



Automated Construction Site Safety Violation Detection using Object Detection and Convolutional Neural Networks

TEAM 2 | Cuadra | Dolores



Introduction

Construction sites are high-risk areas where many accidents and fatalities occur due to human error, safety violations, and lack of proper PPE like helmets and vests, according to OSHA and NIOSH.

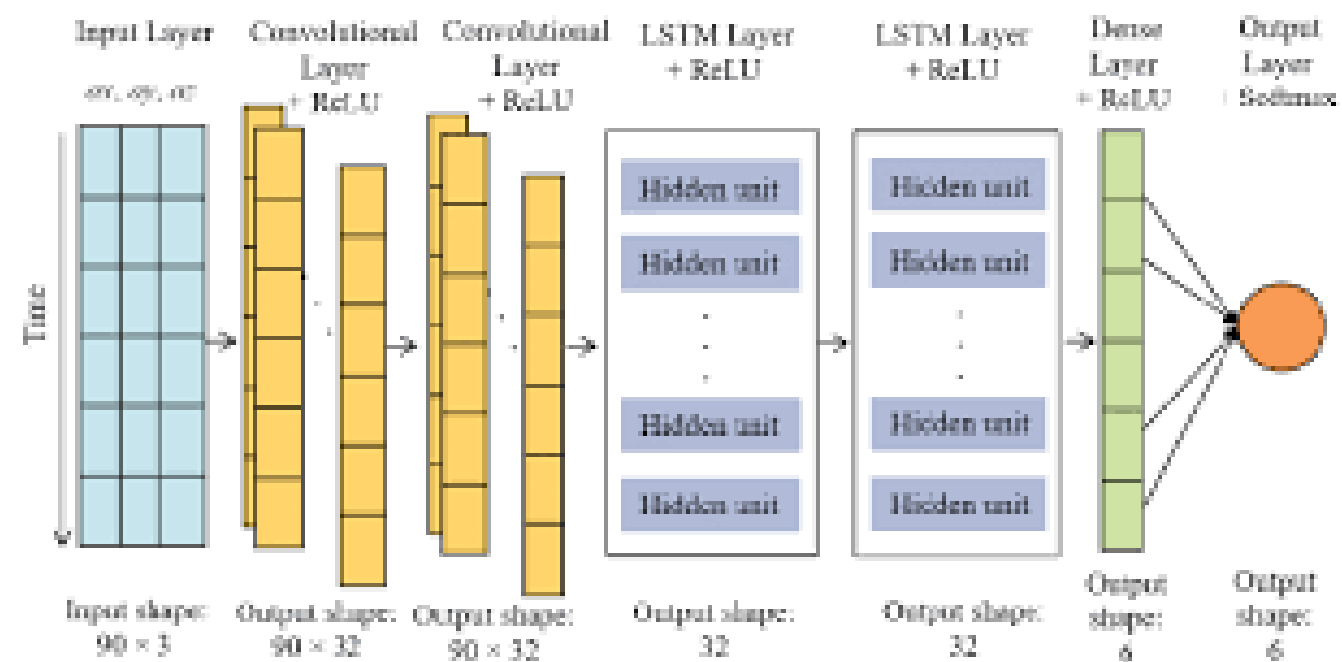


Motivation

