Optimizing communication interfaces for unmanned flight supervision

Project Overview

Wisk Aero is revolutionizing urban air mobility with autonomous, unmanned flying taxis. While these systems operate independently, **human oversight** is essential for safe monitoring and timely intervention during unexpected events.

Scope of the Challenge

Design and optimize a user interface that enable **multi-vehicle supervisors** to safely and efficiently monitor multiple autonomous flights simultaneously. The UI must support real-time situational awareness, reduce cognitive load, and scale effectively as operations expand.

UX Research Approach

Led user-centered research to **identify, evaluate, and refine interface features** that enhance human-in-the-loop flight supervision.

Formative Usability Study

Evaluated **performance across two iterative UI prototypes** for communication under complex use scenarios. The study focused on identifying which design better supported accurate and timely user response under cognitive load.

- **Participants:** ~50 users across multiple studies
- **Use Scenarios:** Simulated communication tasks requiring attention-switching, memory recall, and rapid response

Design & Evaluation Considerations

User-Centered Factors:

- Attentional capacity, working memory span, perceptual limitations in processing information and responding to high-pressure situations.

Regulatory Requirements:

- FAA standards for response accuracy and Air Traffic Control (ATC) compliance time

Design-Specific Criteria

- Evaluated use of industry-standard icons and widgets
- Assessed recognizability, interpretability, and ease-of-use for domain-specific UI components

Methods

- **Usability studies and within-group A/B testing** to compare prototype designs and assess user performance across interface variations
- **Workload simulations** informed by detailed task analysis to model cognitive strain in high-stakes supervision scenarios
- **Eye-tracking and physiological monitoring** (e.g., heart rate variability, skin conductance) to capture real-time indicators of user attention and stress
- **Structured post-scenario interviews** to gather in-depth qualitative feedback on user experience and interface intuitiveness
- **Self-report rating scales** to quantify perceived mental workload and validate objective workload measures

Data variables

Behavioral Performance:
Response accuracy and *response time (RT)* to assess task compliance and decision speed

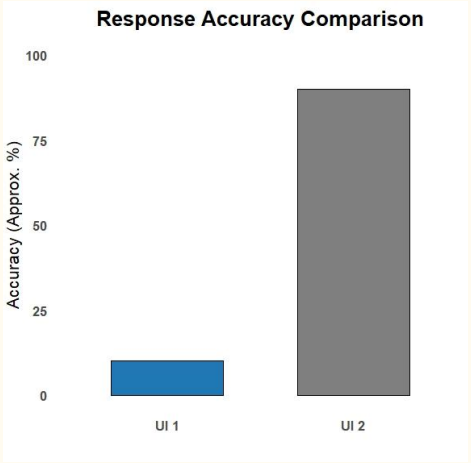
Physiological Indicators:
Eye-tracking metrics (e.g., fixation duration, gaze path) to evaluate attention allocation
Biometric signals (e.g., heart rate, heart rate variability) to infer cognitive load and stress levels

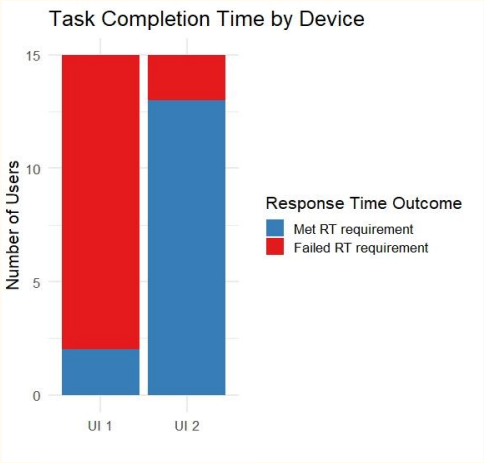
Self-Reported Workload:
Scores from standardized mental workload scales to assess subjective cognitive strain

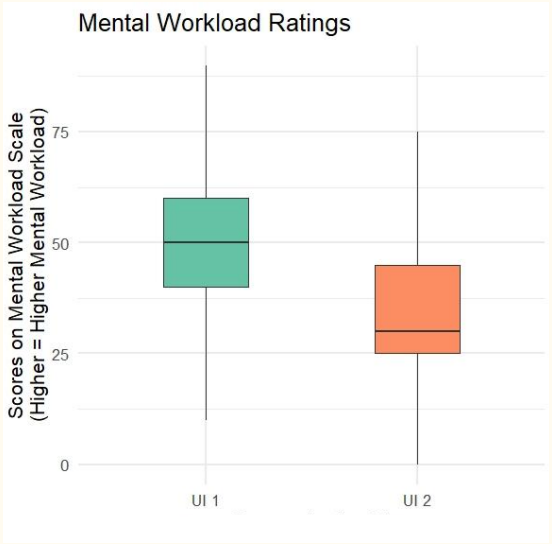
User feedback through structured interviews:
Thematic analysis of interview responses

Results

- **UI #2 improved response accuracy by over 700%** compared to UI #1, significantly enhancing task performance during critical use scenarios.
- **Use of UI #2 resulted in a 500%+ increase** in the number of users who successfully met FAA-defined response time (RT) requirements.
- **Objective response accuracy closely aligned with self-reported mental workload scores**, reinforcing the relationship between cognitive demand and task performance.







Qualitative analysis

Thematic analysis of user feedback revealed usability pain points, including:

- Low visibility and suboptimal placement of critical UI elements
- Ergonomic discomfort with physical communication devices
- Increased reports of *attentional overload* and *mental strain* when using **UI #1** compared to **UI #2**