# Active Robot Vision with Perception-Aware Navigation for Worker Monitoring

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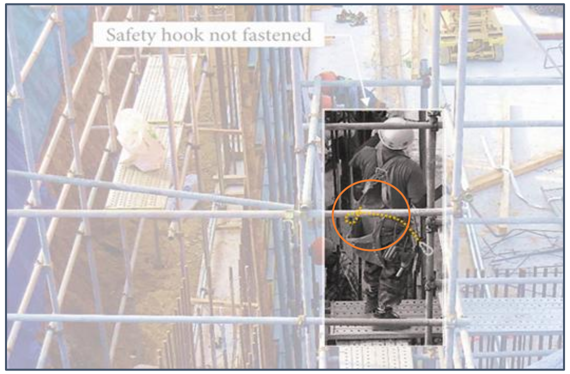
# Research Background

## ▪ Computer Vision Applications for Safety Monitoring

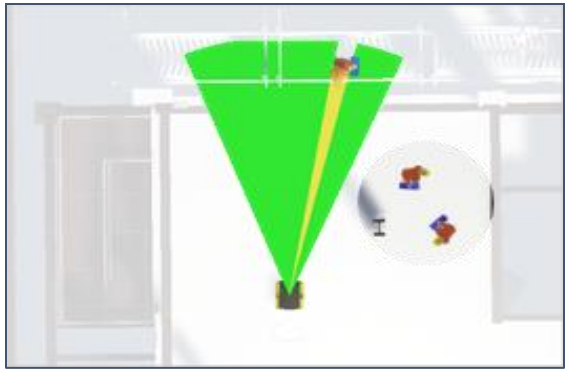
- Vision sensors are used for **verifying personal protective equipment (PPE) compliance through object detection models** on construction sites.
- Fixed-viewpoint monitoring systems struggle **with occlusion** and **limited Field of View (FoV),** which hinder accurate detection and classification(Paneru et al., 2021).



**[ Occlusion by Obstacle ]**

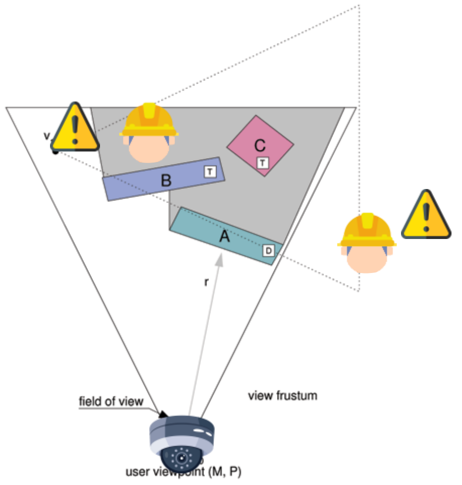



**[ Self-Occlusion ]**



**[ View Occlusion ]**

✓ Types of Occlusion Problems

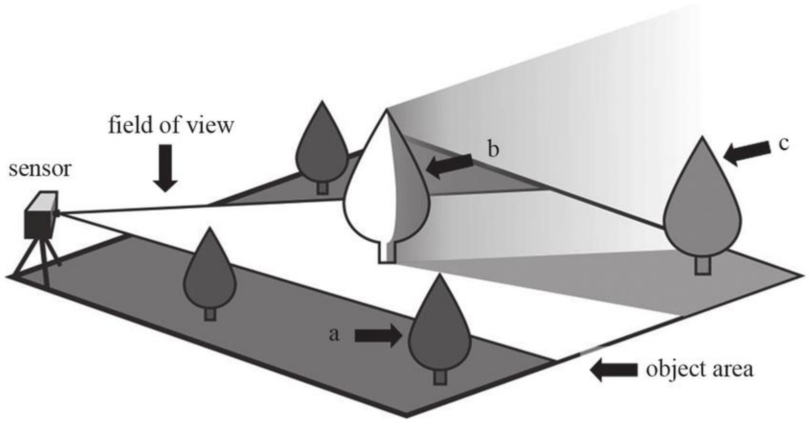



✓ Occlusion problem

# Research Background

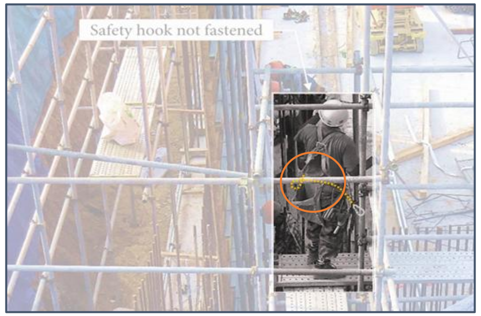
## ▪ Computer Vision Applications for Safety Monitoring

- Fixed-viewpoint monitoring systems struggle with occlusion and limited Field of View (FoV), which hinder accurate detection and classification(Paneru & Jeelani, 2021).
- These limitations, influenced by object angle, position, and environmental factors, reduce detection reliability and system performance.

