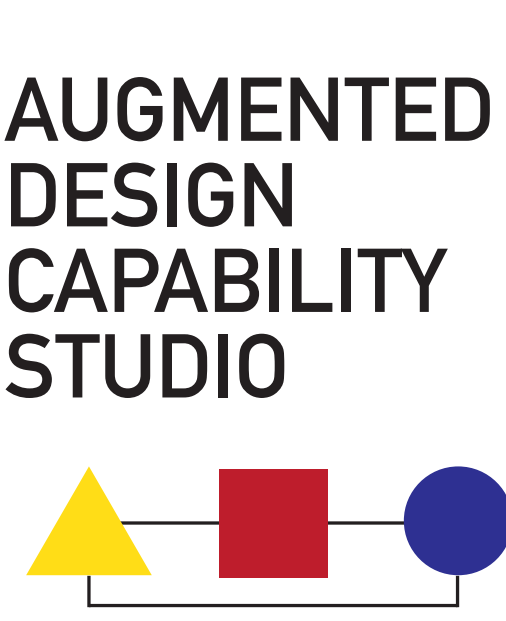


Evaluating WoZ User Studies for Creating Supportive Metacognitive Design Agents

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Background

AI Tools in Design

- **Proliferation of AI Tools:** AI-based design tools increasingly assist engineering and industrial designers in complex manufacturing tasks.
- **Human-AI Interaction:** To effectively use these advanced tools, designers need to develop new skills for interacting and co-creating with AI, which differs significantly from traditional CAD tools.
- **Challenges in AI Integration:** Previous research has highlighted several challenges that designers face when using AI-based design tools, such as understanding AI outputs, specifying design parameters, and iterating on designs.

Research Questions

- What challenges do designers face when learning to co-create with computational AI tools?
- How do designers overcome these challenges?
- What are effective strategies to support designers in learning to co-create with computational AI tools?

Methodology: Wizard of Oz Think-Aloud Studies

- In the previous paper for this research, a series of Wizard of Oz think-aloud user studies were conducted to gain insights into the Human-AI Co-Creation process
 - **Design Task:** Participants, experienced in mechanical engineering, architecture, and industrial design, were tasked with creating an engine bracket using Autodesk Fusion 360, optimizing material usage and ensuring structural integrity.
 - **Think-Aloud Protocol:** Participants verbalized their thoughts and reasoning processes during the design task, allowing researchers to capture cognitive challenges and strategies.
 - **Wizard of Oz Setup:** A human operator simulated the autonomous AI system, providing assistance based on a predefined schema. This setup enabled testing interactions with AI functionalities not yet fully developed.

Different Types of Tested Agents

	Model Type	Response Behavior	Question Model
Pythia	Asking Questions	Gracefully Declining User Requests	Self Regulated Learning / Designerly Questions
SocrAltis	Asking Questions	Responding With Questions	Socratic Questions
HephAlstus	Offering tips and guidance	Answering user questions	Not Asking Questions

