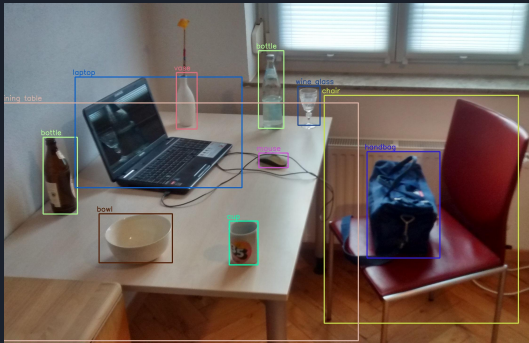# Object Detection on 360 Videos for Firefighting

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What is it?

Object Detection

360 Degree Videos

Firefighting

Previous Work

General Firefighting

- Implicit Coordination in Firefighting Practice: Design Implications for Teaching Fire Emergency Responders.

Deep Learning in Firefighting

- A Deep Learning Framework for Detection of Targets in Thermal Images to Improve Firefighting
- Embedded Real-Time Object Detection for a UAV Warning System
- Towards Monitoring Firefighting Teams with the Iphone

Previous Work

Remote Incident Command

- An Investigation of Operational Decision Making in Situ: Incident Command in the U.K. Fire and Rescue Service

Emergency-Related Objects

- CORE: A Dataset of Critical Objects for Response to Emergency

Overview

- We have created a list of objects to look for in the 360 videos to annotate.
- The objects relate to the safety of firefighters, civilians and to firefighting in general.
- Each frame from every video was annotated according to the list that we created.
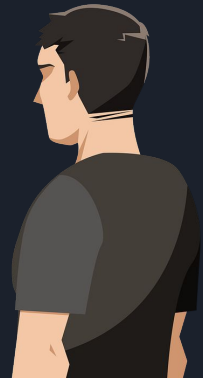
Novelty

- Our project takes into account the safety of firefighters and civilians
- The list of objects is extensive
- The project introduces a new method of annotating 360 videos
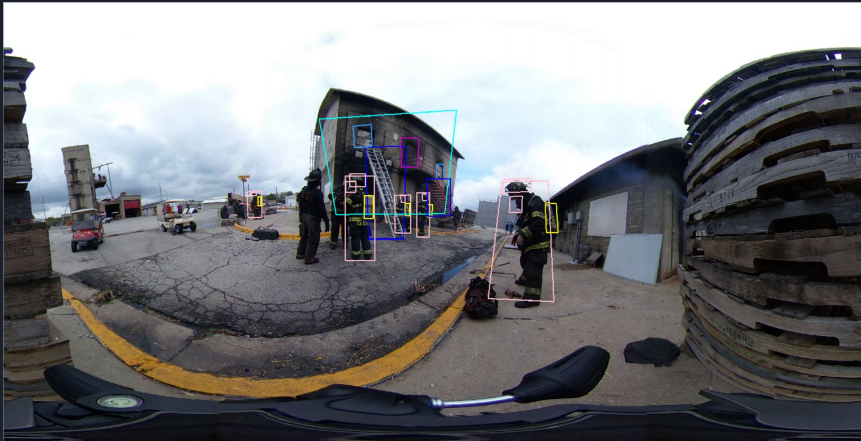
Research Activity

- A data set of 360 degree videos of firefighter training
- Frames at the rate of 1, 2, or 5 seconds were obtained from the videos for a total of 2,712 frames
- A list of objects to annotate the frames was collected
- Modified a tool to annotate these objects onto the frames collected
- Evaluated whether an existing deep learning object detector (YOLO) would work on our annotations

