Effect of Adaptive Communication Support on LLM-powered Human-AI Collaboration

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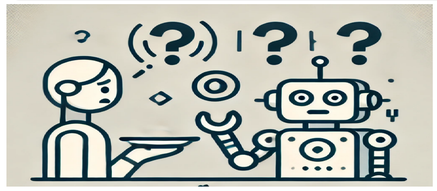
Effective human-AI collaboration relies on adaptive communication strategies, yet traditional human-robot interactions often lack the flexibility needed for dynamic tasks. To explore how AI feedback frequency impacts teamwork efficiency, we developed a Human-Robot Teaming Framework with Multi-Modal Language Feedback (**HRT-ML**) and evaluated it in a simulated Overcooked-AI environment. Through controlled experiments, we found that overly passive agents hinder performance in complex tasks, while excessively active agents overwhelm users with unnecessary feedback, reducing efficiency. By introducing a strategic balance between high-level coordination and subtask-specific feedback, our model enables AI agents to optimize communication dynamically, leading to significant improvements in team efficiency, user satisfaction, and task completion speed.

Teamwork and Coordination need in the kitchen



Chefs must coordinate efficiently to prepare, cook, and serve dishes before time runs out. Precision and collaboration lead to higher efficiency and faster task completion

Experimental Setup

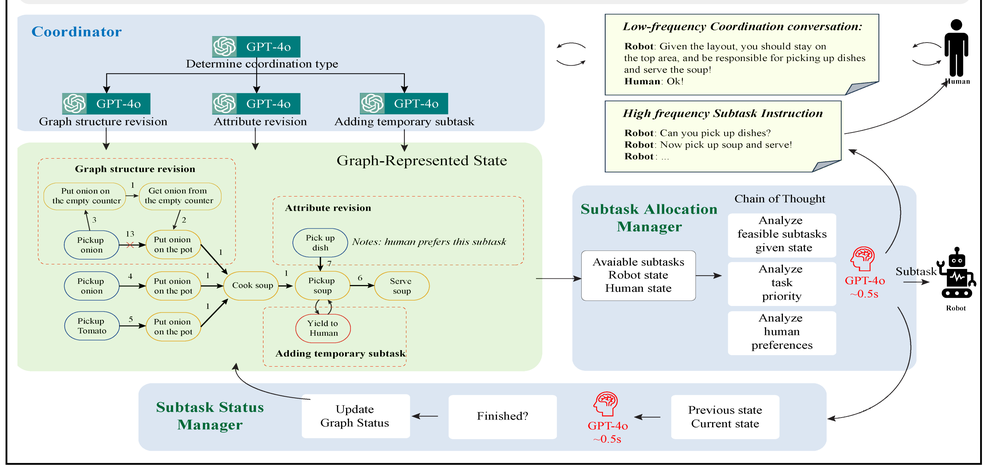
16 participants

Layouts: Easy, Medium, Hard

Agent Support Level: PFA, IFA, AFA, SFA

Survey

Human Robot Teaming (HRT) Framework

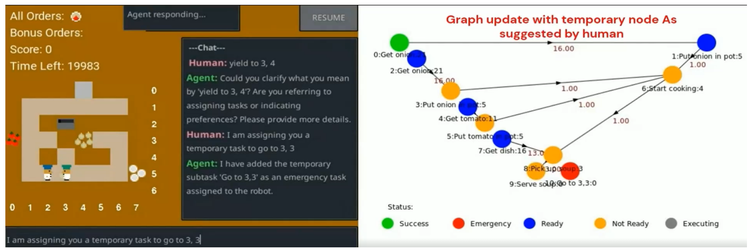


Feedback Modes

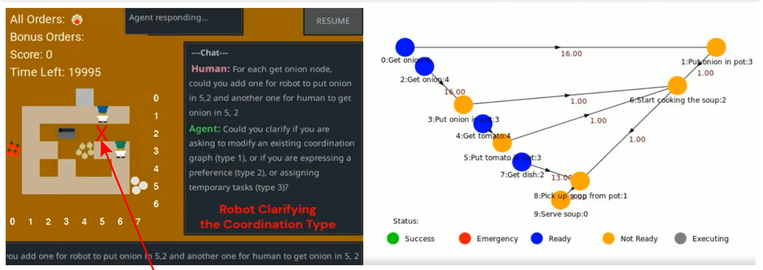
Inactive Feedback Mode (IFA) — No Coordintaion Need

No Communication Between Human and Robot

Passive Feedback Mode (PFA) — Task Execution < Coordintaion Need

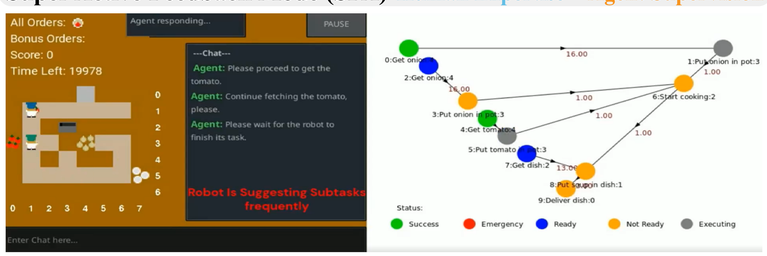


Active Feedback Mode (AFA) — Human Input = Agent Supervision



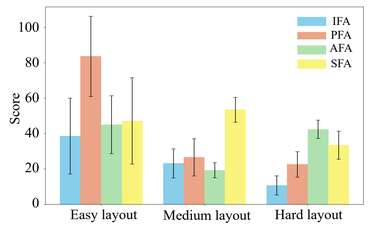
collaboration strategy one chef places ingredients for another to pick up

Super Active Feedback Mode (SFA) — Human Expertise < Agent Supervision



Results

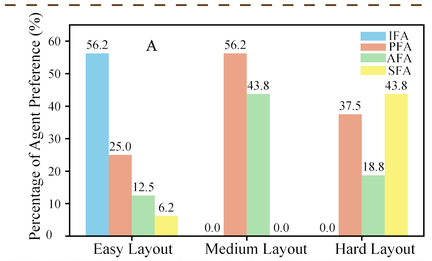
Effect of task complexity on agent feedback preference



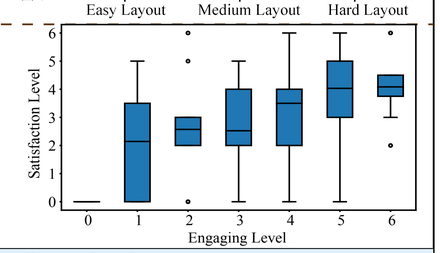
Agent preference

Simple Task (IFA, PFA)

Complex Task (AFA, SFA)

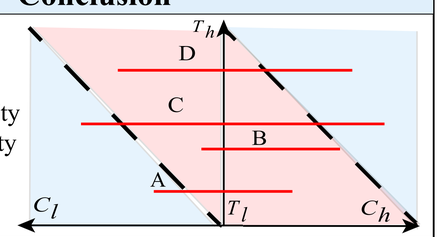


Satisfaction vs Engagement



Conclusion

T: Task Complexity
Ch: Human Capability
Cl : LLM's Capability



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