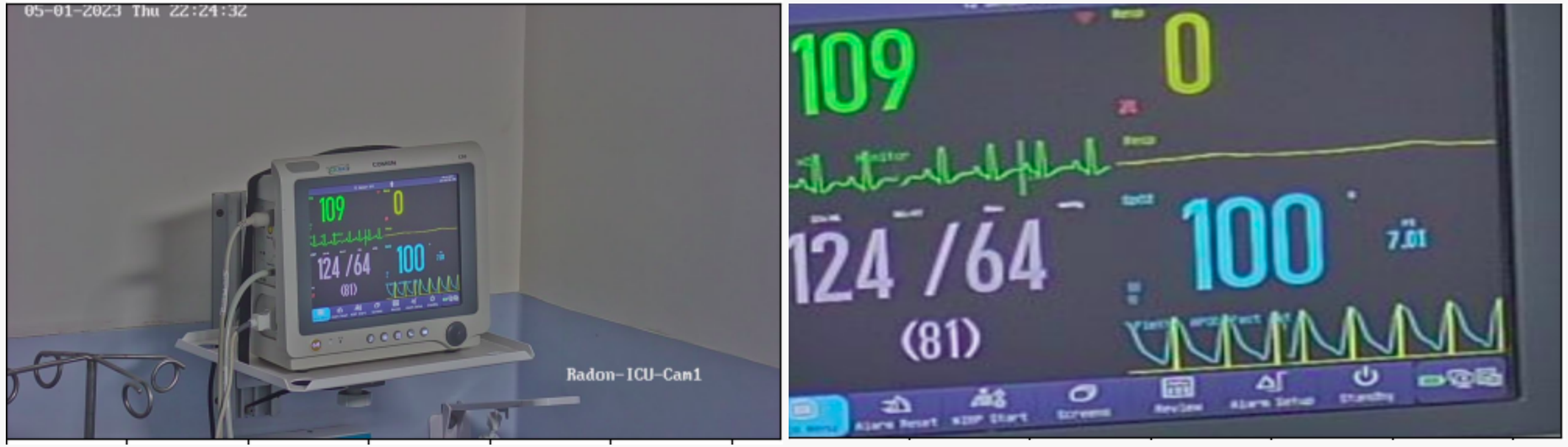
Perspective Transformation

- **Convex hull** and **Contours methods** for finding mask corners.
- **OpenCV perspective transform** for wrapped perception.



Left - Original Image, **Right** - Segmented and Perspective transformed image

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Step 2: Detection

- **YOLOv5nano** model - fast and lightweight
- Preprocessing and normalization done by the model itself
- **Inference time** (on CPU): 0.05 - 0.1 s

