

# Obstacle Detector for Level Crossing using Infrared Camera and Image Processing

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# Level Crossings in Japan

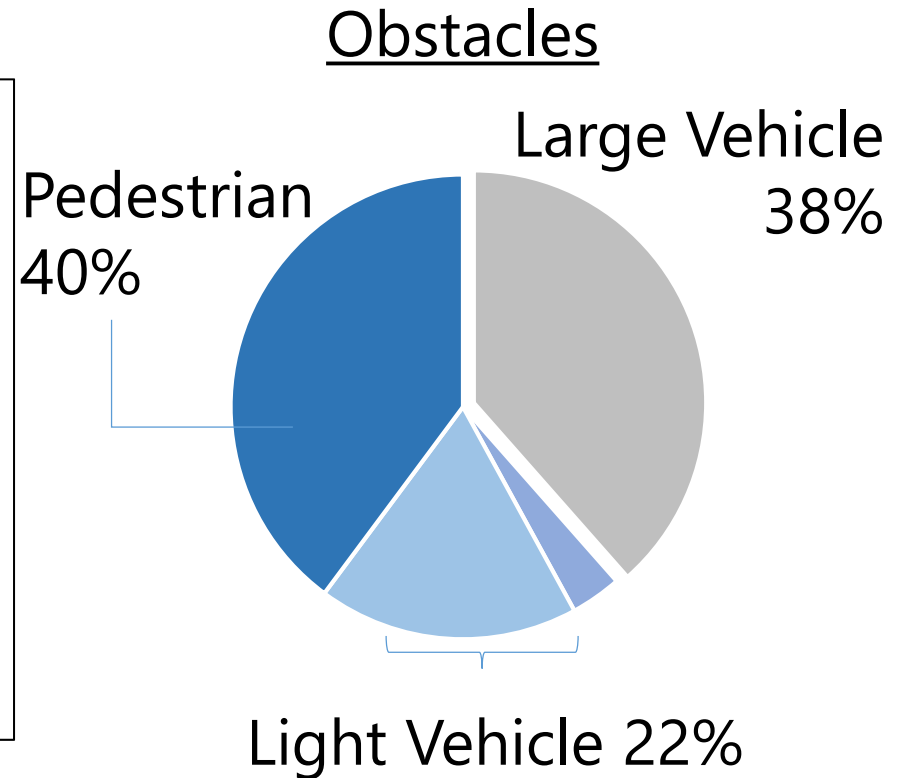
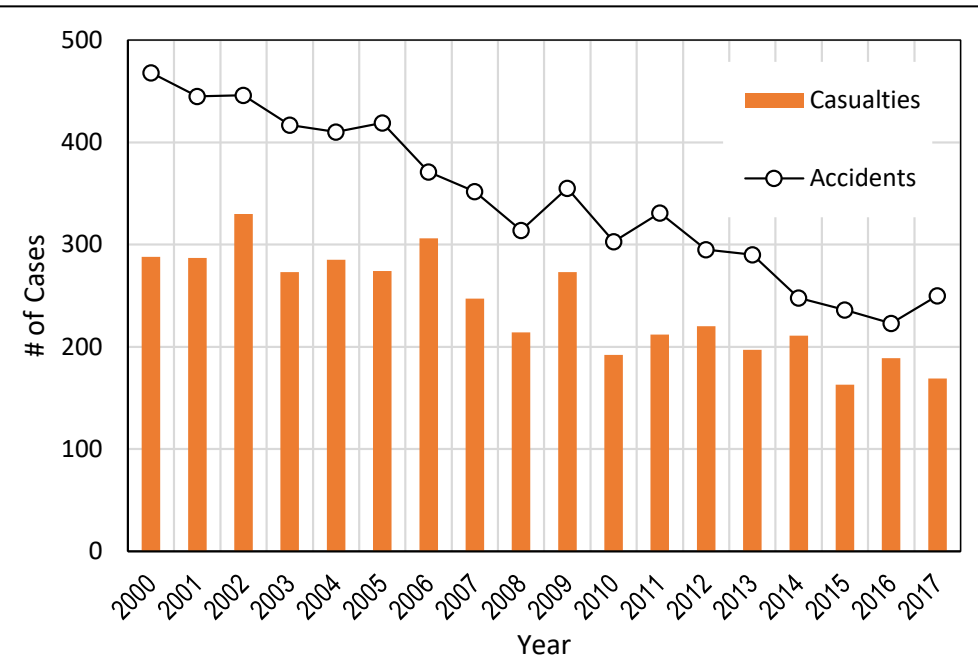


