'Talking with your car'

A Design Exploration of Human-Centered Conversational AI in Autonomous Vehicles

Introduction

The development of Fully Autonomous Vehicles would fundamentally change the nature of user interactions, behaviors, needs, and activities within vehicles. Passengers who are free from driving would expect to undertake diverse in-vehicle Non-Driving-Related Tasks (NDRTs) to keep themselves occupied and free from boredom. Conversational Artificial Intelligence with its ability to have free-flowing conversations could offer a solution to improve in-vehicle user experience. Our literature review pointed to a research gap wherein what nature of conversations would passengers want to have with Conversational AI in fully Autonomous Vehicles (level 5) when involved in Non-Driving Related Tasks (NDRTs) or are free from driving activity had not been studied. The scenarios of usage also hadn't been established in these. Future opportunities for innovation would lie in understanding these finer points. As a result, the following research questions evolved to be explored further.

RQ1: What roles and relationships can Conversational AI play towards users in Fully Autonomous Vehicles?

RQ2: How do users qualitatively assess the embodied user experience provided by Conversational AI roles and relationships designed for Fully Autonomous Vehicles?

Keywords:
Design guidelines, Human-Autonomous Vehicle interaction, Human-Artificial Intelligence interaction, Conversational AI roles and relationships, user experience
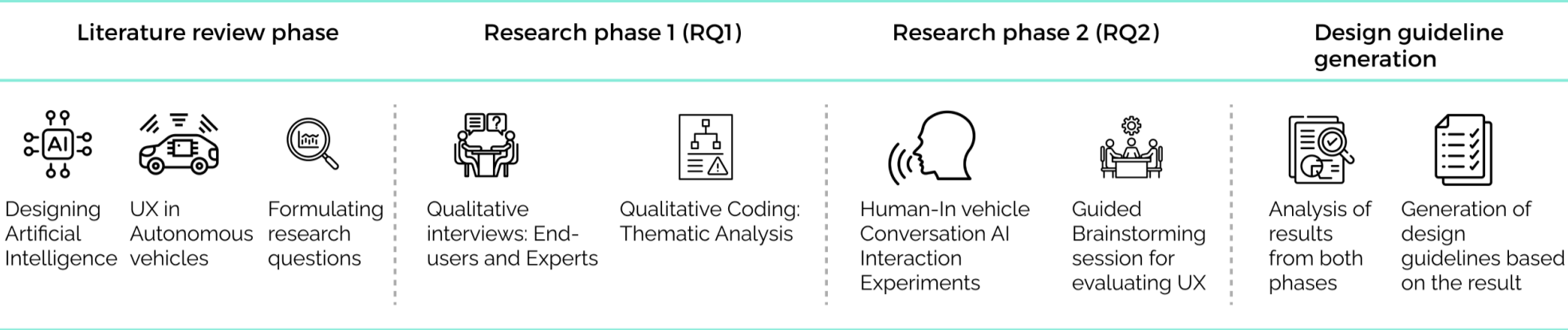
Method

Fig 25: The design research process.

