

Motivation

➤ **Background** : Social robots (e.g., Misty) are increasingly used in mental health counseling and children's education, but current systems rely on open APIs and complex frameworks, creating high technical barriers for non-technical users.

➤ **Solution**: To address the above challenges, we propose AutoMisty, which converts natural language instructions into executable robot code, enabling non-engineers to easily customize and operate social robots.

➤ **Contributions** :

➤ **Multi-Agent Collaborative Framework**:

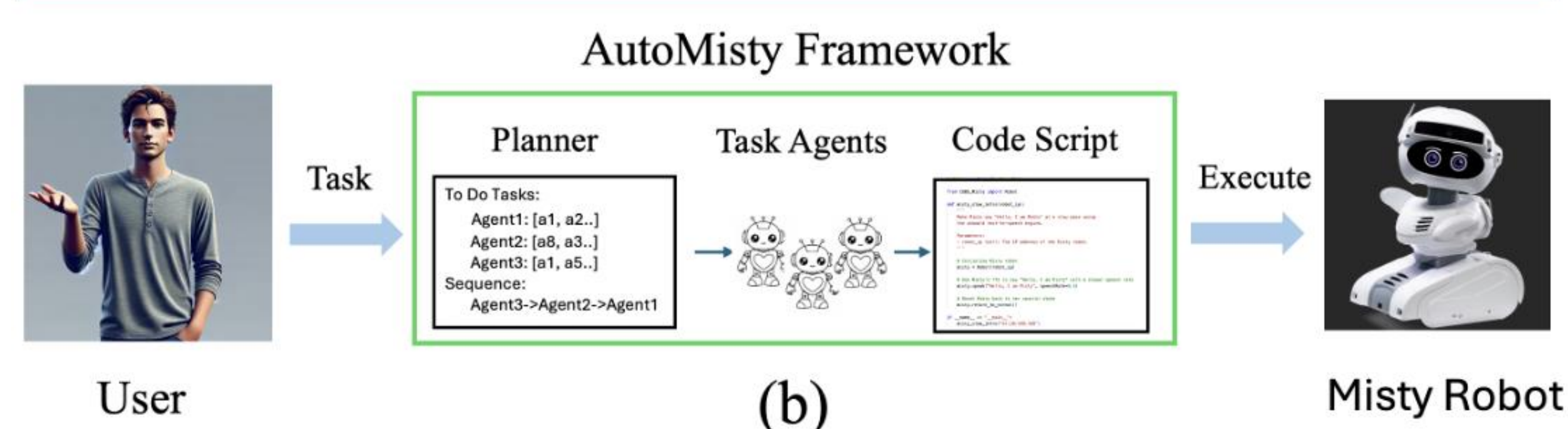
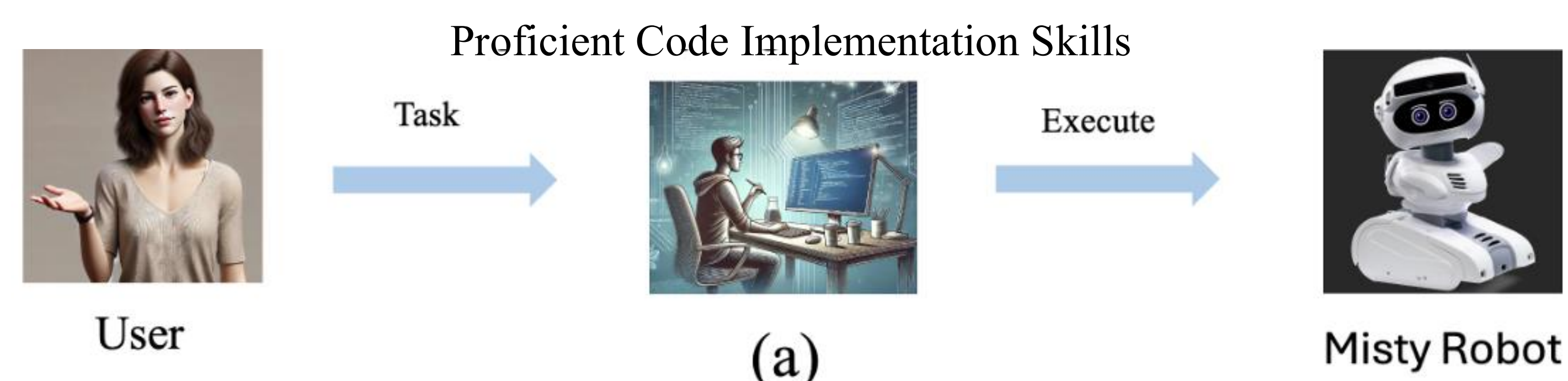
Specialized agents handle sub-tasks for efficient NL-to-code transformation.

➤ **Two-Layer Optimization**:

Self-reflection: Auto-checks and fixes code issues.
Human-in-the-loop: Allows user-driven fine-tuning.

➤ **Transparent and Controllable Reasoning**:

Keeps reasoning steps visible and editable for user intervention.