Total  
> 33,000

90%  
Automatic Barriers  
27%  
Obstacle Detectors

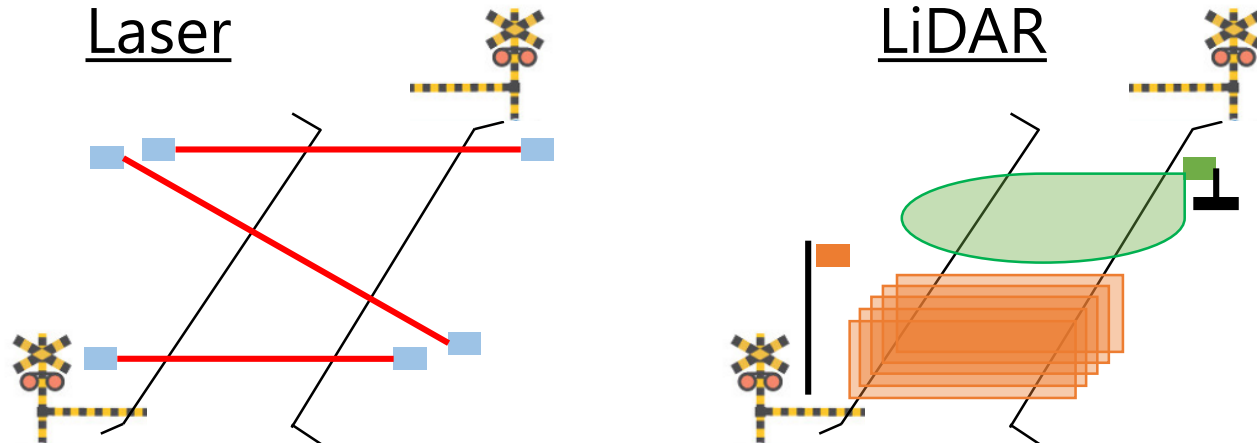
	Inner Tokyo	London	Berlin
# of LCs	620	13	46
Population M	9.14	8.31	3.38
Area km2	623	1,572	892