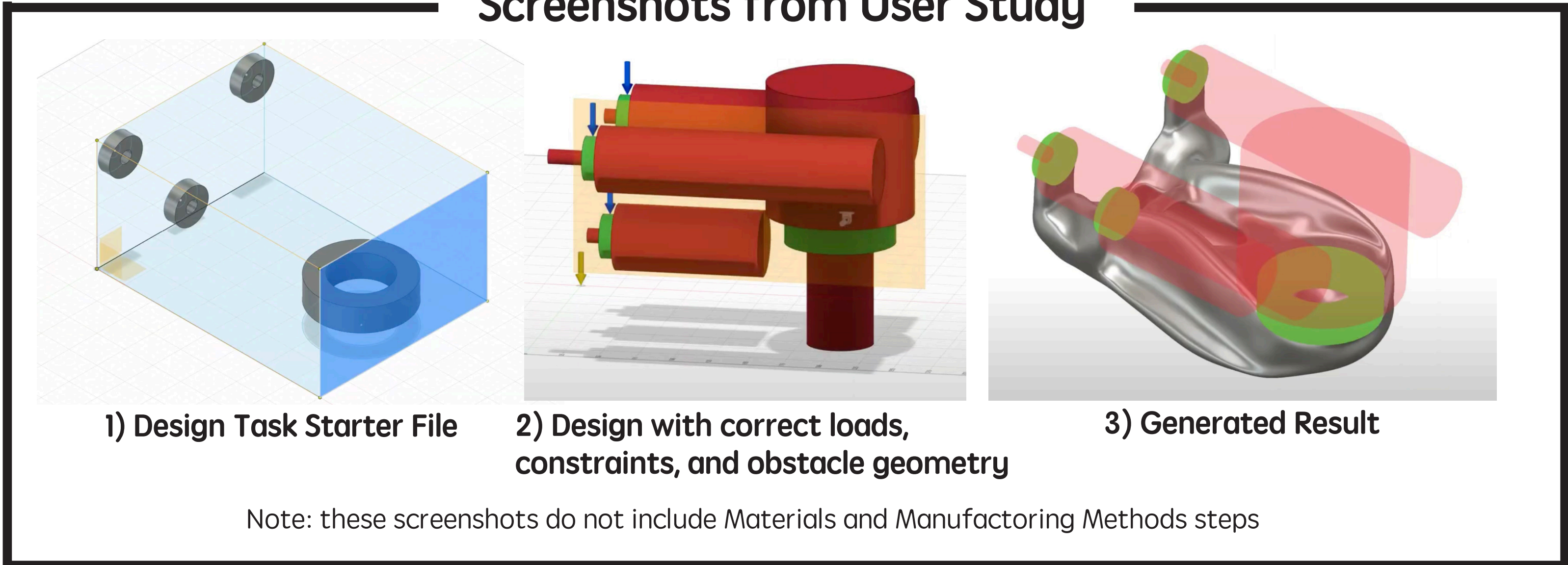
Encoding Schema

- For all 3D models, we verify the correctness of forces, constraints, bolt clearances, damper clearances, and the bounding box at each message.
- We document the agent's message aim, observed response, and any new considerations by the user.
- For HephAlstus sessions, we also encode user questions. Additionally, we categorize all messages by type (inquiry, answer, hedging, confirming, etc.), how they were prompted (initialized/reply), design phase, and observed helpfulness

Results

- 28 Participants had 1 to 10 years of mechanical design experience. Excluding some baseline studies, 14 out of 25 were deemed successful.

Screenshots from User Study

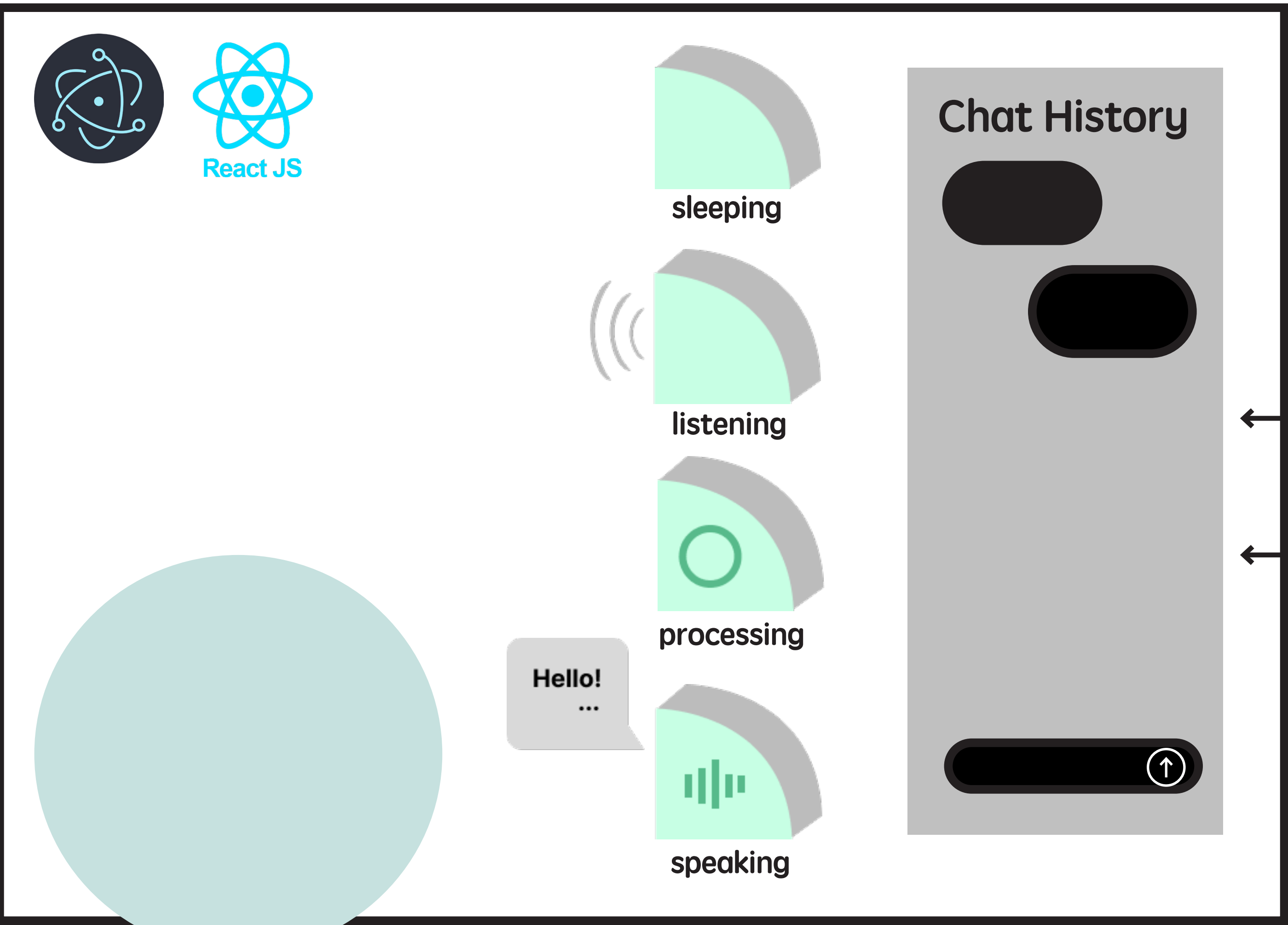


Conclusions/Next Steps

- Reactions to the agents ranged from minimal engagement with short responses to extensive interactions. Miscommunications between users and assistants sometimes required intervention by the experiment designer.
- The next steps involve analyzing the encoded results, though the specific methodology is still being determined.

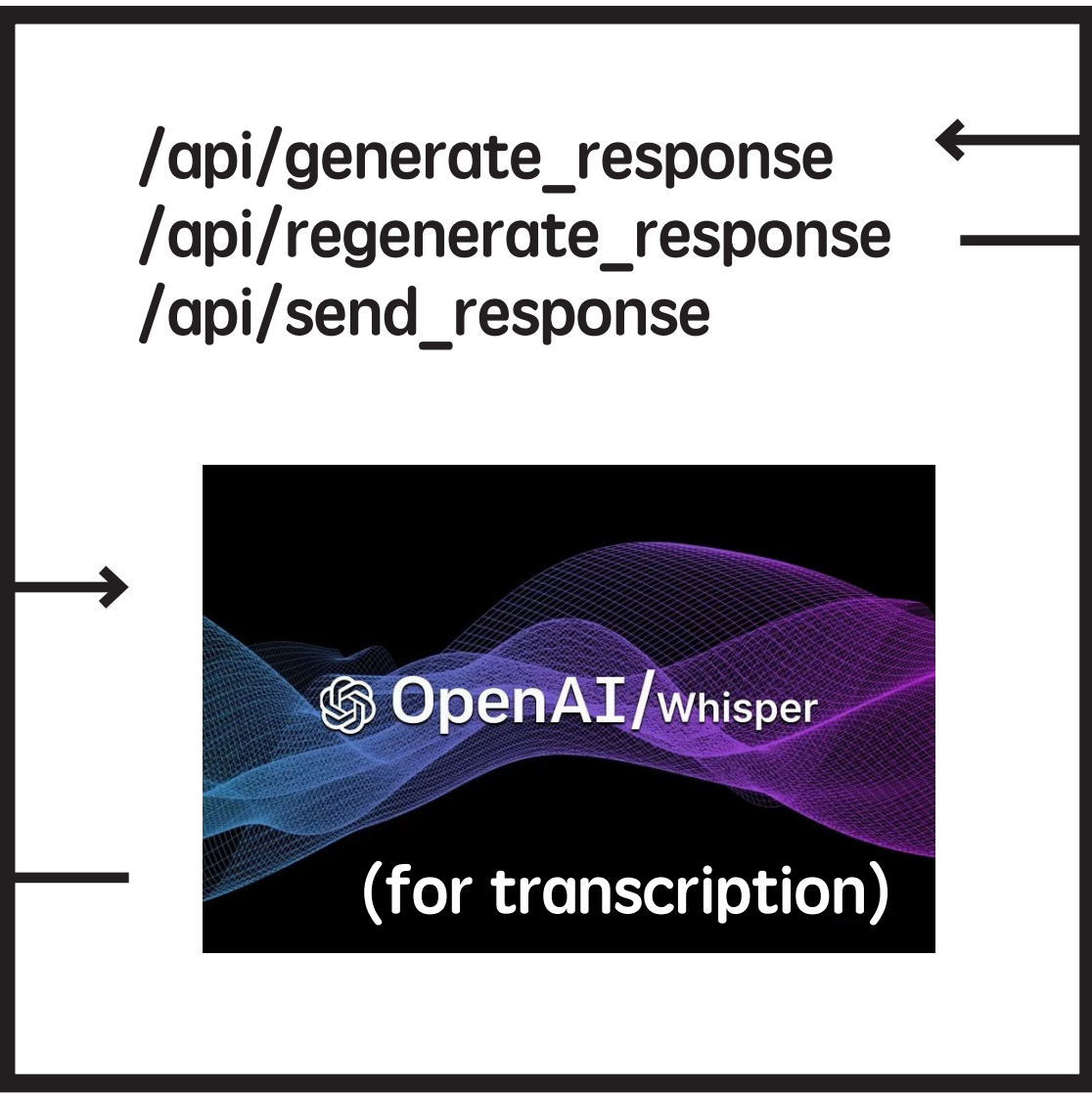
Creating an Autonomous Design Agent for Future User Studies

