

UXAgent: A System for Simulating Usability Testing of Web Design with LLM Agents

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What's the worst nightmare as a researcher?

- The myth of “Review 2”
- Paper being scooped
- Realizing that your experiment design is flawed one week before deadline

As someone from both NLP and HCI, I think . . .

Field	NLP	HCI
Experiment Subject	Models and Machines	Human Subjects
Experiment Design	Code and Data	Study Protocol
Experiment Cost	Money	Human Participants' Time
"Debugging" Method	Code Debugging	???

Human Participants' Time is Valuable and Limited

How can we better evaluate UX Research study design before running the study?

How can we better evaluate usability testing
study design before running the study

LLM Agent as a promising solution



- Generative Agents¹ – “Believable” human behavior
- SimUser² – simulate user and application for UX research
- AXNav³ – accessibility testing

¹Joon Sung Park et al. “Generative Agents: Interactive Simulacra of Human Behavior”. In: *Proceedings of the 36th Annual ACM Symposium on User Interface Software and Technology*. UIST '23. New York, NY, USA: Association for Computing Machinery, Oct. 2023, pp. 1–22.

²Wei Xiang et al. “SimUser: Generating Usability Feedback by Simulating Various Users Interacting with Mobile Applications”. In: *Proceedings of the CHI Conference on Human Factors in Computing Systems*. CHI '24. New York, NY, USA: Association for Computing Machinery, May 2024, pp. 1–17.

³Maryam Taeb et al. “AXNav: Replaying Accessibility Tests from Natural Language”. In: *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*. CHI '24. New York, NY, USA: Association for Computing Machinery, May 2024, pp. 1–16.

LLM Web Agent as a promising solution for web designs

- WebGPT⁴ – Search Engine enhanced QA
- WebAgent⁵ – Planning for Web Automation
- WebVoyager⁶, LASER⁷, ...

⁴Reiichiro Nakano et al. *WebGPT: Browser-assisted Question-Answering with Human Feedback*. June 2022. arXiv: 2112.09332 [cs].

⁵Izzeddin Gur et al. "A Real-World WebAgent with Planning, Long Context Understanding, and Program Synthesis". In: *The Twelfth International Conference on Learning Representations*. Oct. 2023.

⁶Hongliang He et al. *WebVoyager: Building an End-to-End Web Agent with Large Multimodal Models*. June 2024. arXiv: 2401.13919 [cs].

⁷Kaixin Ma et al. *LASER: LLM Agent with State-Space Exploration for Web Navigation*. Feb. 2024. arXiv: 2309.08172 [cs].

Challenges

- Existing LLM Agent systems mostly works in **sandboxed environments**
- Existing LLM Web Agents focus on **task completion rate**, not simulating complex and dynamic human behavior
- Existing reasoning architecture of LLM Agents/LLM Web Agents either fail to simulate human reasoning process (too simple) or introduces additional latency (too complex) for real time simulation.

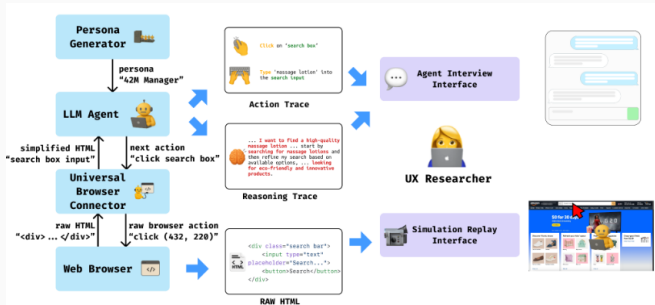


Figure 1: System Architecture of UXAgent

<https://broadcast.amazon.com/videos/1691301>

Persona Generator

1 Participant Recruitment

2 Survey

3 Review

Configure participant demographics

Provide a questionnaire

Confirm & Run

Recruitment Target Setting

URL of website being tested *

https://www.example.com

Number of Participants *

20

Participant Task *

Buy a jacket

Example Persona *

Persona: Clara
Background:
Clara is a PhD student in Computer Science at a

Demographics

Field Name

Age

Value	Weight	Actions
18-55	1	<div>+ Add Choice</div> <div>Remove Value</div>

Field Name

Gender

Value	Weight	Actions
Male	1	<div>+ Add Choice</div> <div>Remove Value</div>
Female	1	<div>+ Add Choice</div> <div>Remove Value</div>
Non-binary	1	<div>+ Add Choice</div> <div>Remove Value</div>