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List of Objects

1. Firefighter
2. Civilian
3. Ladder
4. Fire
5. Window
6. Oxygen Tank
7. Door
8. Gas Tank
9. Fire Truck
10. Firefighter Helmet
11. Firefighter Mask
12. Civilian Car
13. Trees
14. Water Hose
15. Building
16. Fence
17. Stairs
18. Water
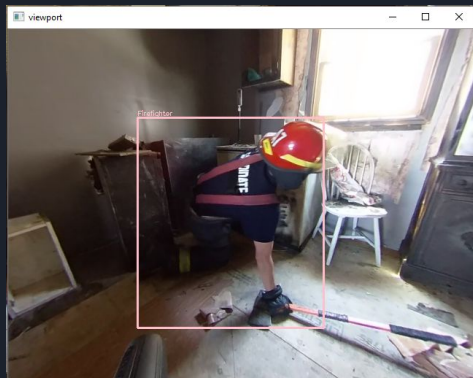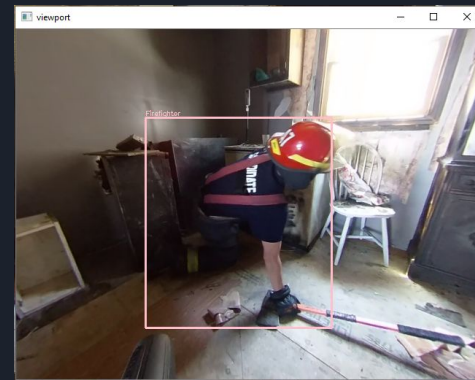19. Structural Damage
20. Smoke