Voice Assistant Interface

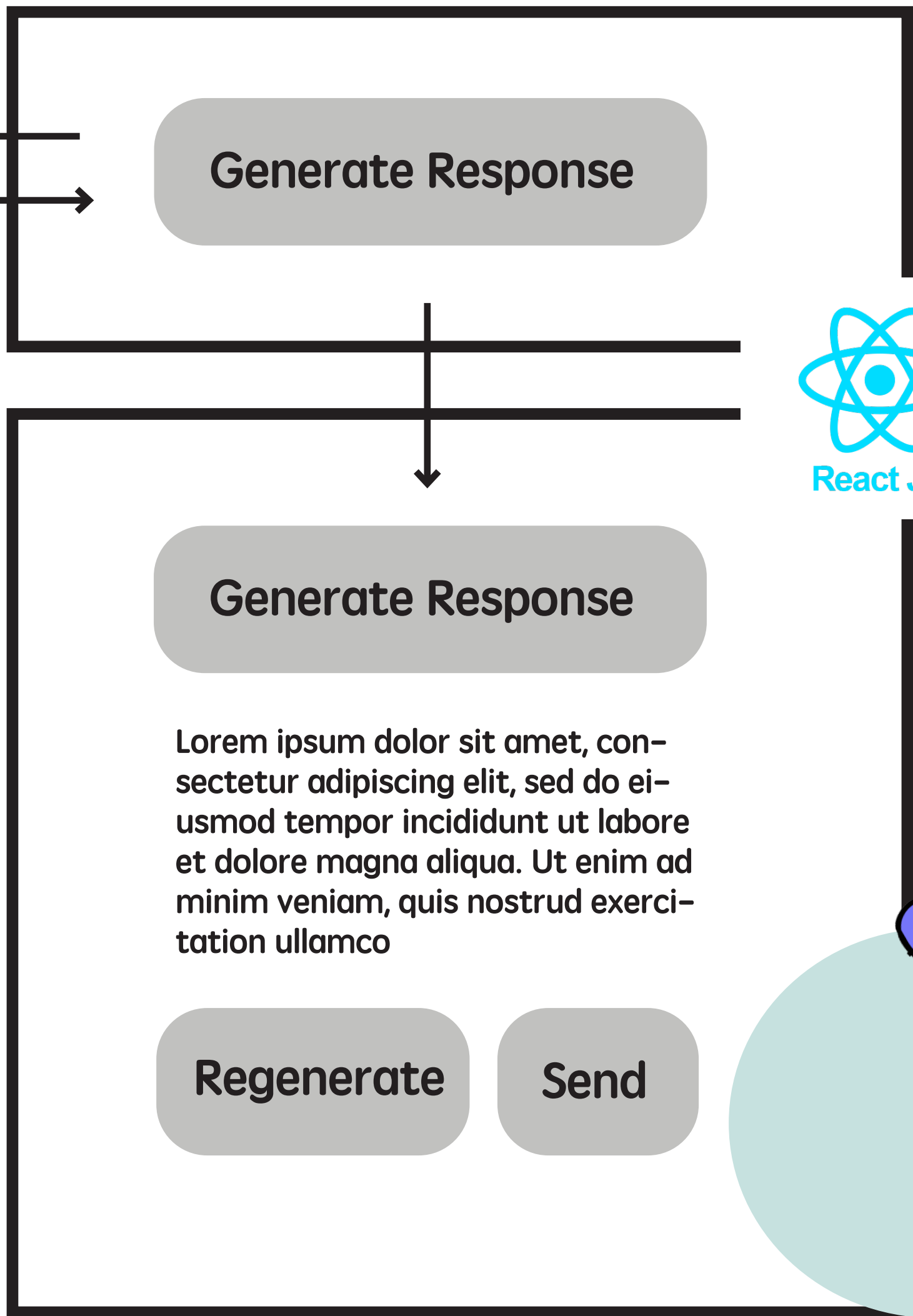


User

Express Server



Wizard Interface



Current Problems

- realtime transcription
- latency
- multi-modal support

Wizard