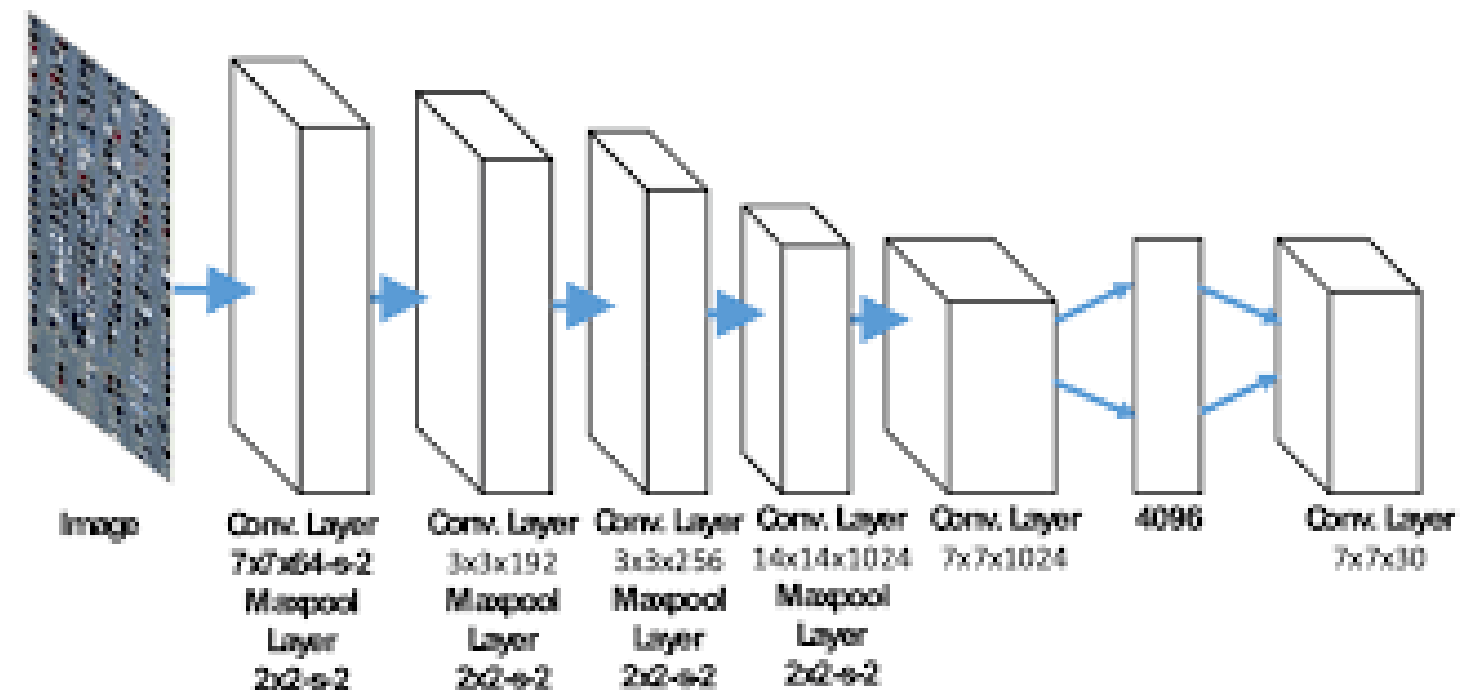
Manual monitoring is inefficient and error-prone. Automated systems can enhance safety by detecting violations in real-time.

Metric	Manual Monitoring	Automated AI Monitoring
Detection Speed	Slow (lag from human review)	Real-time
Accuracy	70–80% (human error)	90–95% (AI model accuracy)
Coverage	Limited (small teams)	Full camera coverage 24/7
Cost Over Time	High (labor-intensive)	Lower (after deployment)