AutoMisty Overview

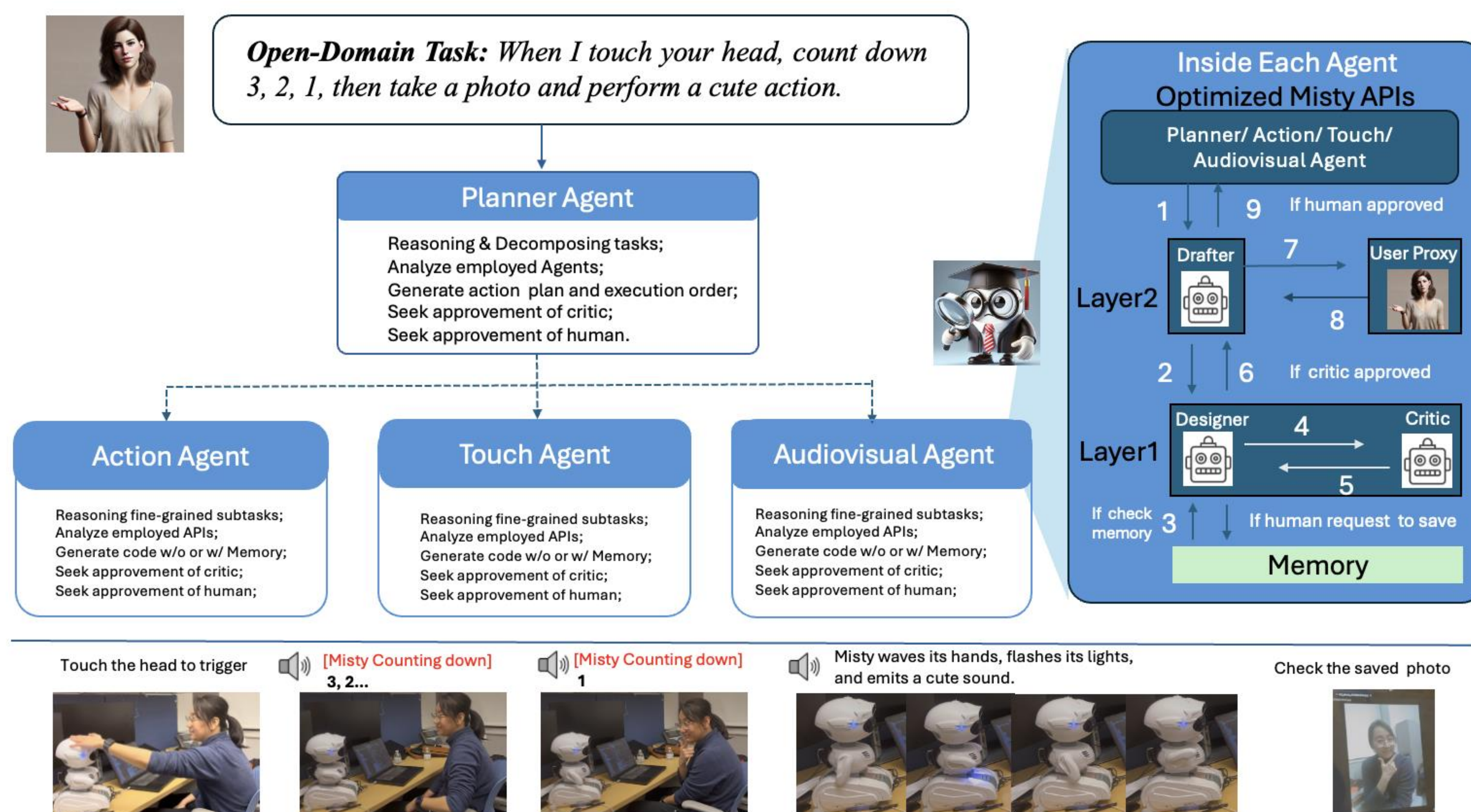
➤ **AutoMisty** is designed for the Misty robot and provides a complete solution from low-level APIs to final execution and verification, enabling it to perform open-domain tasks through natural language. Specifically, it includes:

➤ **Optimized Misty API**: The original interfaces are reorganized and extended, with clearly defined functions and parameters, along with annotations adapted for large language models.

➤ **Dual-Layer Iteration Mechanism**: Self-reflection is performed first, followed by continuous optimization based on user feedback.

➤ **Multi-Agent Collaboration**: Complex tasks are decomposed and delegated to agents such as Planner, Action, Touch, and Audiovisual, each responsible for specific roles and working collaboratively.

➤ **System Verification and User Proxy**: Robot control code is compiled and tested locally to ensure logical correctness before deployment; a user proxy is used to collect and process human feedback.



Experiments

TABLE I
LIST OF TASKS UNDER EACH CATEGORY

Elementary Task	(1) Hand Raise Direction Change, (2) Hand Raise Count Change, (3) Hand Raise Speed Change, (4) Head Turn Direction Change, (5) Head Turn Count Change, (6) Head Turn Speed Change, (7) Expression Transformation Test, (8) Speech Speed Change Test, (9) LED Color Change Test
Simple Task	(10) Storytelling, (11) Timed Reminder, (12) Emotional Comfort, (13) Poetry Composition and Performance, (14) Key Word Triggered Video Recording, (15) Rock-style Dance Performance, (16) Key Word Triggered Photography
Compound Task	(17) Reacting to Head Touch with Pikachu Noise, (18) Expressing Different Emotions Based on Touch Location, (19) Recognizing Colors and Displaying with LED, (20) Waving in Response to a Greeting
Complex Task	(21) Recognizing and Reading Signs, (22) Simulating a Child's Persona in Conversation, (24) Math Tutoring, (24) Intelligent Storytelling, (25) Real-Time Translation, (26) Taking a Photo and Performing Analysis, (27) Countdown Before Taking a Photo and Performing an Action (28) Playing a Game Like Concentration

- **Elementary Tasks**: Basic commands (raise hands, adjust head angles, control speed), testing precise robot control through conversation.
- **Simple Tasks**: Single-agent tasks with straightforward solutions, requiring minimal creativity.
- **Compound Tasks**: Multiple-agent tasks with clear instructions and structured collaboration.
- **Complex Tasks**: Highly abstract instructions requiring multiple agents, autonomous LLM prompt design.

Evaluation Metrics

- **Task Completion (TC)**: Completed within 20 interactions.
- **Number of User Interactions (NUI)**: Total user interactions.
- **User Preference Interactions (UPI)**: Triggered by user's personal preference.
- **Technical Correctness Interactions (TCI)**: Address coding correctness or logic.
- **Code Efficiency (CE)**: -1 for removable code; max score is 10.
- **User Satisfaction (US)**: -1 for misinterpretation or noncompliance; max score is 10.

Project Page



TABLE II
PERFORMANCE COMPARISON OF CHATGPT-4o, CHATGPT-o1, AND AUTOMISTY ACROSS DIFFERENT CATEGORIES OF TASKS

Tasks	ChatGPT-4o					ChatGPT-o1					AutoMisty (Ours)							
	TC	NUI	UPI	TCI	CE	US	TC	NUI	UPI	TCI	CE	US	TC	NUI	UPI	TCI	CE	US
Elementary Tasks																		
1 - 4	Success	0	0	10	10	10	Success	0	0	10	10	10	Success	0	0	10	10	10
5	Success	1	0	10	10	10	Success	0	1	10	10	10	Success	1	0	10	10	10
6	Fail	-	-	-	-	-	Success	0	0	10	10	10	Success	0	0	10	10	10
7	Success	2	1	10	10	10	Success	0	1	10	10	10	Success	1	0	10	10	10
8	Success	0	0	10	10	10	Success	0	0	10	10	10	Success	0	0	10	10	10
9	Success	0	0	10	10	10	Success	0	1	10	10	10	Success	1	0	10	10	10
Simple Tasks																		
10	Success	1	0	10	10	10	Success	1	0	10	10	10	Success	1	0	10	10	10
11	Success	0	0	10	10	10	Success	0	0	10	10	10	Success	0	0	10	10	10
12	Success	1	0	10	10	10	Success	0	0	10	10	10	Success	1	0	10	10	10
13	Success	0	0	10	10	10	Success	0	0	10	10	10	Success	0	0	10	10	10
14	Fail	-	-	-	-	-	Fail	-	-	-	-	-	Success	0	0	10	10	10
15	Success	0	0	10	10	10	Success	0	0	10	10	10	Success	0	0	10	10	10
16	Fail	-	-	-	-	-	Success	0	0	10	10	10	Success	0	0	10	10	10
Compound Tasks																		
17	Fail	-	-	-	-	-	Success	1	0	10	10	10	Success	0	1	10	10	10
18	Fail	-	-	-	-	-	Fail	-	-	-	-	-	Success	1	0	10	10	10
19	Fail	-	-	-	-	-	Success	1	0	10	10	10	Success	1	0	9	10	10
20	Fail	-	-	-	-	-	Success	1	0	10	10	10	Success	1	0	9	10	10
Complex Tasks																		
21	Fail	-	-	-	-	-	Success	0	0	10	10	10	Success	0	1	9	10	10
22	Success	0	0	10	10	10	Success	0	0	10	10	10	Success	0	0	9	10	10
23	Fail	-	-	-	-	-	Success	0	0	10	10	10	Success	0	0	9	10	10
24	Success	0	0	9	10	10	Success	0	0	10	10	10	Success	0	0	10	10	10
25	Fail	-	-	-	-	-	Success	0	0	10	10	10	Success	0	0	9	10	10
26	Fail	-	-	-	-	-	Fail	-	-	-	-	-	Success	0	0	9	10	10
27	Fail	-	-	-	-	-	Fail	-	-	-	-	-	Success	1	2	10	10	10
28	Fail	-	-	-	-	-	Success	6	4	10	8	8	Success	3	2	9	10	10