# Accidents at Crossings



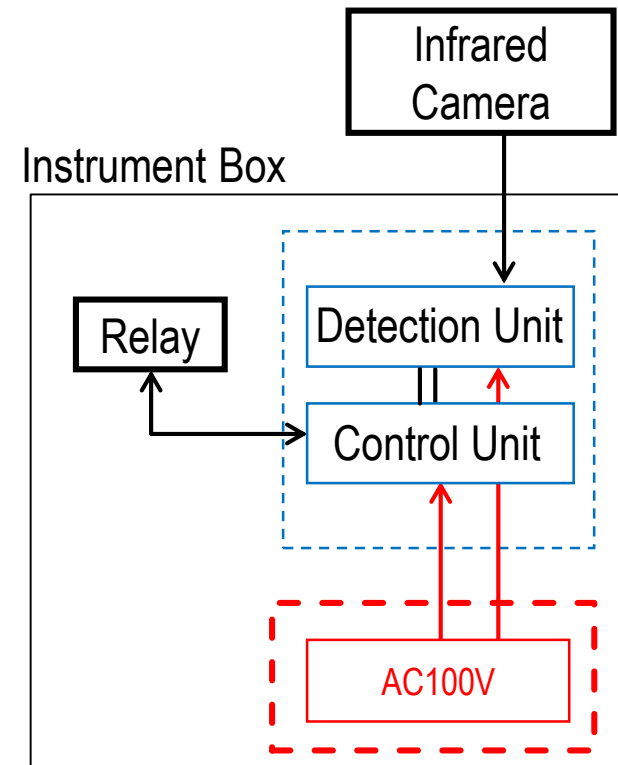
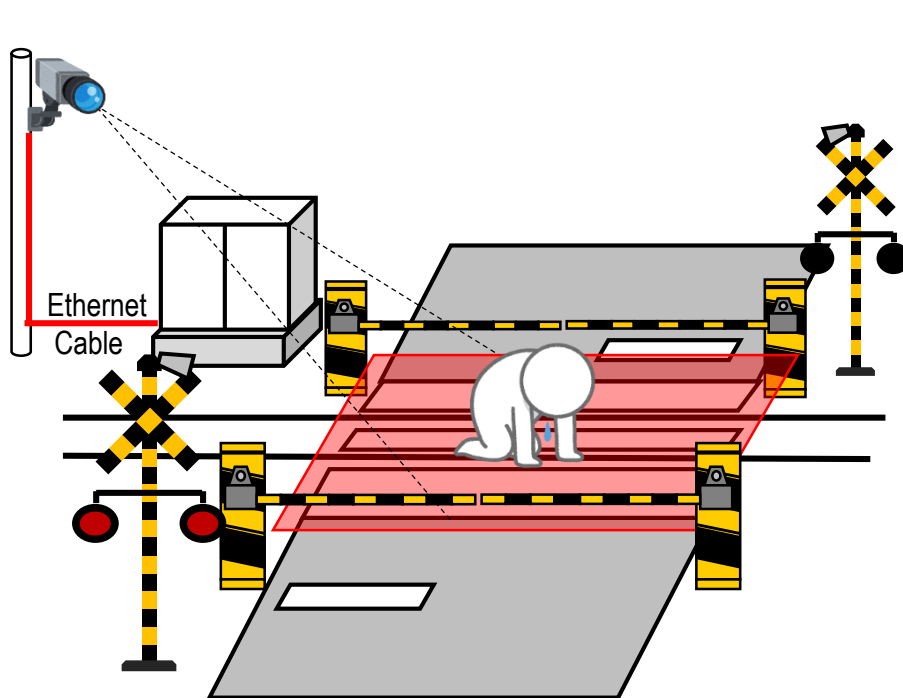
- Steady decrease in overall # of accidents
- Shift in public concern : Vehicles  $\Rightarrow$  Pedestrian