Top - Perspective Transformed Image
Bottom - Yolo Extracted Vitals and Graph

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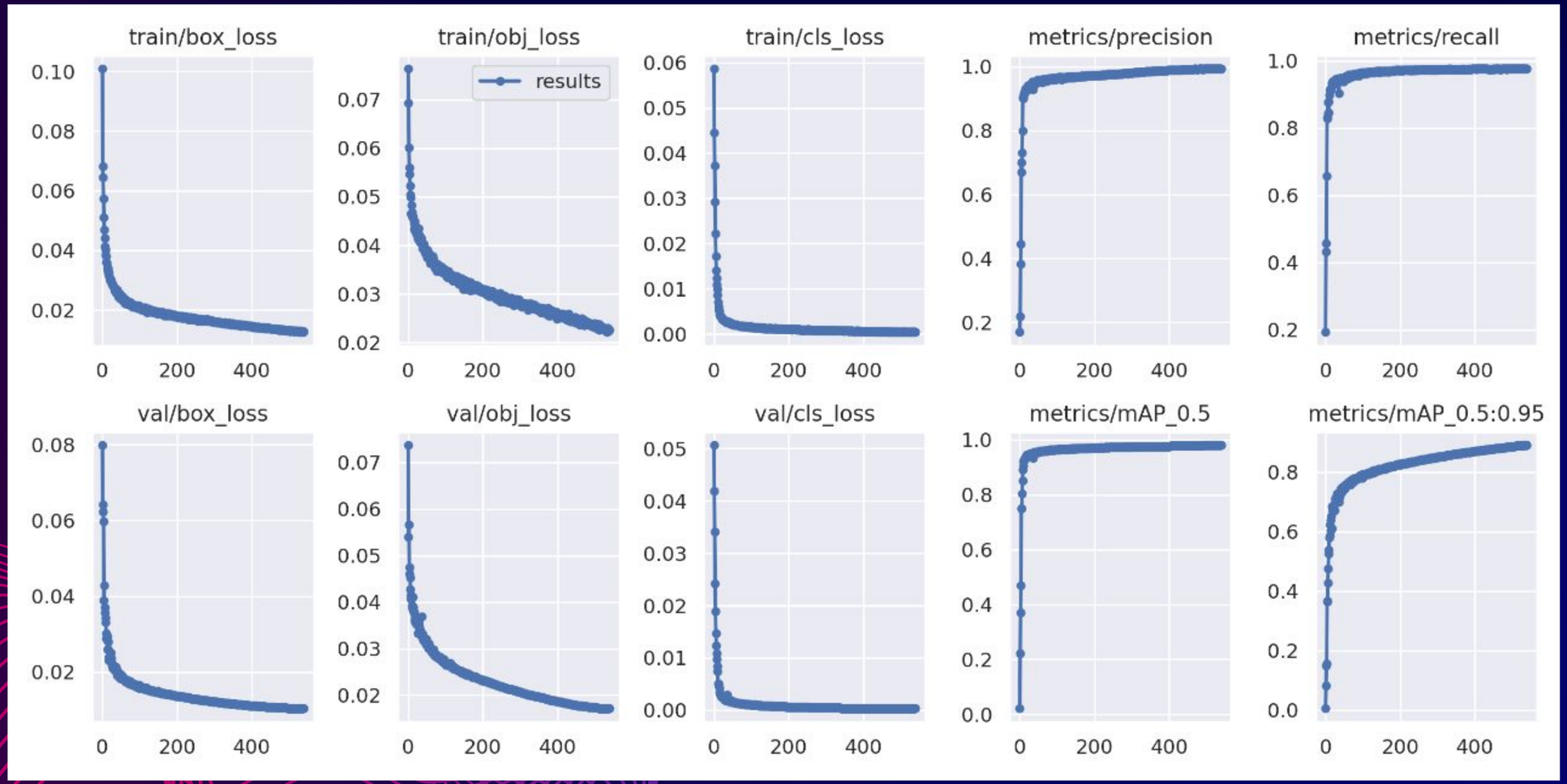
Metrics



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Step 3: Character Recognition

- **PaddleOCR**, an open source OCR model
- Performed **OCR recognition** for vitals from the bounding boxes extracted from YOLO.
- Done **post-processing** on the predicted results based on monitor layout info.
- **Inference time** (on CPU): 0.15 - 0.20 s

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PaddleOCR Framework

ODM OEM

ODM OEM

Image → Text Detection (db_mv3_slim, 1.4M) → Detection Boxes Rectify (dir_cls_mv3_slim, 0.5M) → Text Recognition (crnn_mv3_slim, 1.6M) → Output

1. Light Backbone
2. Light Head
3. Remove SE
4. Cosine Learning Rate Decay
5. Learning Rate Warm-up
6. FPGM Pruner

1. Light Backbone
2. Data Augmentation
3. Input Resolution
4. PACT Quantization

1. Light Backbone
2. Data Augmentation
3. Cosine Learning Rate Decay
4. Feature Map Resolution
5. Regularization Parameters
6. Learning Rate Warm-up
7. Light Head
8. Pre-trained Model
9. PACT Quantization