To explore design innovation opportunities that Conversational AI may offer within Fully Autonomous Vehicles, this work first researches what roles and relationships can Conversational AI play towards users of fully Autonomous Vehicles. These are investigated by conducting qualitative interviews of end-users and subject matter experts, and analyzing these interviews using the Thematic Analysis method. Second, this work examines how end-users qualitatively assess the embodied user experience provided by Conversational AI roles and relationships designed for Fully Autonomous Vehicles through the means of user-technology interaction experiments. These are conducted by employing a combination of participant role enactment method and a Wizard of Oz experimental setup with a mock Conversational AI operated within a prototyped Autonomous Vehicle under laboratory conditions. Ensuing these interaction experiments, the qualitative assessment of these in-vehicle Conversational AI roles and relationships was done by conducting guided brainstorming sessions using the parameters outlined in the Subjective Assessment of Speech System Interfaces (SASSI) questionnaire along with two free-from questions. Results from both phases are presented in the form of user-desired in-vehicle Conversational AI roles, aspects that would enable the forming of Human-Autonomous Vehicle relationships mediated by Conversational AI, and user experience evaluation of the embodied idea. Based on these results, design guidelines are articulated that are aimed to inform design professionals as well as internal design strategies of Autonomous Mobility and Artificial Intelligence companies looking to innovate.
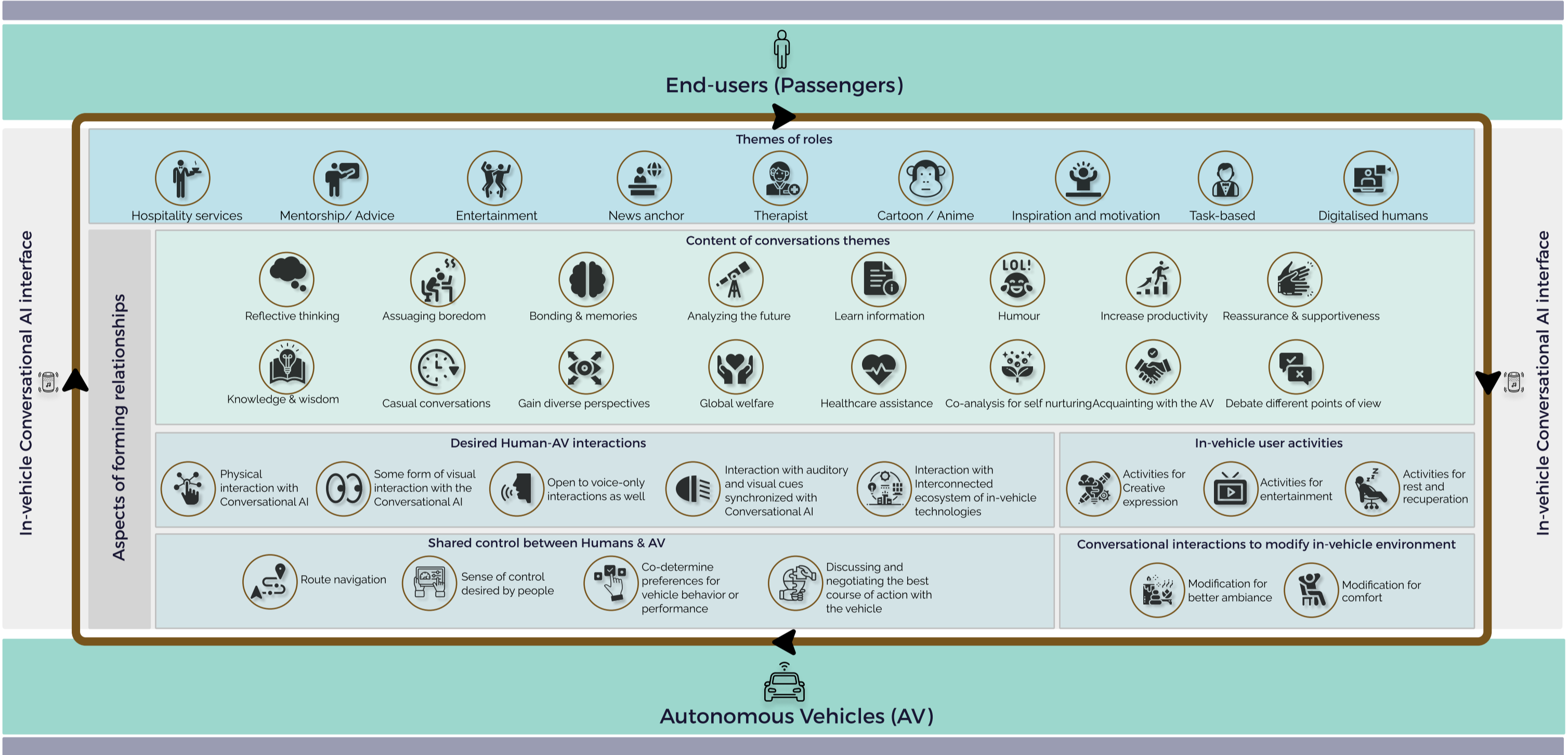
Results

Fig 42: Summary diagram explaining user desired in-vehicle Conversational AI roles and components of forming Human-AV relationships mediated by the Conversational AI.

Design Guidelines

Guidelines to inform the design of Conversational AI user interface in Autonomous Vehicles

(1) Conversational AI interfaces should integrate into an ecosystem of technologies within and beyond Autonomous Vehicles to provide a seamless user experience.

(2) The design of in-vehicle Conversational AI should not conceal characteristics that reflect its artificial nature but rather leverage them in implementing the roles to provide an authentic user experience.

(3) The design of Conversational AI should apply a relationship-based rather than task-based user interaction paradigm, to establish and maintain user perception of its usefulness over time.

(4) Conversational AI roles should be aware of and be able to converse about the vehicle's external environment regardless of the role it's playing.

(5) The design of the Conversational AI should communicate to users the limits of its capabilities to avoid unsuccessful user interactions.

(6) A system of reassuring users regarding ethical usage of their data should be developed, as part of Conversational AI's recurring maintenance and update procedure to nurture customer-organization relationships.

(7) Conversational AI should be judiciously implemented in order not to annoy or overwhelm the passengers of Autonomous Vehicles.

Guidelines to inform the design process

(1) Autonomous Mobility and AI companies should imbibe user-centric thinking into their design process to increase designer attentiveness to providing a personalized user experience.

(2) Develop an organization-passenger feedback loop to detect and ameliorate undesirable effects of Conversational AI towards passengers in Autonomous Vehicles.

Limitations

Firstly, users' behavior, activities, and needs with the Conversational AI in Autonomous Vehicles, might differ based on in-vehicle occupants and fellow travelers. This research hasn't tested the effect of individual versus shared in-vehicle occupancy on user interaction with Conversational AI.

Secondly, the scenarios of vehicle ownership versus vehicle as shared public transport could have an effect on user interaction with its Conversational AI.

Thirdly, as this study was conducted in a simulated environment, it wasn't able to account for the effects of on-road conditions such as distractions, changing visuals, motion so on and so forth on in-vehicle passengers and their experience.

Conclusion

This research generated a list of roles and aspects of relationships with the in-vehicle AI that design and engineering organizations can access to further develop and implement in the products and services they offer.

The top 3 conversational AI roles that emerged were AI Advisor (Mentor), AI Tour guide & AI Storyteller. Further, aspects that will enable Conversational AI mediated Human-AV relationships are user desired content of conversations, in-vehicle user activities, in-vehicle user interactions & some forms of shared control.

Further, qualitative assessment of the user experience presented in the paper can give a sense of direction to organizations when designing product/ service embodiments of Conversational AI in Autonomous Vehicles. This was based on the parameters of (1) Likeability, (2) System Response Accuracy, (3) Cognitive Demand, (4) Annoyance, (5) Intuitiveness, (6) Speed, (7) Embodiment & (8) quality of idea.

This assessment can enable organizations to think from a human-centered perspective by understanding the positive and negative qualities of the embodiment of roles and relationships.

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TUDelft x **Stanford**

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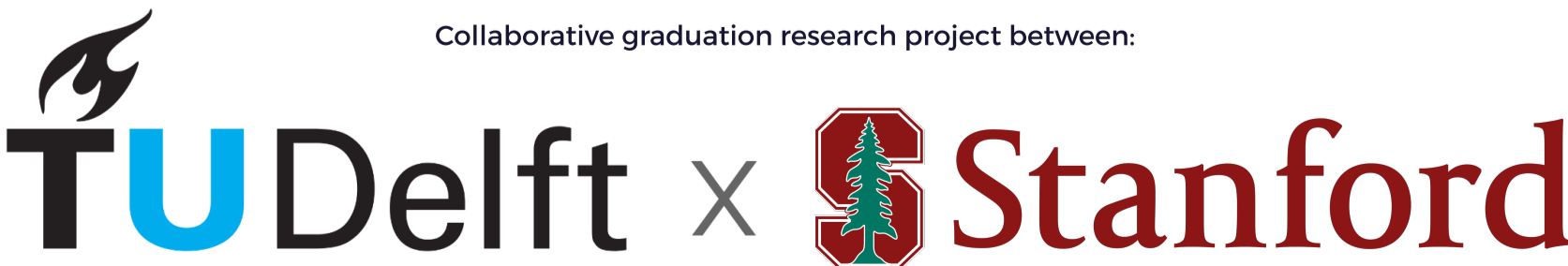
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