Equirectangular 360 degree Video

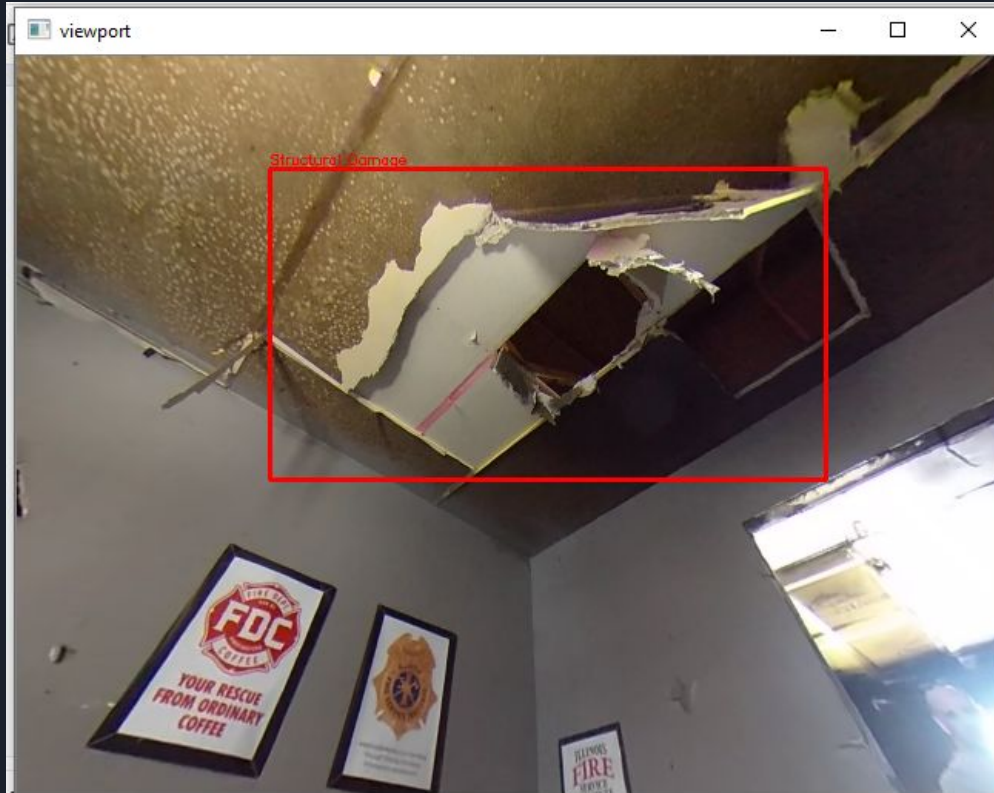# Equirectangular 360 degree Video

Solution: Viewport Annotation
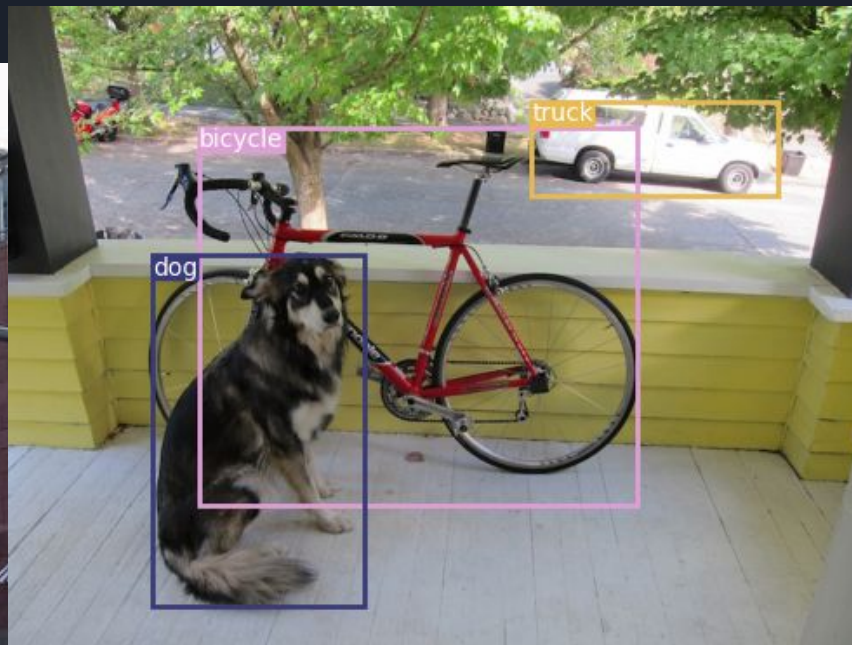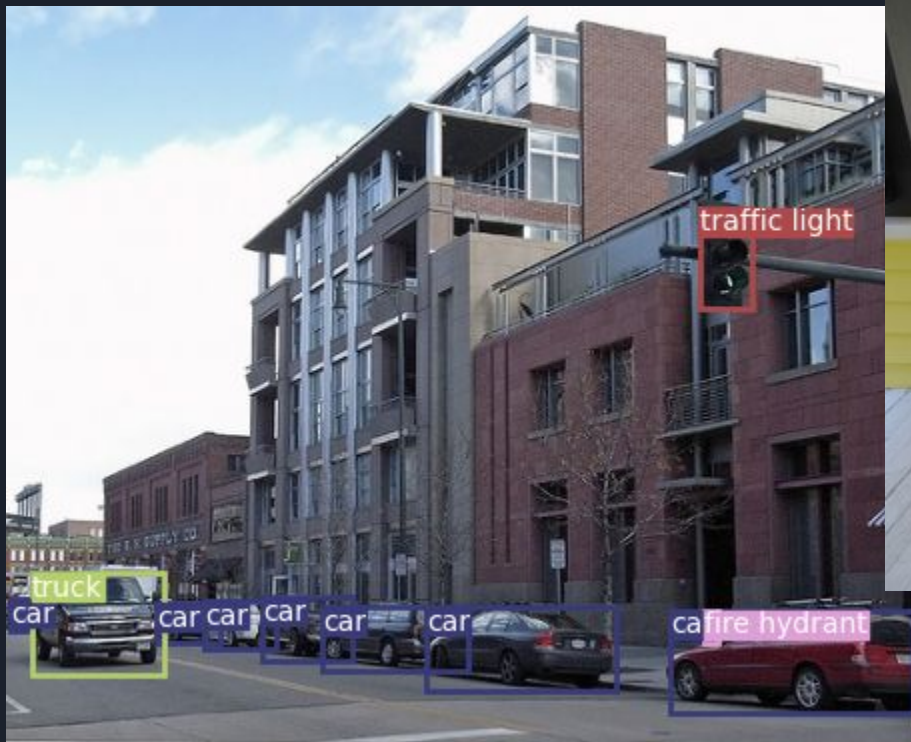
Solution: Viewport

