Deep Reinforcement Learning based Worker-following Path Planning with Occlusion Aware agent

Chaewon Yang
M.S. Student
Dept. of Architecture & Architectural Engineering
Seoul National University
chaewony@snu.ac.kr

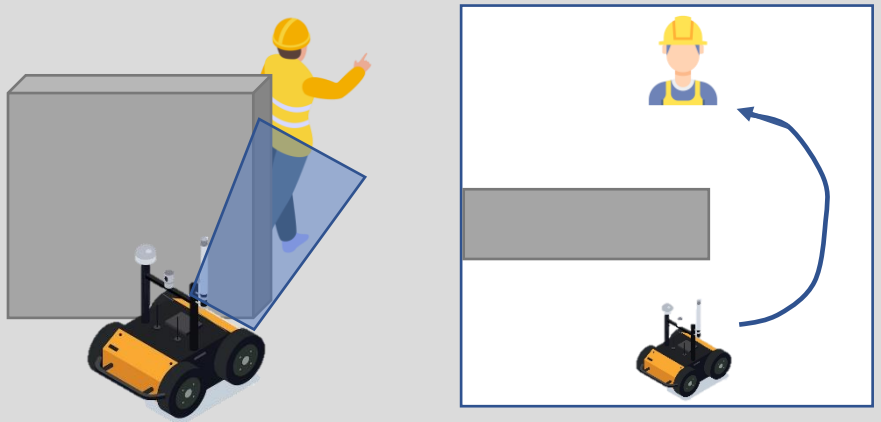
2024. 08. 27.

Research Background

Problem Statements

- When monitoring construction workers using mobile robots equipped with vision sensors, occlusions can create blind spots that make hazard detection difficult.
- To ensure safety, the robot must reposition itself to gain visibility into areas obscured by these occlusions.

Computer Vision



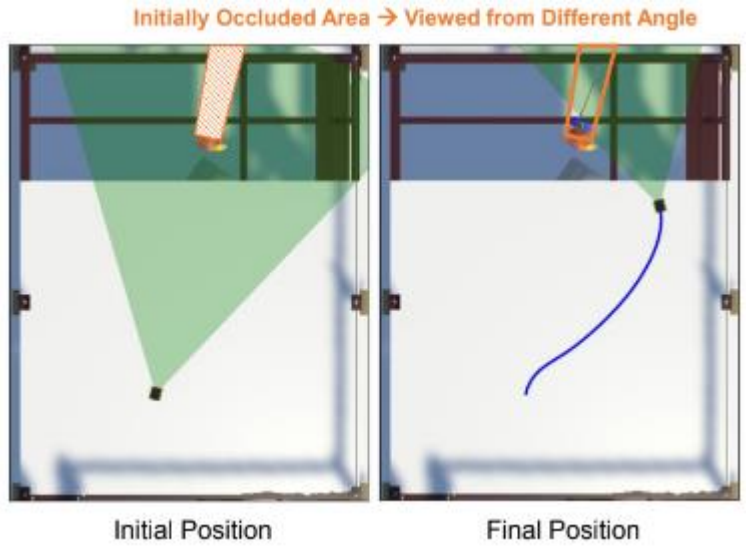
✓ Inter Object Occlusion

✓ Self- Occlusion

Research Background

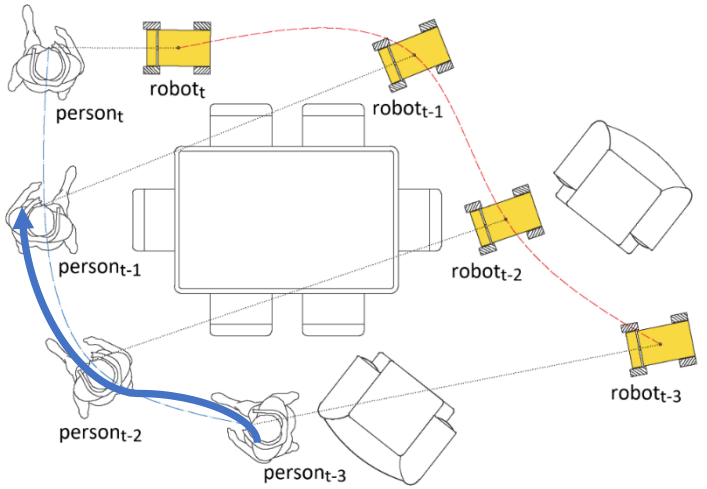
Problem Statements

- Previous studies have shown that reinforcement learning methods can enhance the proactive capabilities of autonomous monitoring systems in obstacle-rich environments. (J Park et al. 2024)
- However, the proposed policies were limited to fixed workers.