Source: Arxiv

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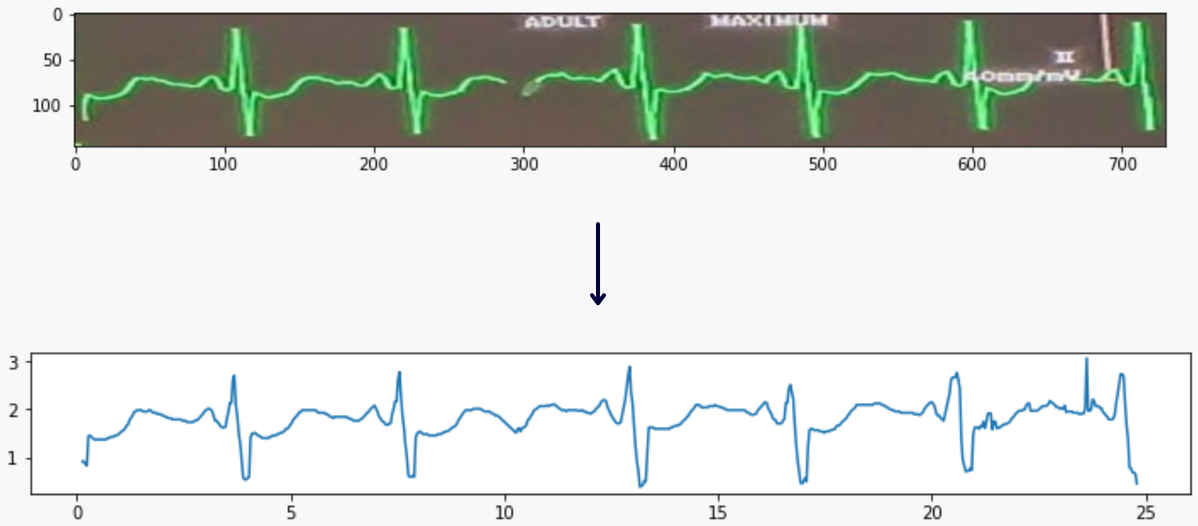
Graph Digitizing

- Python implementation of **WebPlotDigitizer**.

- WebPlotDigitizer - web based tool to extract numerical data from plot images or maps.



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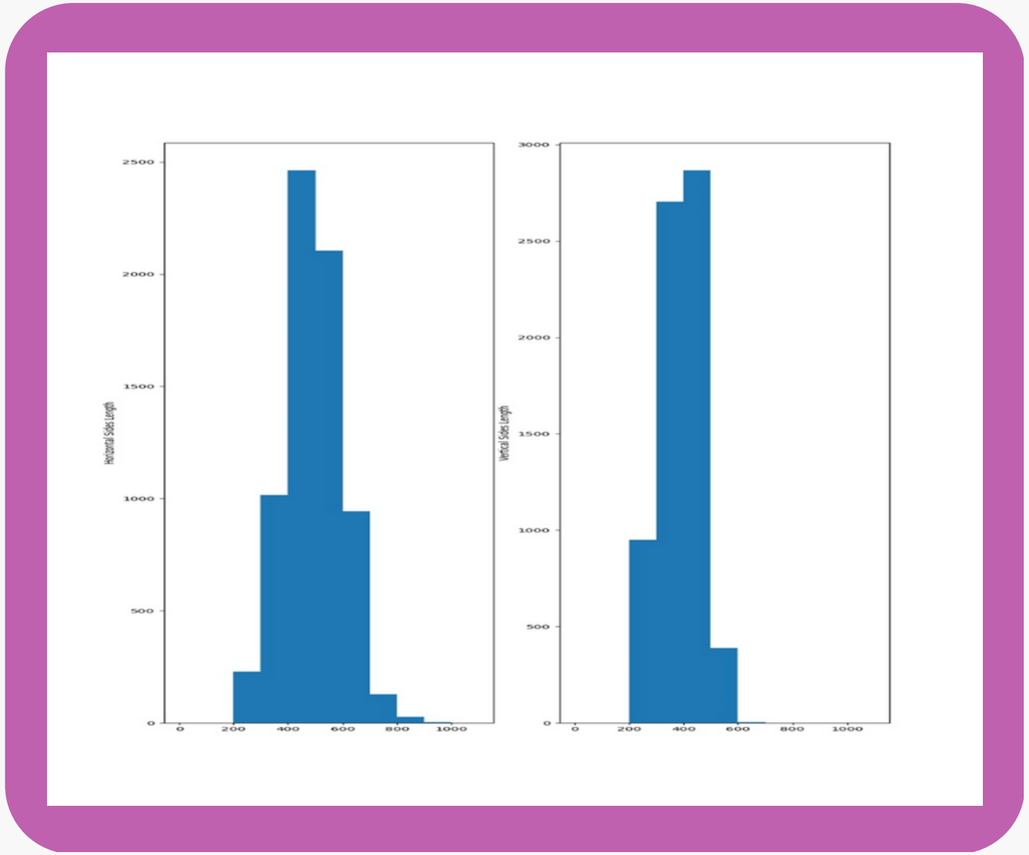
Novelty

In terms of Speed

- **Multiprocessing** during OCR recognition boosted speed by **2.5X.**
- **YOLOv5nano** for direct extraction of vitals very fast on CPU
- **Carefully chosen input size** - plotted histogram of both dimensions of extracted masks and took the mean of histogram as the optimal dimension for YOLO.



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Novelty

In terms of Accuracy

- **Post-processing** on the predicted results based on monitor layout info.
- **Segmentation instead of detection**
- **Semi-supervised** based segmentation approach to leverage unlabelled data.

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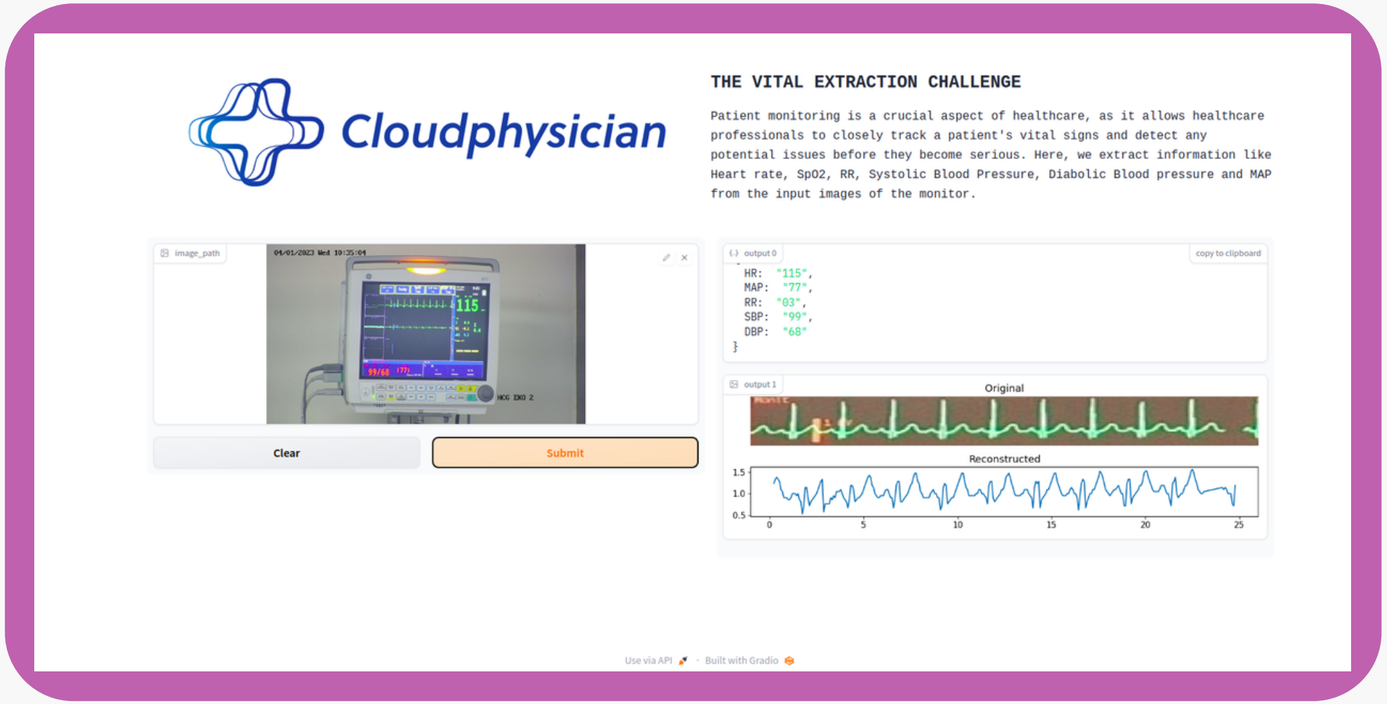
Novelty

In terms of Visualization

- **Gradio visualisation** to show results - a library which runs in Colab itself.

- Provides a localhost to drop images and get results.



Thank You