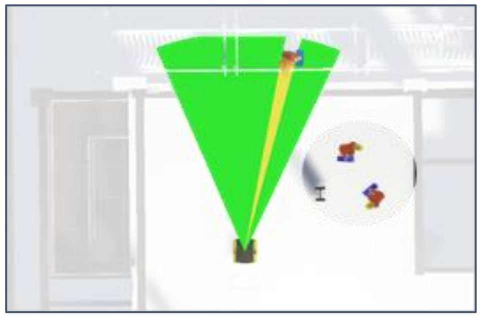



✓ Occlusion


[ Occlusion by Obstacle ]




[ Self-Occlusion ]



[ View Occlusion ]

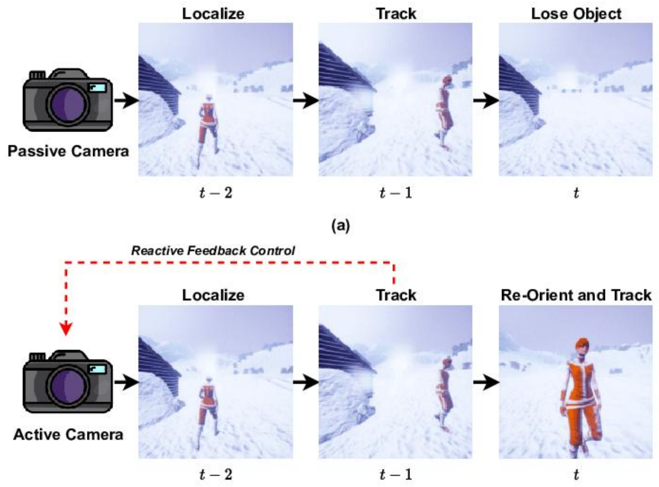
✓ Types of Occlusion Problems

## ▪ Active Vision: Related work

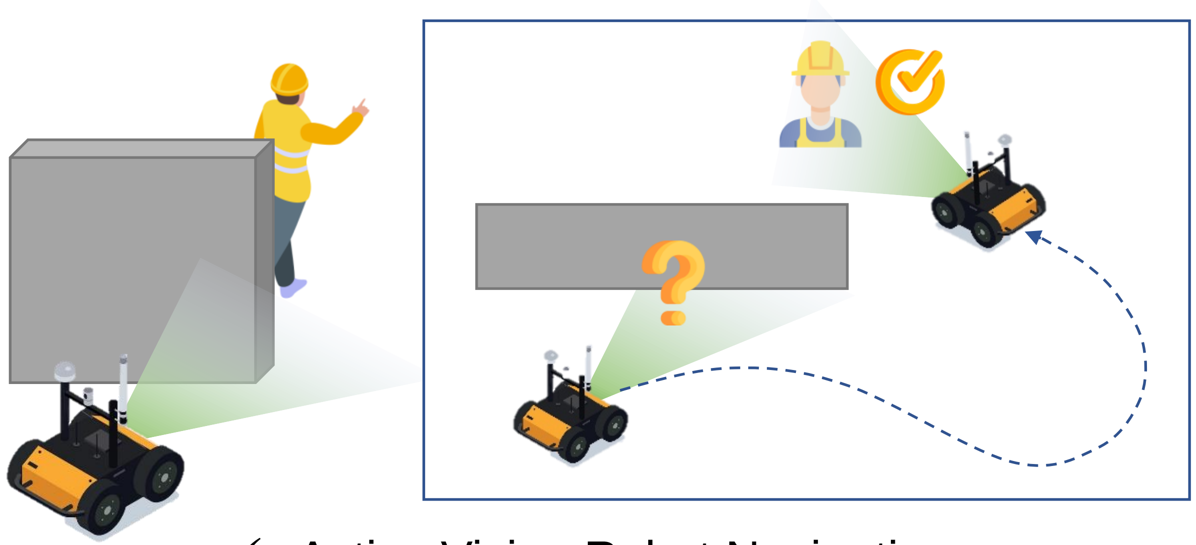
- Mobile robots offer a solution through dynamic repositioning called ‘Active Vision’ (Zhang et al., 2022).