# Conventional ODs



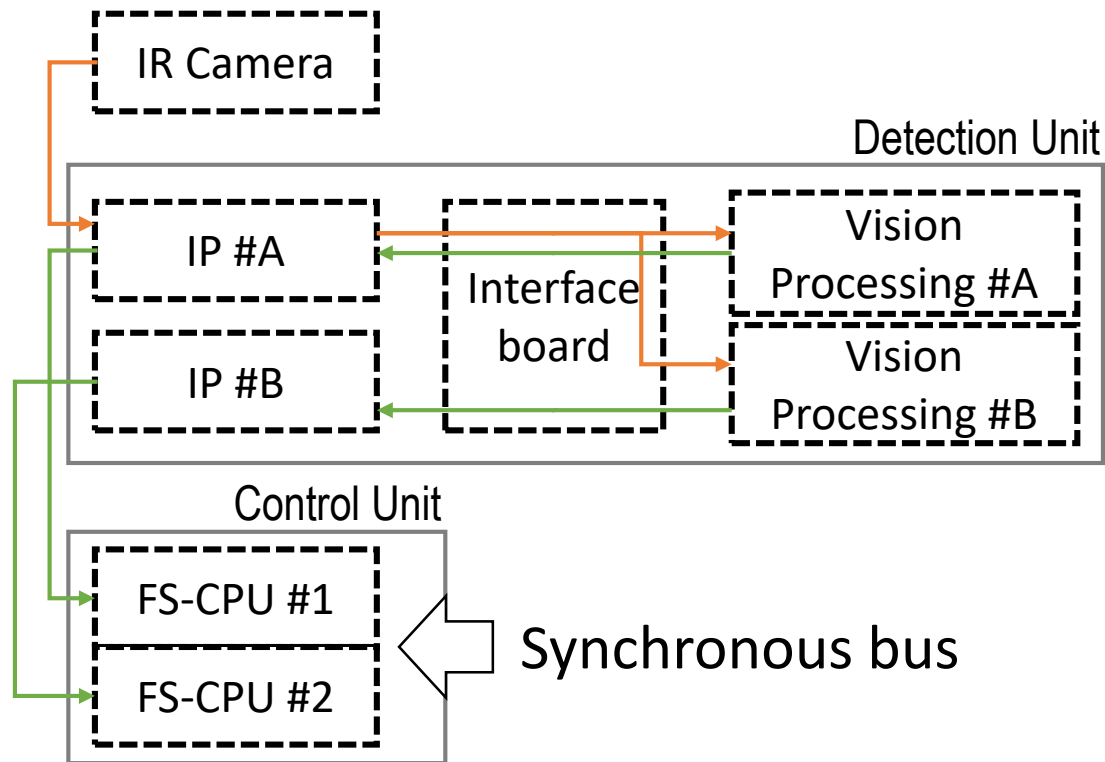
- Initial design : Detect large vehicles
- High Reliability, High Cost (> 120,000 € per LC)

# Proposed System



- Initial design : Detect pedestrians in need
- High measurement resolution with limited blind spots

# Proposed System



- VP boards A and B are mounted with same algorithm
- Comparison between system A and B to check liveness

