Motion Planning with Moving Obstacles

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Advanced Deep Learning in Robotics (CIT433027)

Introduction

Problem

Robots must navigate not only through static environments but also through dynamic environments where they encounter moving obstacles.

Contribution

- Develop a reliable way to encode moving obstacles into 2D environments.
- Introduce a globally guided reinforcement learning approach.

Environment Representation

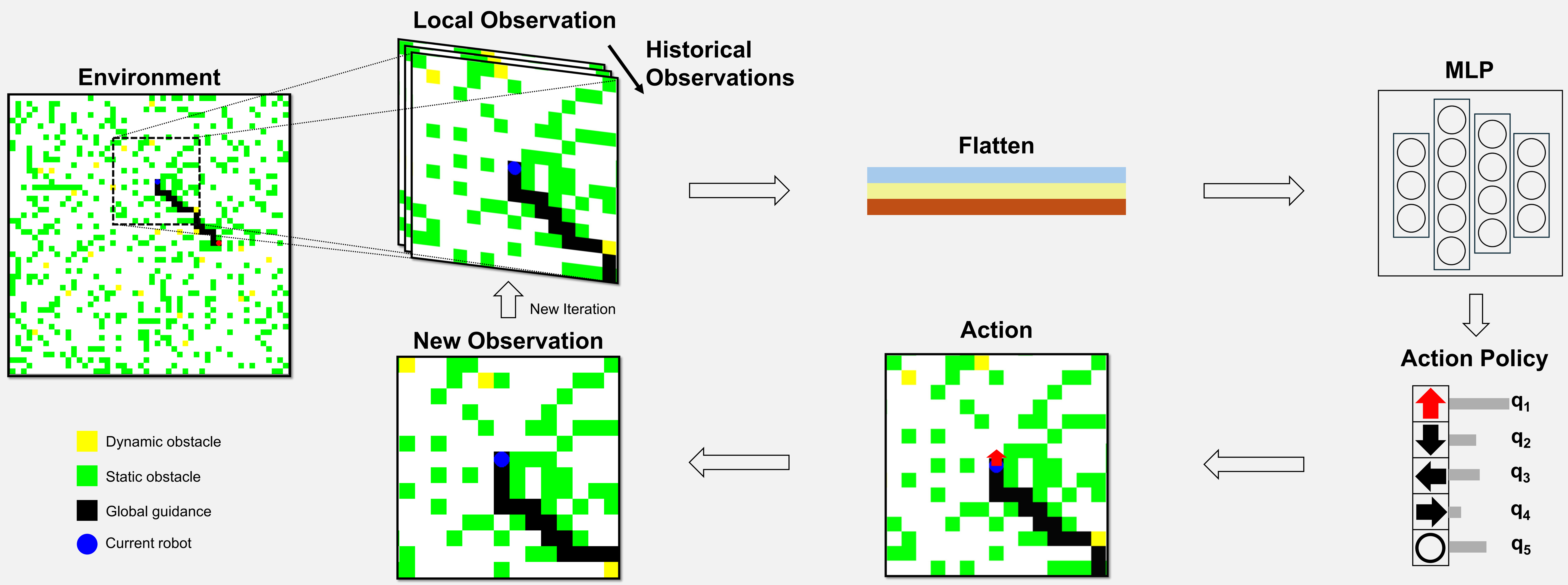
Global Guidance

We apply the A-star search algorithm to find a global path to navigate the robot.

Local Planner

We utilize Proximal Policy Optimization (PPO) for dynamic local route planner. PPO enables the robot to adapt and find optimal paths in dynamic environments.