    1) The physical movement of the camera to dynamically collect more information about the environment, allowing it to overcome the limitations of FoV without additional visual devices.

    2) It should be learned to move actively while continuously checking the surrounding environment according to the robot's own goal.




✓ Concept of Active Vision



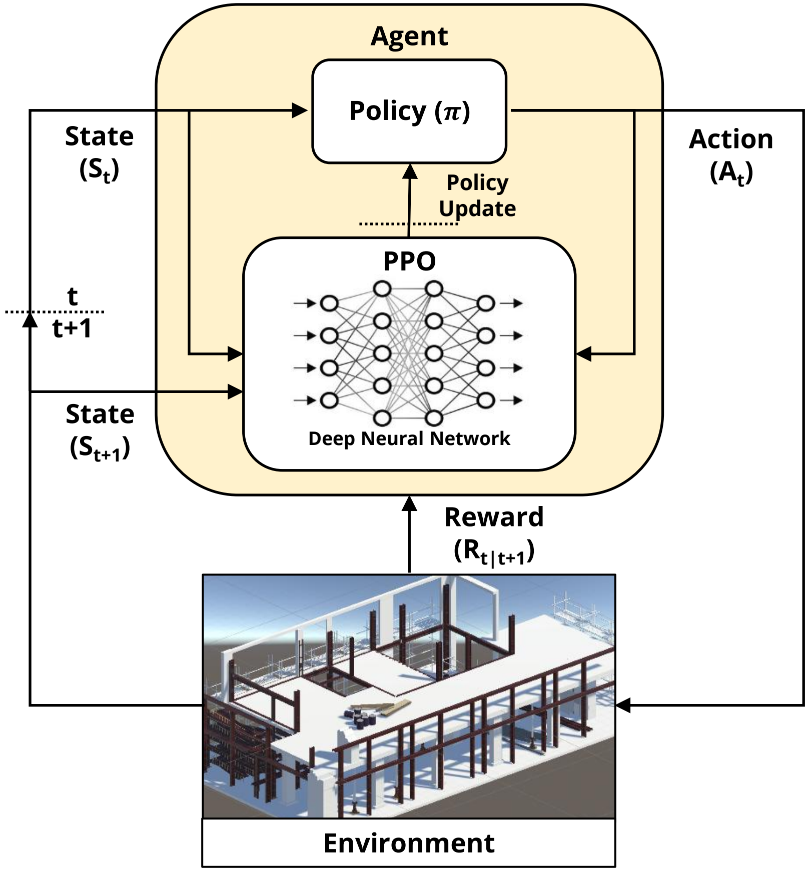
✓ Active Vision Robot Navigation

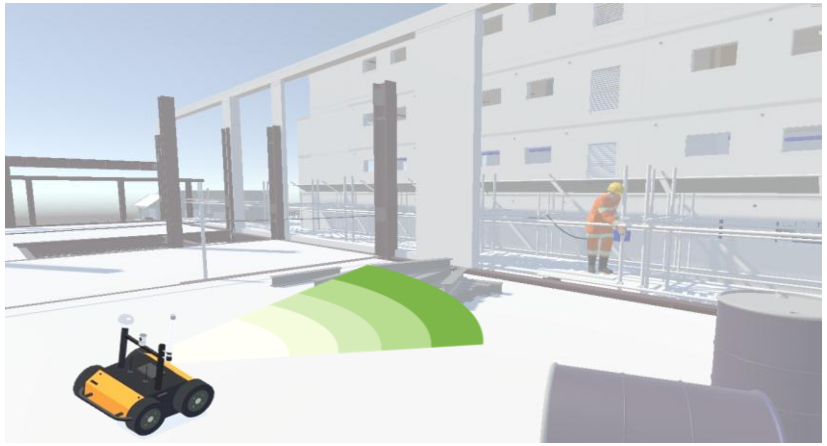
# Research Framework

## ▪ Research Framework

- It focuses on the detection of PPE compliance that may cause self-occlusion during safety monitoring.
- The path planning, in which the robot finds the best viewpoint to locate the target within its detection field, was learned through reinforcement learning DRL.

✓ Reinforcement learning framework



✓ Detection Field


✓ PPE

# Experiments

## ▪ Evaluation Metrics

- Success Rate (SR): the proportion of episodes in which object detection exceeds a predefined confidence threshold 0.8.

$$SR = \frac{1}{N}\sum_{i=1}^{N} S_i$$

Success Rate

- Trajectory Length (TL)

- Minimum Distance ($D_{min}$): the target along the path to assess the robot's proximity to workers

✓ Sample video of Experiment

# References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# Thank you!

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