# Infrared Imaging

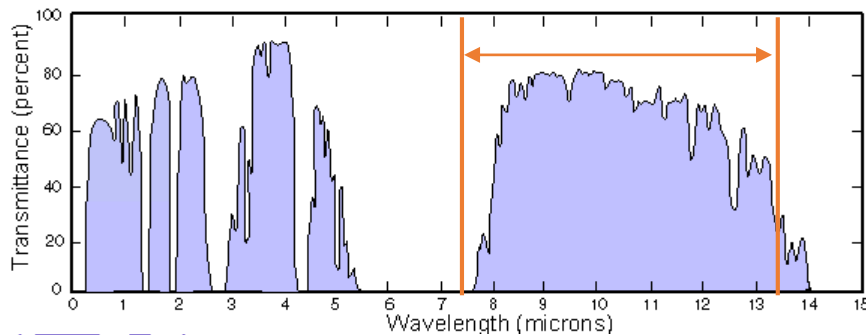
## Infrared Image



## Color Image



## Atmospheric window



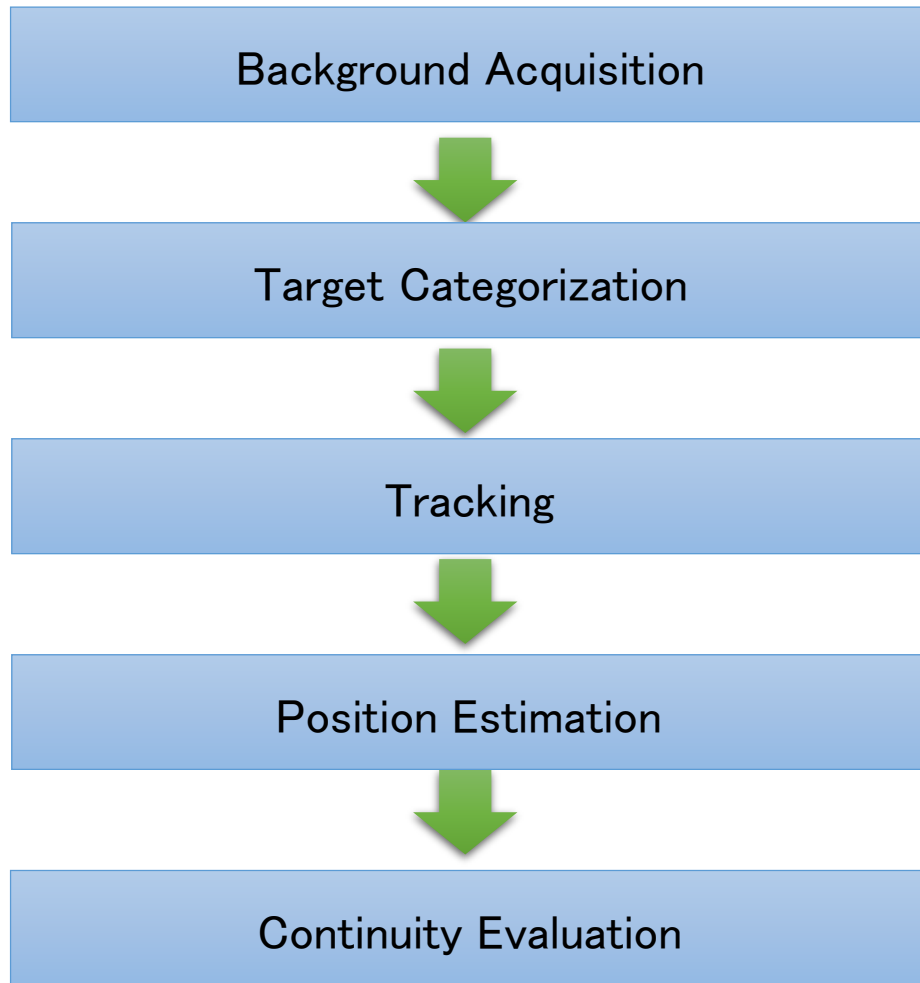
Spectral range:

7.5 – 13.5  $\mu\text{m}$

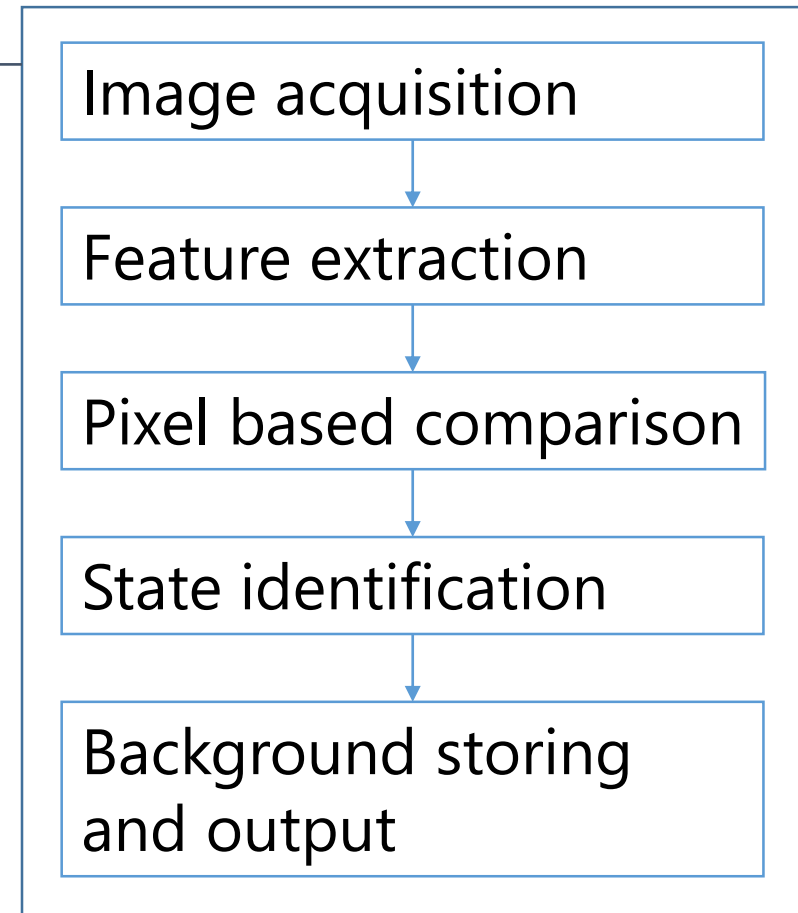
Resolution:

640 \* 480 px

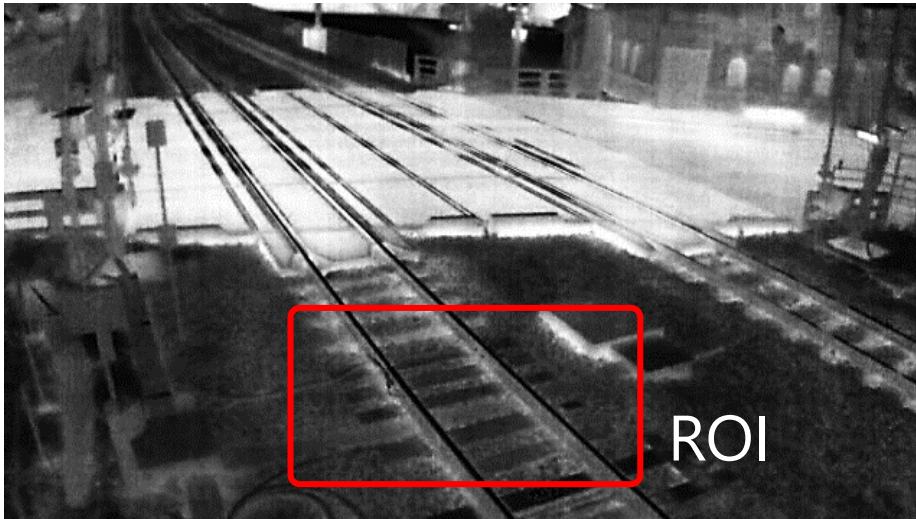
# Image Processing



## Background Subtraction



# Specific Features

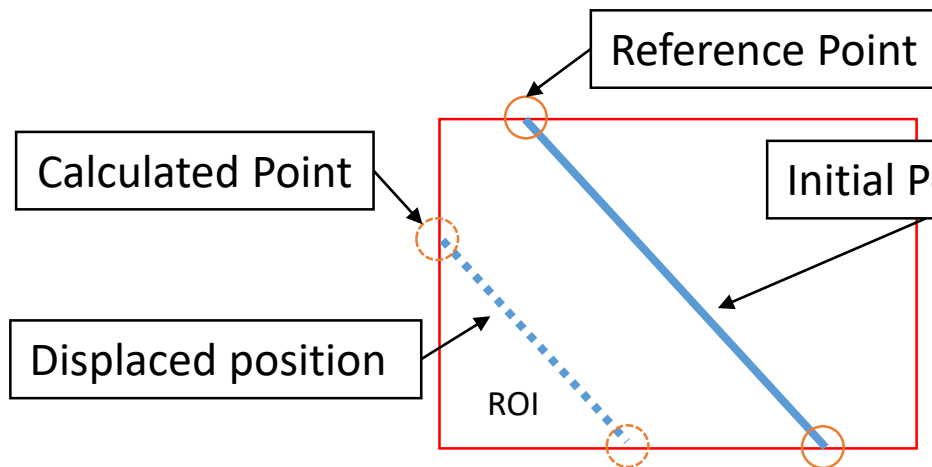


## Camera Movement Detection

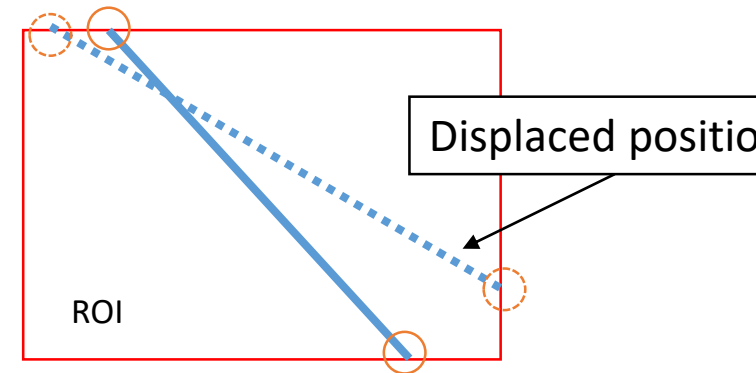
Area configuration

Line extraction

Point calculation and verification



(Parallel displacement)



(Rotation)

# Evaluation

		<u>True State of LC</u>	
		with Obstacle	Obstacle Free
Detection Output	1	True Positive	False Positive
	0	False Negative	True Negative

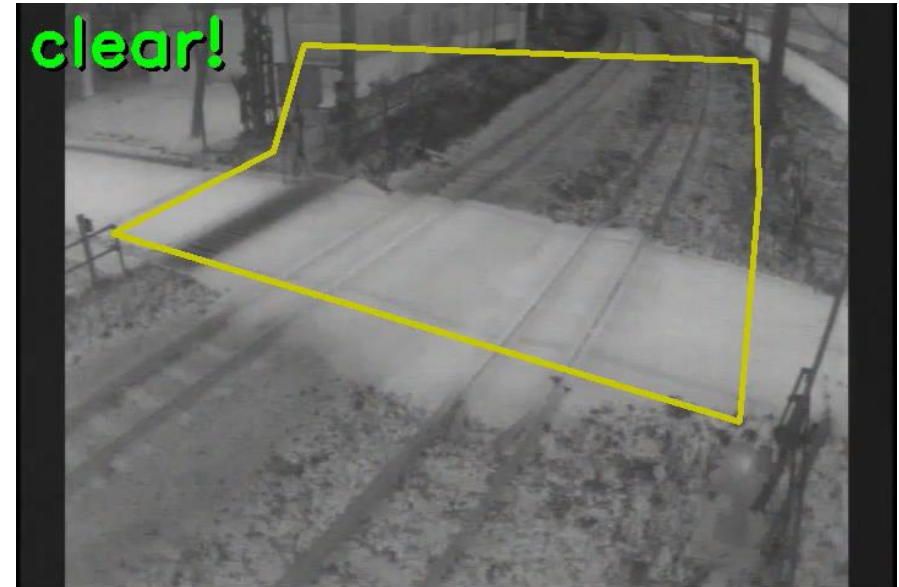
## Evaluation Criteria

- Detection Rate = # of FP / Total # of frames with obstacles
- False Detection Rate = # of frames with FP / Total frames evaluated
- Continuity of FN output (Max # of continuous FN )

# Basic Evaluation



## Detection in rain



Weather : Rain

Outside Temp : 16 °C

Surface Temp (BG) : 22 °C

Surface Temp (FG) : 23 °C

- Total frames obtained : 20,968
- # of frames with target : 6,482
- Detection Rate = 100% False Detection Rate =  $17/20968 = 0.08\%$