YOLO and COCO

YOLO Classes vs Our Classes

Person -> Firefighter/Civilian

Car -> Civilian Car

Truck -> Fire Truck

68 Images Through YOLO:

68 Images Through YOLO:

Evaluation

	Object Is There	Object Not There
Object Is Detected	**True Positive**	**False Positive**
Object Not Detected	**False Negative**	

Evaluation

	Object Is There	Object Not There
Object Is Detected	**True Positive**	**False Positive**
Object Not Detected	**False Negative**	

Precision = TP/(TP + FP)
   How many identified objects were right?

Recall = TP/(TP + FN)
   How many right objects were identified?
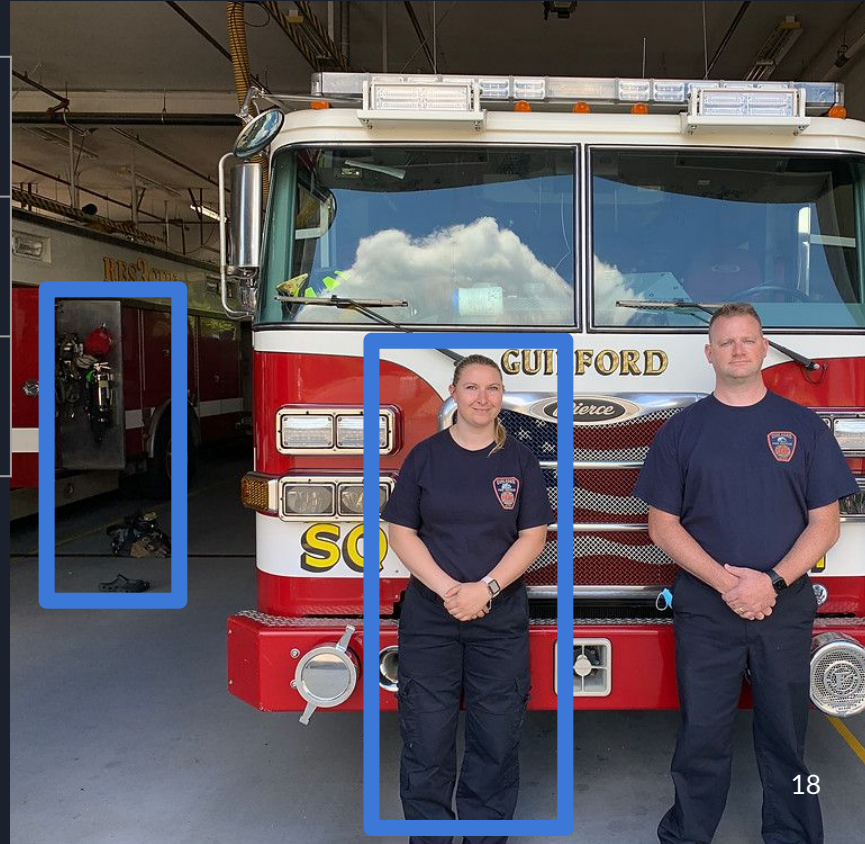
YOLO Results

Class	TP	FP	FN	Precision	Recall
Person	296	9	225	0.970	0.568
Car	2	1	35	0.667	0.054
Truck	22	2	38	0.917	0.367

Shows need for firefighting and 360-video specific object detector

Conclusion

Novel Combination

Our Contribution: Annotation Tool and Dataset

Future Work: Firefighting & 360-specific object detector