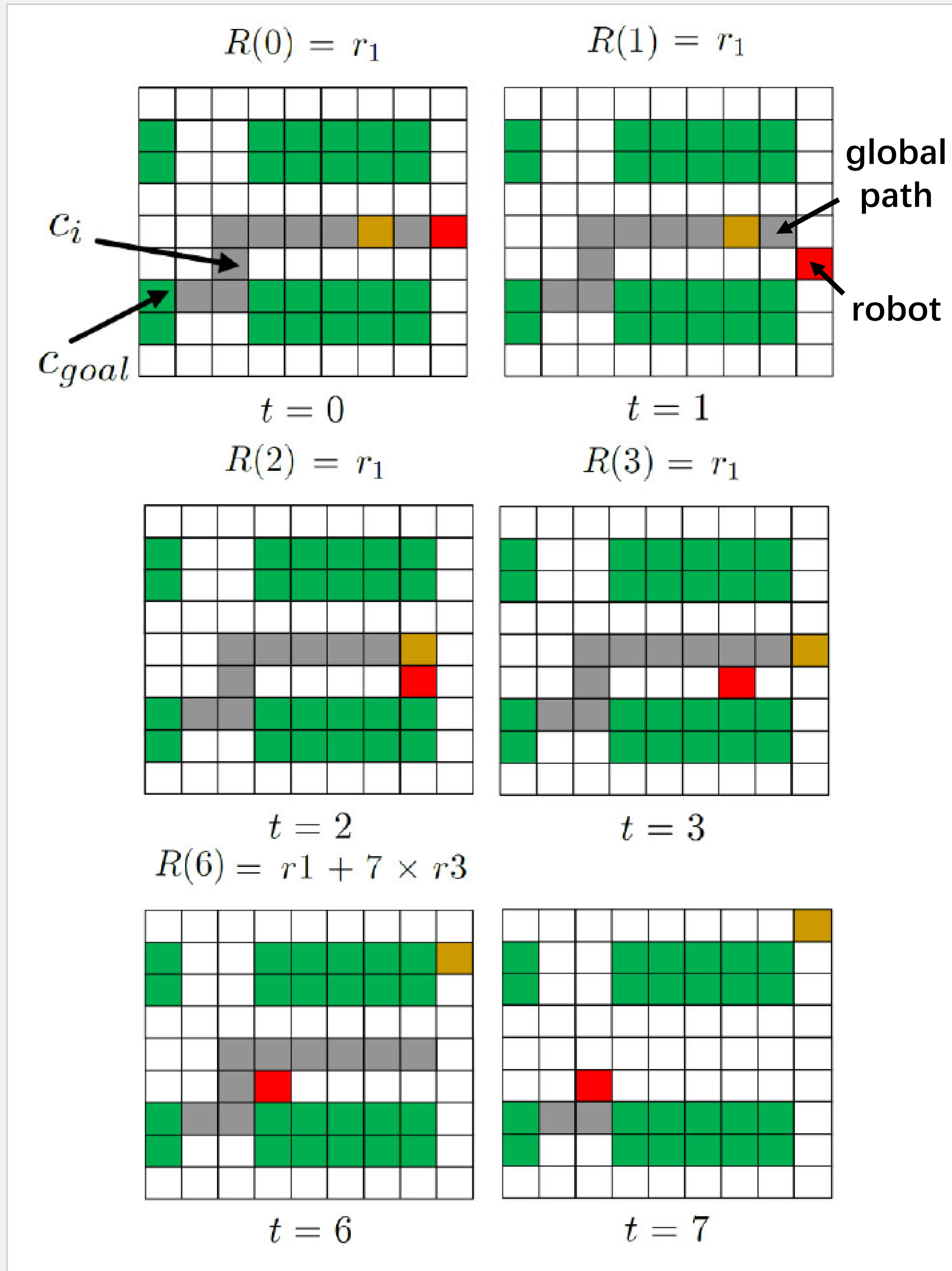
Architecture



Reward design

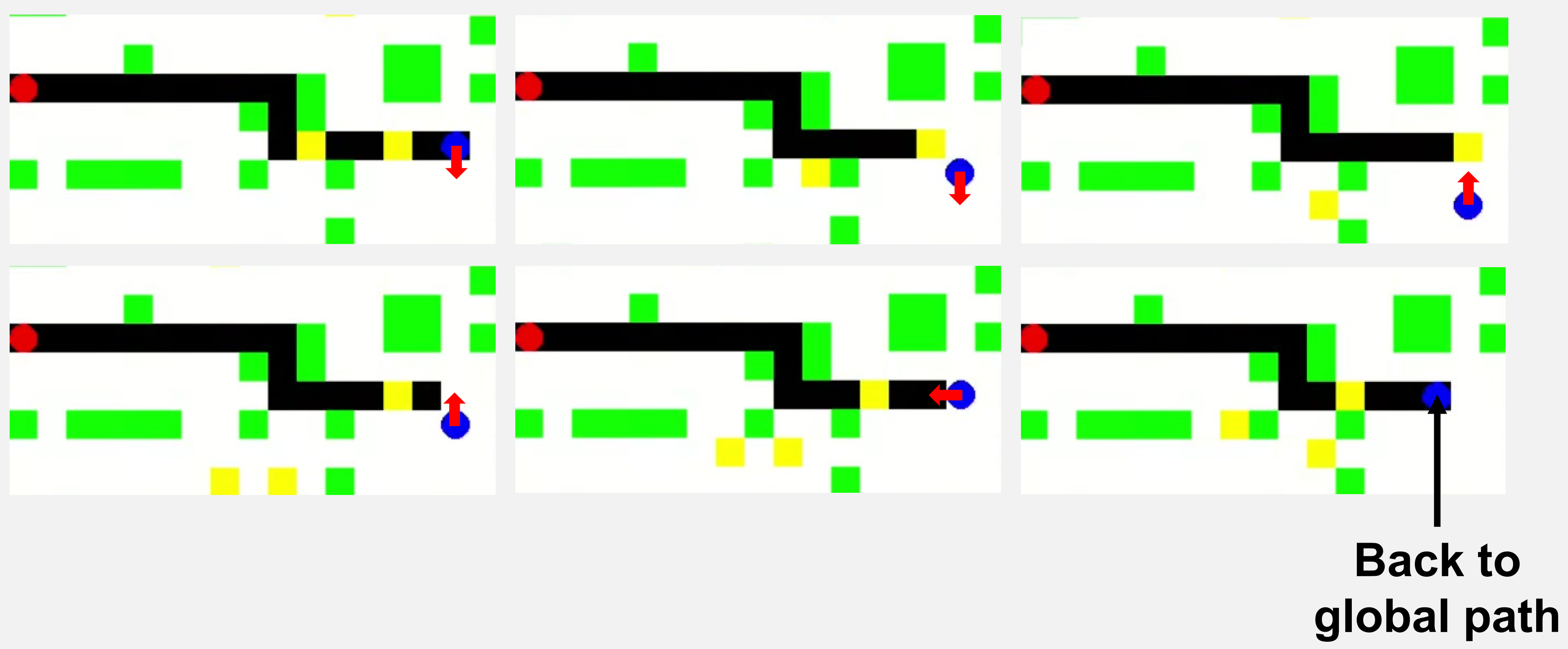
$$R(t) = \begin{cases} r_1 \\ r_2 \\ r_1 + N_e \times r_3 \end{cases}$$

- A small negative reward $r1$ ($r1$=-1) is given when the robot is not on the global guidance path.
- A large negative reward $r2$ ($r2$=-100) is given when the robot collides with a static or dynamic obstacle.
- A large positive reward $r1+Ne\times r3$ ($r3$=4) is awarded when the robot reaches the global path. Ne is the number of steps the robot has deviated from the global path.



Quantitative results	Success rate	Avg reward
Only static obstacles	79.5%	270
Dynamic environment without Global path	0%	-50.3
Dynamic environment with hybrid algorithm (ours)	**57.9%**	**244.93**

Qualitative results



Future works

- Extend the 2D environment to 3D
- Use LSTM to enhance temporal performance

Project page: