Usability Engineering Strategy for Volvo's AI-Based Smart Car System

Yaswanth Rahul Yarlagadda
Email: yayr24@student.bth.se

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1 Introduction

As smart automotive systems increasingly incorporate AI technologies, the usability of these systems becomes central to ensuring a positive and safe experience for users. This report presents a human-centered usability engineering approach, informed not only by theoretical knowledge but also by practical design experience. While redesigning the Arngren.net website—a highly cluttered and unresponsive platform—I developed a deeper understanding of how structured, accessible, and adaptive design can significantly improve user experience. Drawing from these insights, I propose a strategy to develop a responsive and inclusive smart vehicle system that adapts to real-world use cases.

2 Understanding Users and Their Needs: The PACT Framework

To create a truly usable system, it's essential to consider all factors that affect how people interact with technology. The PACT framework—People, Activities, Contexts, and Technologies—offers a structured way to identify these variables [1].

2.1 People

Different types of users will interact with Volvo's smart system: tech-savvy youth, older adults, individuals with limited mobility, and families. Each group brings distinct expectations and challenges. Interfaces must be inclusive and considerate of varied cognitive and physical abilities, ensuring ease of use across demographics.

2.2 Activities

Users will perform tasks such as adjusting settings, navigating routes, communicating hands-free, and engaging with infotainment systems. Each of these activities must be streamlined to minimize cognitive load and distractions, particularly while driving.

2.3 Contexts

Cars are used in an array of scenarios—from calm highway cruising to hectic city traffic, and from daylight to adverse weather conditions. My redesign of Arngren.net emphasized responsiveness across screen sizes and devices. Similarly, the car system must dynamically adjust to external conditions and user states, offering optimal interaction in each scenario.

2.4 Technologies

Modern car interfaces include AI-based voice assistants, touch displays, gesture recognition, and augmented reality overlays. These technologies must be integrated thoughtfully so they enhance—not hinder—the user experience [4].

3 Applying the Usability Engineering Life Cycle

The development process will follow the Usability Engineering Life Cycle [3], ensuring user input drives every decision:

1. **Requirements Analysis:** Through interviews, observation, and co-design workshops, we'll gather insights from real users to uncover both needs and frustrations.
2. **Prototyping:** Ideas will be turned into wireframes, mockups, and interactive prototypes. When working on Arngren.net, early sketches helped identify poor visual hierarchy—this iterative exploration will similarly guide interface layouts in the car system.
3. **Evaluation:** Every iteration will be tested using techniques like A/B testing and cognitive walkthroughs. This ensures the design is both effective and intuitive [2].
4. **Implementation and Feedback:** Once deployed, the system will continue evolving through user feedback and behavior analytics, similar to how I continuously refined website usability post-launch.

4 Cognitive Psychology and Design Principles

The human brain has limits—especially under stress or multitasking, such as while driving. Designs must respect these limitations [2]:

- **Chunking:** Group related controls together—climate settings, media controls, etc.—so they're easier to locate and remember.
- **Progressive Disclosure:** Avoid showing too much at once. Gradually introduce features so users learn by doing, without feeling overwhelmed.
- **Familiarity:** Align interface structure with user expectations. Just like in websites, consistency reduces errors and speeds up learning.

5 User Experience and Emotional Design

A good system does more than function—it connects emotionally. In the Arngren.net redesign, subtle improvements like organized menus and gentle transitions made the interface feel welcoming. In the car context, such emotional touches include:

- **Gamification:** Provide feedback on eco-friendly habits or safe driving patterns.
- **Ambient Responses:** Adaptive lighting, sounds, and visuals that reflect mood or driving conditions.

These features help drivers build a sense of comfort and control [2].

6 Human-AI Interaction and Adaptation

6.1 Transparency and Trust

For AI features like route suggestions or automated decisions, transparency is key. Users must understand why a certain recommendation is made—just as users of a website need clear navigation and labels [4].

6.2 Learning Preferences

The AI should adapt over time—suggesting frequent routes or remembering seat positions—but always with user control and override options. This fosters trust and prevents frustration [5].

7 Hierarchical Task Analysis (HTA)

Breaking down tasks into logical steps is essential. Whether adjusting cabin temperature or syncing a mobile device, users should always know where they are in the process. During the Arngren.net project, I simplified multi-level menus using this same logic [1].

8 Evaluation and Feedback Loops

Evaluation isn't a final step—it's ongoing. Tools and methods include:

- **User Testing:** Simulated and real-world testing with diverse participants.
- **Expert Reviews:** Heuristic evaluations and expert-led walkthroughs.
- **Feedback Mechanisms:** In-system prompts and feedback forms.
- **Error Logs:** Track misused features or repeated actions to refine design.

These strategies mirror the testing cycles I applied in the website project, ensuring insights translate into real improvements.

9 Constraints, Affordances, and Global Design

- **Affordances:** Controls should hint at their function—buttons that feel pressable or sliders that resemble dials [2].
- **Cultural and Hardware Constraints:** The design must accommodate different languages, habits, and driving laws. Similar to optimizing Arngren.net across global devices, the system must adapt to cultural contexts.

10 Conclusion

A usable AI-powered car system must be deeply rooted in empathy, design thinking, and practical experience. The process I followed while redesigning Arngren.net—from deconstructing its flaws to building a structured and user-friendly version—reflects the mindset I will bring to this role. My focus will be on making technology feel seamless, respectful of users' time and attention, and above all, safe and trustworthy.

References

References

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