# Basic Evaluation

## Detection in snow



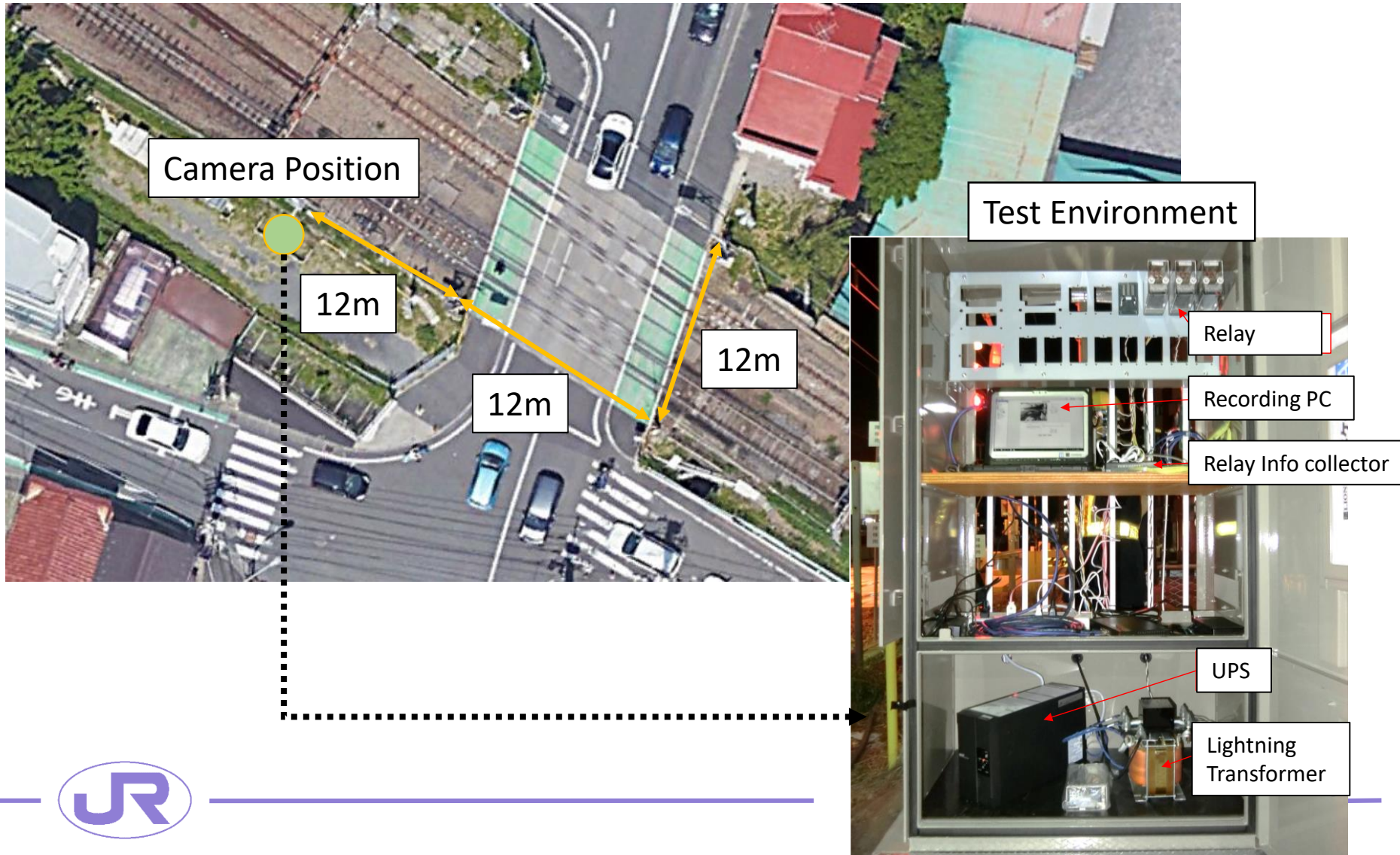
## Main cause of FP



Weather : Snow  
Outside Temp : -5 °C

- Total frames obtained : 50,000
- # of frames with target : 2,496
- Detection Rate = 100% False Detection Rate =  $1341/50000 = 2.7\%$

# Additional Study



## Conclusion

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- Proposed a method to detect pedestrians inside level crossings using image processing.
- Introduced basic equipment configuration and detection method for safe operation.
- Basic evaluation and additional study show proposed method is highly effective in detecting pedestrians, compared to conventional ODs.