+ Add Field

Reset Form

Next

(a) Participant Task Config

(b) Demographic Distribution Config

Figure 2: Study Configure Interface

Agent Architecture

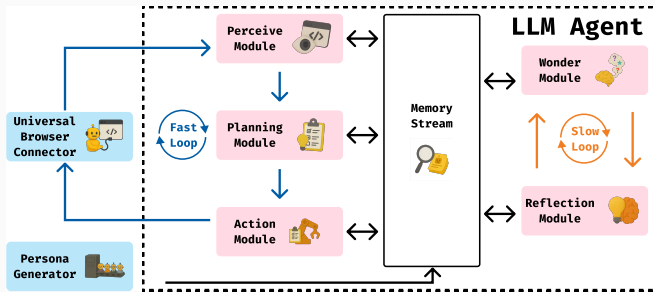


Figure 3: Agent Architecture

Agent Architecture: Two-Loop + Memory

- To allow both in-depth reasoning and real-time simulation:
 - Fast Loop: rapid response to the outside environment
 - Slow Loop: in-depth reasoning and thinking
- Asynchronous; interact through Memory Stream
- Each module retrieves and generate memories

Result Viewer Interface

The diagram illustrates the Agent Memory Trace, showing how an agent's memory evolves through interactions. It consists of several interconnected components:

- Agent List**: A vertical list of agents, each with a unique ID and a brief description of their background (e.g., "Agent ID: 1: He has a bachelor's degree and lives in Portland, Oregon, a...").
- Action Trace**: A sequence of actions performed by the agent, such as "Action 1: click", "Target: grocery_gourmet_food", and "Clicking on the 'Grocery & Gourmet Food' category from the main navigation menu".
- Screenshot**: A visual representation of the environment at a specific point in time, showing a webpage titled "One Stop Market" with various product listings.
- Observation Snapshot**: A detailed view of the current state or observation, showing the same webpage as the screenshot but with more context or focus.
- Interview**: A section where the agent is interviewed about its current state or actions, represented by a green button labeled "Interview This Agent".
- Reasoning Trace**: A table showing the reasoning process behind the agent's actions, including timestamps, kinds of reasoning (e.g., "observation", "thought"), importance levels, and content descriptions.

The Reasoning Trace table is structured as follows:

	Kind	Importance	Content
Timestamp: 1			Interview Agent at This Moment🕒
>	observation	0.8	I can see the One Stop Market e-...
>	thought	0.8	I need to find

Figure 4: Result Viewer Interface

Universal Browser Connector

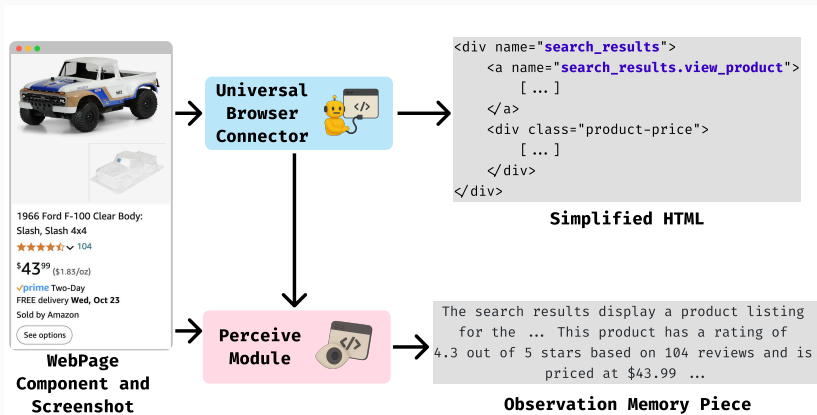


Figure 5: Universal Browser Connector

Generalizability

- The agent is designed to be generalizable to different websites and tasks
- Rufus: <https://broadcast.amazon.com/videos/1685504>
- Customer Service Agent:
<https://broadcast.amazon.com/videos/1685507>
- AC3: <https://broadcast.amazon.com/videos/1769741>

Questions?