Multi-Agent Task Planning with Fire Detection for Firefighting Based on Linear Temporal Logic

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Abstract

This paper proposes a Linear Temporal Logic (LTL)-based approach for multi-robot path planning in firefighting environments. Each robot is assigned an LTL formula, and the proposed strategy combines offline discrete path planning with online path updates. When resources are insufficient, robots can autonomously plan paths for replenishment. Vector-field-based navigation is used to guide the robots along the planned discrete paths, while a repulsion force equation is incorporated into the field to enable collision avoidance between robots. The YOLOv5-based method is used to detect fires in actual inspection robots. The proposed method is validated in a simulated fire environment: robots initially plan their paths and update them during movement to recharge and refill water. After completing the first firefighting task, if a second fire breaks out, the firefighting robots can update their paths and move towards to the new fire area. In the constructed real-world environment, the patrol robots can accurately detect fires, and the firefighting robots can move to the scene to perform firefighting tasks.

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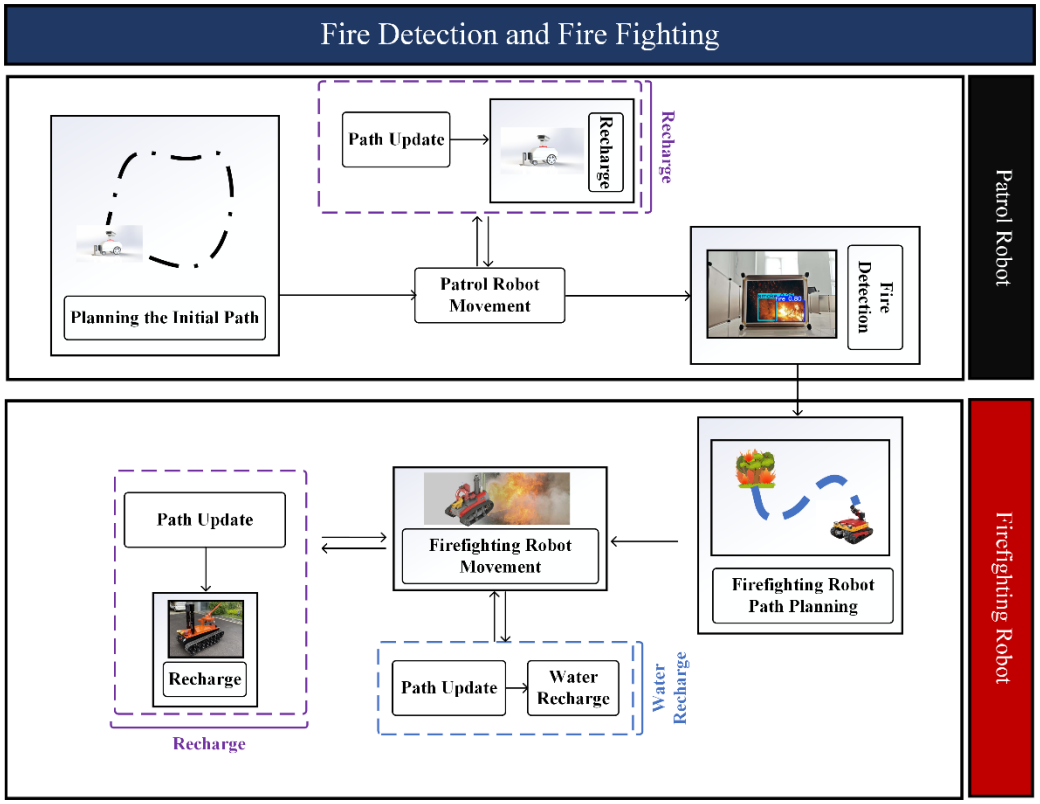

Innovative Description: A novel LTL-based multi-agent framework integrates real-time fire detection and autonomous firefighting with adaptive path updates.