Proposed Solution



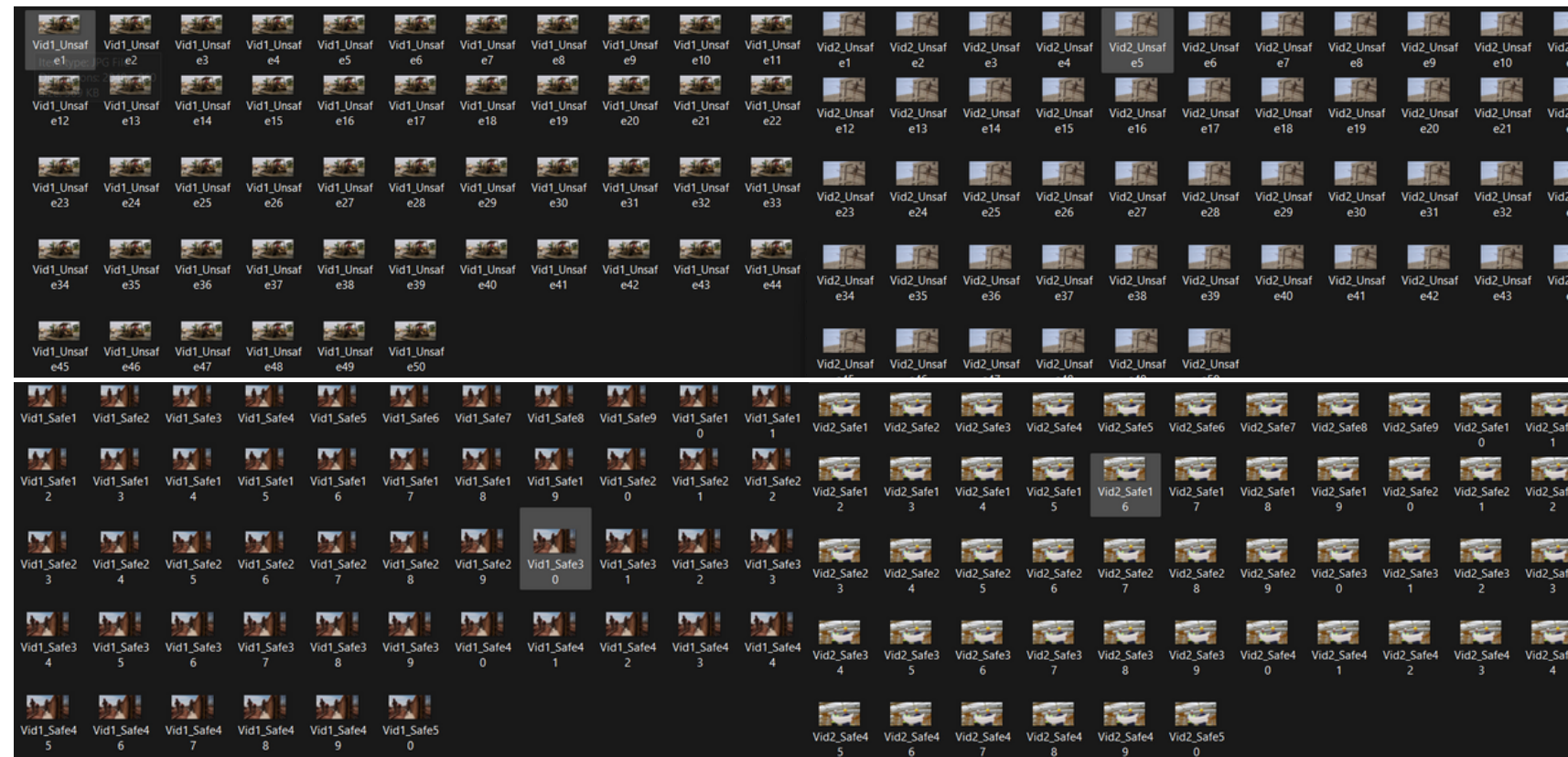
CNN-LSTM for
classification whether the
Construction Site is Safe or
Not



Object Detection for
Detecting PPEs from the
Workers

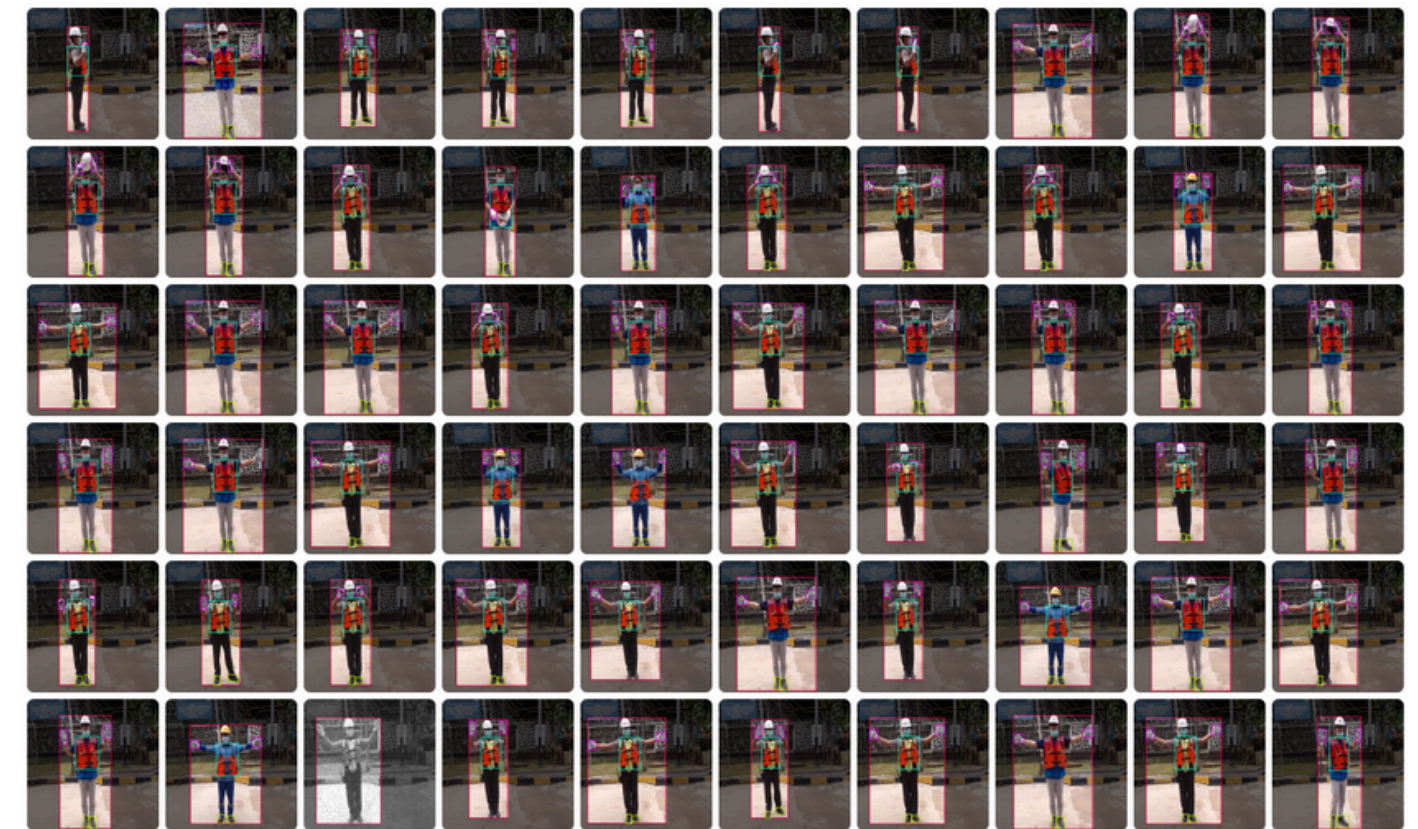
Data Set

For the CNN-LSTM network dataset we collected video then we separated it into frames for the sequence data



1399 Total Images

Train 989 Valid 262 Test 148



For the Object Detection, the dataset was retrieved from the roboflow

Results

In the three CNN models the Custom CNN-LSTM model have reached the highest Validation Accuracy whereas the two models did not pass the 90% threshold

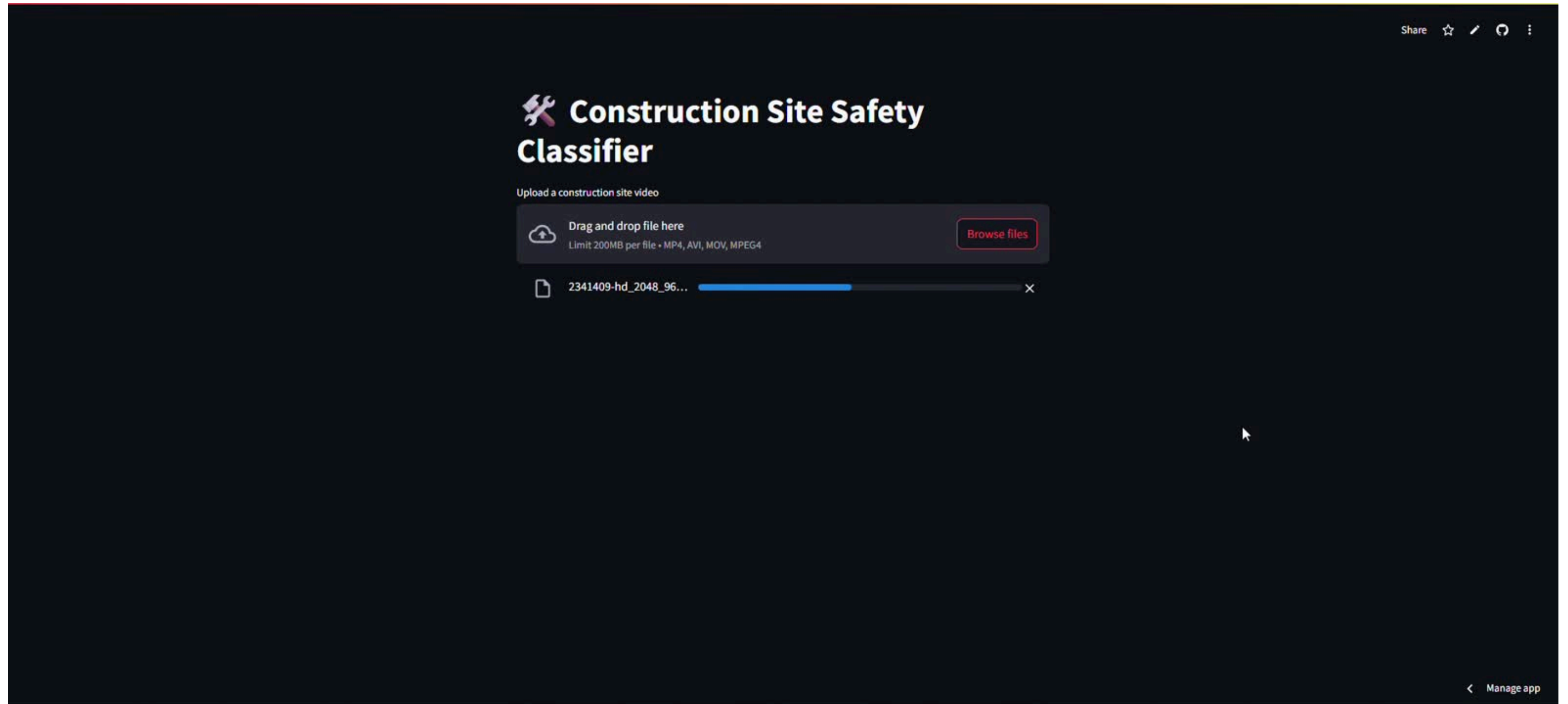
Validation Metric	Models		
	Custom CNN-LSTM	CNN-Bidirectional LSTM	NASNetMobile
Train Accuracy	94.37%	97.08%	96.33%
Validation Accuracy	92.05%	85.17%	83.53%

Results

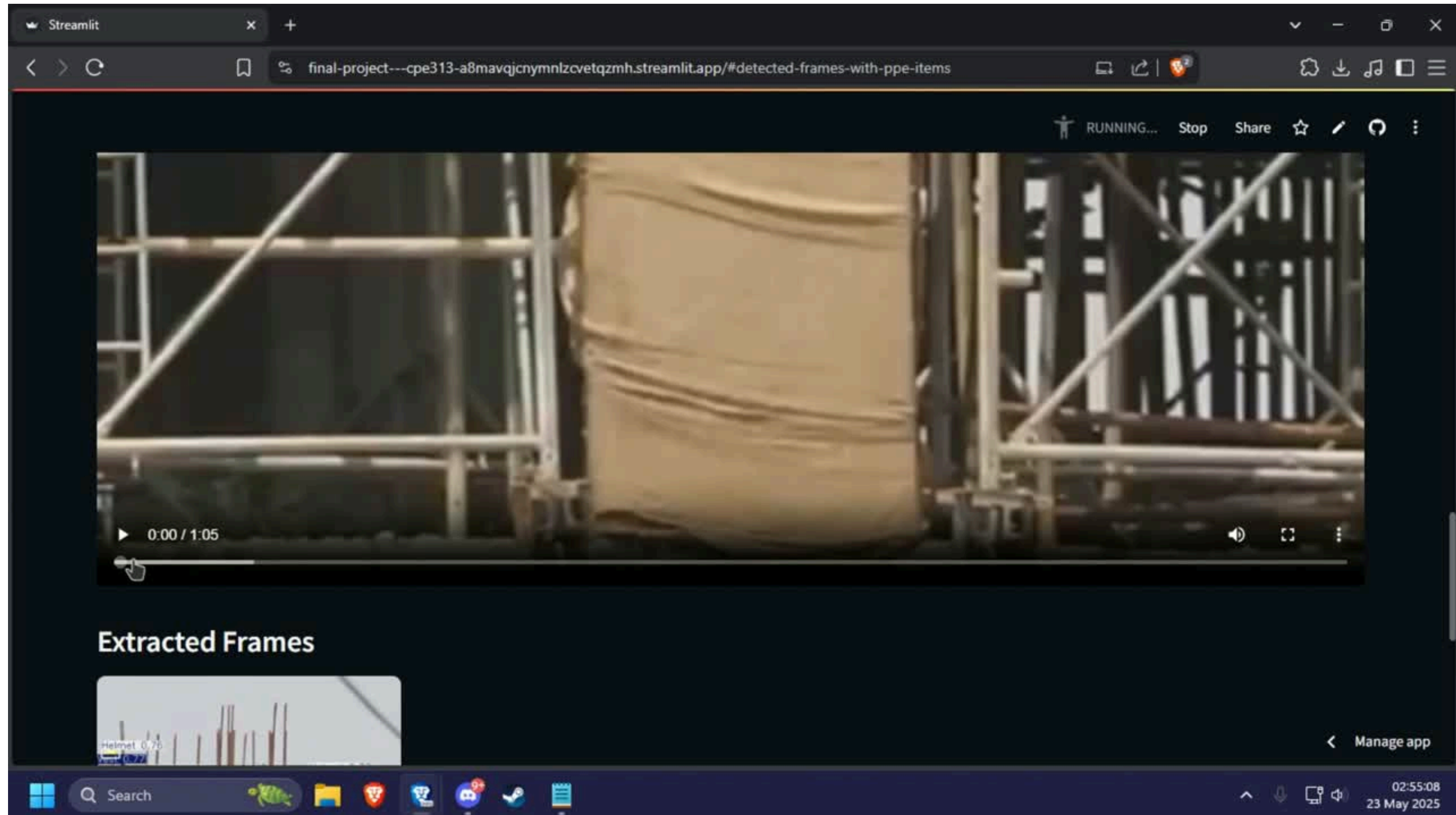
Validation Metric	Models		
	YOLOv8n	RTDETR-L	RetinaNET
mAP50	91.7%	94.2%	89.1%
mAP50-95	71.2%	73.4%	57.5%

The three object detection models were compared using validation mAP50 and mAP50-95 scores. RTDETR-L achieved the highest mAP50 of 94.2% and mAP50-95 of 73.4%. This suggests that the RTDETR-L is overall better at pinpointing each PPE item class.

StreamLit Deployment



StreamLit Deployment



Links:

Dataset:

<https://drive.google.com/drive/folders/10zQvWGMcO5UQeQbbR5v6c3hk-d2cEBvt?usp=sharing>

StreamLit:

<https://modelsatasci.streamlit.app/>

Colab Ntbks:

https://colab.research.google.com/drive/17cnysmh2xG5ZgLHQB92St4Zz_ef_950U?usp=sharing
<https://colab.research.google.com/drive/1EdtvPw6tPhIHh5EcY0aLBQ2DQgUyTbGZ?usp=sharing>

<https://colab.research.google.com/drive/13gLrRJZFmMASfvnN-FMJ1FnctUyhzOnY?usp=sharing>

Dataset:

<https://universe.roboflow.com/randomlangyan/ppe-project-7brvs/dataset/1>

StreamLit:

<https://final-project---cpe313-a8mavqjcnymnlzcvetqzmmh.streamlit.app/>

Colab Ntbks:

<https://drive.google.com/file/d/1XpVrkPxEUTex2XFIC-gz2Z7wbz84aQcM/view?usp=sharing>