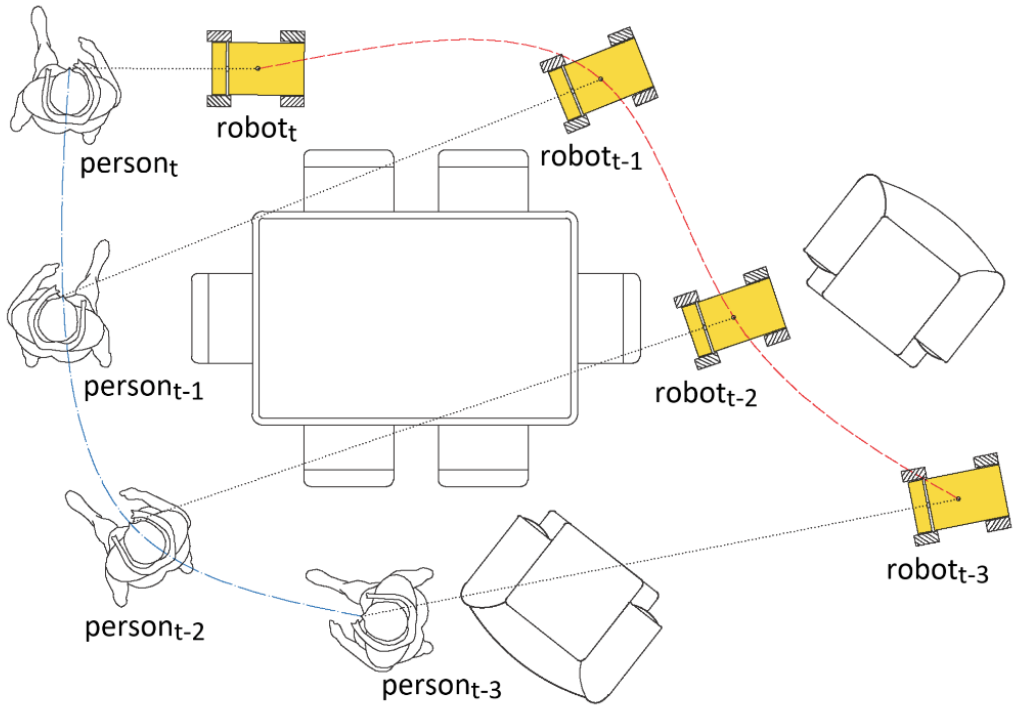
Research Objectives

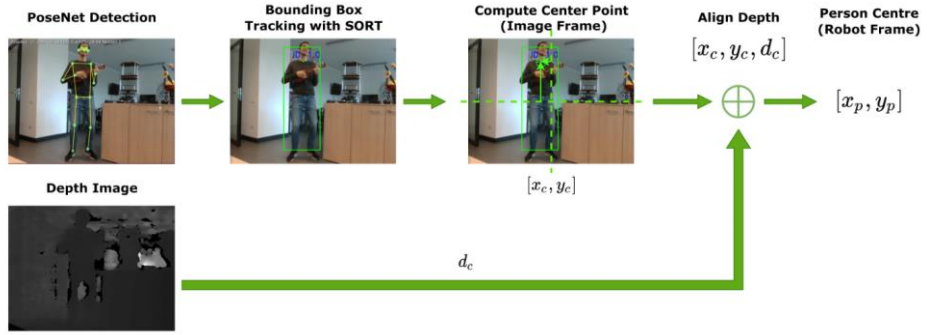
- To address this, a path planning method is being developed to enable robots to perform effective occlusion-aware navigation while continuously tracking a moving worker on construction sites.

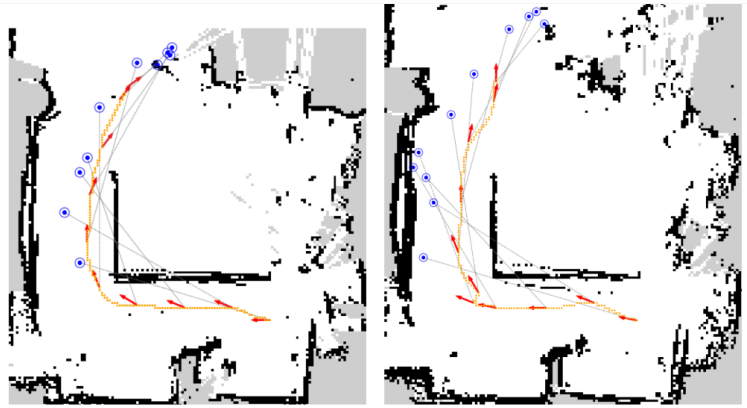


Related Research

- **Person-Following of Mobile Robot & Integrating Policies (D-DQN)**
  - Human-Centered Navigation and Person-Following with Omnidirectional Robot for Indoor Assistance and Monitoring. (Eirale A. et al., 2022)

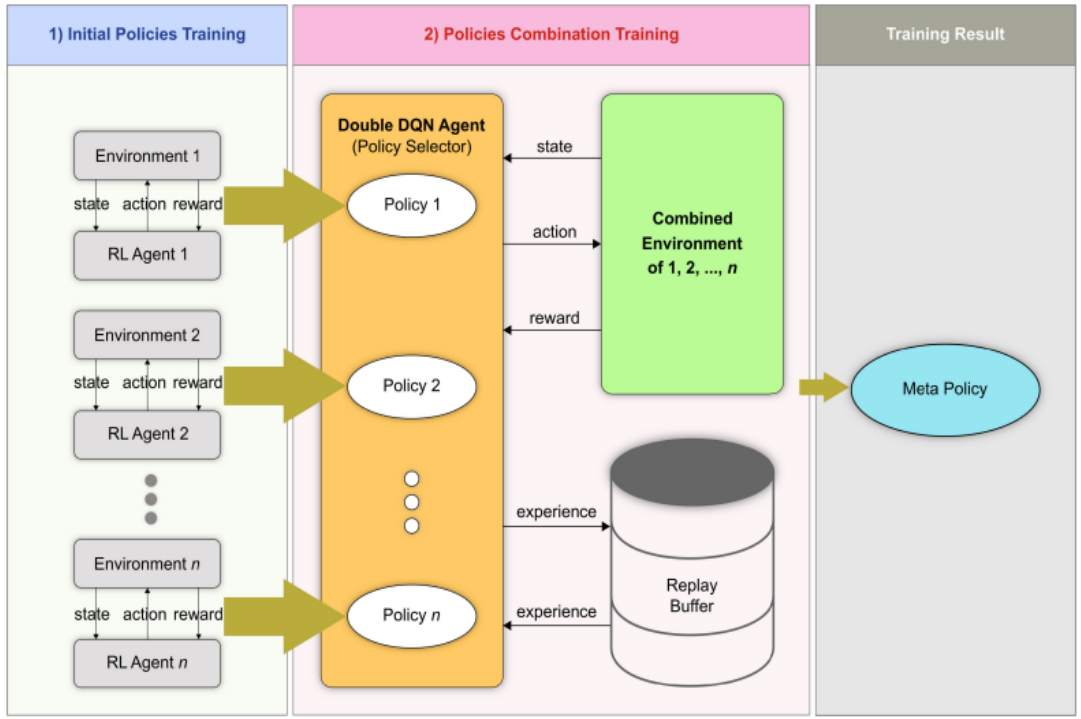


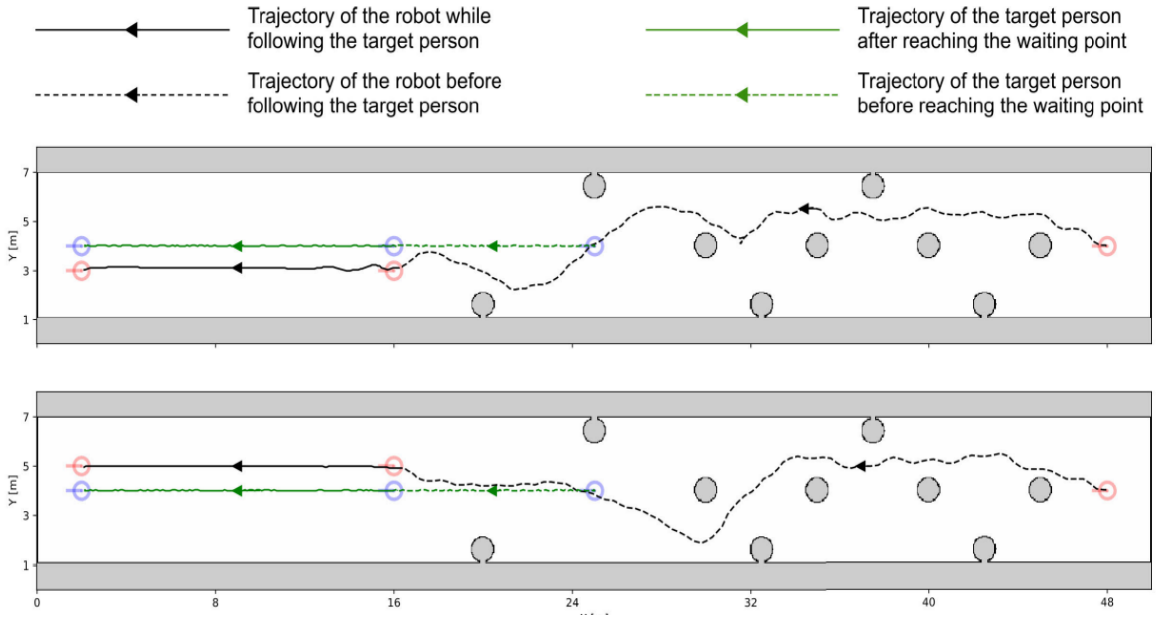




Related Research

- **Person-Following of Mobile Robot & Integrating Policies (D-DQN)**
  - Integrating multiple policies for person-following robot training using deep reinforcement learning (Dewa. et al., 2021)





Research Framework

Research Plan

- Develop a dynamic construction site with moving worker in virtual environment.
- Implement worker tracking through person-following within this environment, using the worker's pose information from the robot’s vision sensor.
- Train a reinforcement learning-based model for occlusion aware path planning model.
- Integrate policies including occlusion-aware navigation, obstacle-avoidance, and person-following capabilities.

Expected Results

- Contribute to the development of more robust occlusion-aware robots that can adapt to the movement of workers.

References

1. Eirale A, Martini M, Chiaberge M. Human-Centered Navigation and Person-Following with Omnidirectional Robot for Indoor Assistance and Monitoring. *Robotics*. 2022; 11(5):108. https://doi.org/10.3390/robotics11050108
2. Dewa, C. K., & Miura, J. (2021). Integrating multiple policies for person-following robot training using deep reinforcement learning. *IEEE Access*, *9*, 75526-75541.
3. Cao, Y., Ni, K., Kawaguchi, T., & Hashimoto, S. (2024). Path following for autonomous mobile robots with deep reinforcement learning. *Sensors*, *24*(2).
4. Algabri, R., & Choi, M. T. (2020). Deep-learning-based indoor human following of mobile robot using color feature. *Sensors*, *20*(9), 2699.
5. Huang, Z., Ou, C., Guo, Z., Ye, L., & Li, J. (2024). Human-Following Strategy for Orchard Mobile Robot Based on the KCF-YOLO Algorithm. *Horticulturae*, *10*(4), 348.
6. Ye, H., Zhao, J., Pan, Y., Cherr, W., He, L., & Zhang, H. (2023, May). Robot person following under partial occlusion. In *2023 IEEE International Conference on Robotics and Automation (ICRA)* (pp. 7591-7597). IEEE.
7. Fang, W., Ding, L., Love, P. E., Luo, H., Li, H., Pena-Mora, F., ... & Zhou, C. (2020). Computer vision applications in construction safety assurance. Automation in Construction, 110, 103013.
8. Fang, Q., Li, H., Luo, X., Ding, L., Luo, H., Rose, T. M., & An, W. (2018). Detecting non-hardhat-use by a deep learning method from far-field surveillance videos. Automation in Construction, 85, 1-9.
9. Li, Z., & Li, D. (2022). Action recognition of construction workers under occlusion. Journal of Building Engineering, 45, 103352.
10. Safronov, E., Piga, N., Colledanchise, M., & Natale, L. (2021). Active Perception for Ambiguous Objects Classification. 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 4437–4444.
11. Kumrai, T., Korpela, J., Maekawa, T., Yu, Y., & Kanai, R. (2020). Human Activity Recognition with Deep Reinforcement Learning using the Camera of a Mobile Robot. 2020 IEEE International Conference on Pervasive Computing and Communications (PerCom), 1–10.
12. Ishara, K., Lee, I., & Brinkworth, R. (2015). Mobile robotic active view planning for physiotherapy and physical exercise guidance. 130–136.

Thank you for your attention

Chaewon Yang
M.S. Student
Dept. of Architecture & Architectural Engineering
Seoul National University
chaewony@snu.ac.kr