SFU
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# An MCTS-DRL Based Obstacle and Occlusion Avoidance Methodology in Robotic Follow-Ahead Applications

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## Introduction

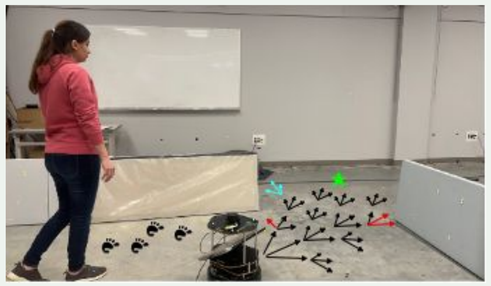
A mobile robot follows a target person in front of him/her while avoiding obstacles and occlusions.

Application:

- Shopping carts
- Autonomous suitcases
- Capturing physical activities

## Contributions

- A follow-ahead mobile robot
  - in front of a target person
  - avoid collisions and occlusions
- A high-level decision-making
- Integrating Monte Carlo Tree Search with Deep Reinforcement Learning



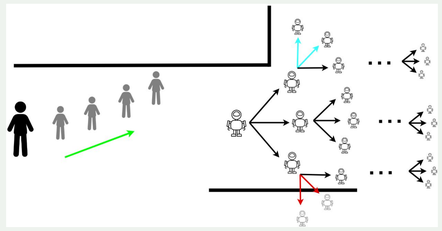
## Methodology

### Monte Carlo Tree Search

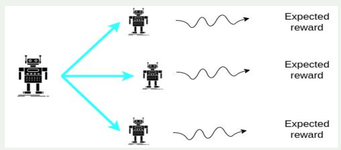
- Inputs:
  - Human's traj prediction for 3 seconds,
  - An occupancy map of the environment,
- Expands a tree to find a best goal point for the next 3 sec,
- Considers robot and human's current and future poses as the nodes of the tree,
- Assigns the value of (-1) to a node when occlusion or collision happens,
- The value of (1) means that the robot is in front of the human,
- Selects a leaf node with the highest value as a goal point.
- Updates the goal point each $\delta t = 0.5$ sec

### Deep Q-Network

- Estimates the expected return of each action and helps MCTS to evaluate each node,
- Receives a higher reward if it stays in front of the human within certain distance.



$$R = \sum_{i=0}^{n} \gamma^i r_i$$

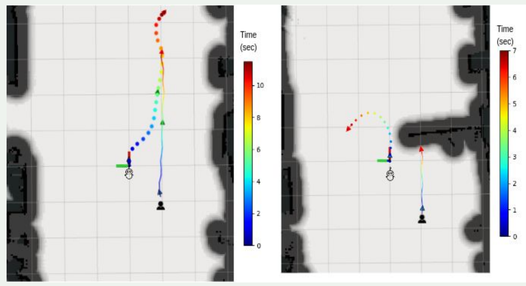



## Results and Experiments

- Comparing performance in the presence and absence of obstacles
- Timing is shown with rainbow color
  - Purple shows the first time step
  - Red shows the last time step

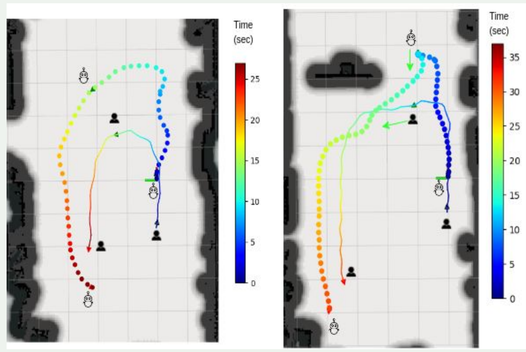
Straight line:

The robot turns left to avoid occlusion.



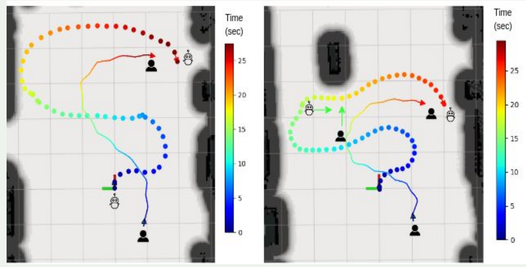

U-shape:

The robot changed its direction to avoid occlusion at T=12 sec.




S_shape:

The robot changed its direction to avoid occlusion at T=17 sec.




*Scan the QR code to view the project description*