STUDY AND ANALYSIS ON HUMAN COMPUTER INTERACTION FOR AUTONOMOUS SYSTEM

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ABSTRACT

The interaction between drivers and their cars will change significantly with the introduction of autonomous vehicles. The driver's role shifts to supervisory control of the autonomous vehicle. The eventual relief from driving enables new areas of research and practice in human-computer interaction and interaction design. In this one-day workshop, participants will explore the opportunities the design space of autonomous driving can bring to HCI researchers and designers. On the day before the workshop, participants are invited to visit (with workshop organizers) Google Partnerplex and Stanford University. At Google, participants will have the opportunity to explore Google's autonomous car simulator and have the chance to experience one of the Google Cars (if available). At Stanford, participants are invited to ride in a Wizard-of-Oz autonomous vehicle. Based on this first-hand experience, we will discuss design approaches and prototype interaction systems during the next workshop. The outcome of this workshop will be a set of concepts, interaction sketches, and low-fidelity paper prototypes that address the constraints and potential of autonomous driving.

In the field of artificial intelligence, human-computer interaction (HCI) technology and its related intelligent robot technologies are essential and interesting contents of research. From the perspective of software algorithms and hardware systems, these above-mentioned technologies study and try to build a natural HCI environment. The purpose of this research is to provide an overview of HCI and intelligent robots. This research highlights the existing technologies of listening, speaking, reading, writing, and other senses, which are widely used in human interaction. Based on these same technologies, this research introduces some intelligent robot systems and platforms.

We argue that a general theory of trust in networks of humans and computers must be built on both a theory of behavioral trust and a theory of computational trust. This argument is motivated by increased participation of people in social networking, crowdsourcing, human computation, and socio-economic protocols, e.g., protocols modeled by trust and gift-exchange games [3, 10, 11], norms-establishing contracts [1], and scams [6, 35, 33]. User participation in these protocols relies primarily on trust, since on-line verification of protocol compliance is often impractical; e.g., verification can lead to undecidable problems, co-NP complete test procedures, and user inconvenience. Trust is captured by participant preferences (i.e., risk and betrayal aversion) and beliefs in the trustworthiness of other

protocol participants [11, 10]. Both preferences and beliefs can be enhanced whenever protocol noncompliance leads to punishment of untrustworthy participants [11, 23]; i.e., it seems natural that betrayal aversion can be decreased and belief in trustworthiness increased by properly defined punishment [1].

➢ KEYWORDS

- Human-computer interaction (HCI)
- Autonomous vehicles
- Supervisory control
- Interaction Design for AVS and Robot
- intelligent robot
- Human-AI Collaboration
- Behavioral and Computational Trust

Introduction

Human-Computer Interaction (HCI) for autonomous systems is a rapidly expanding field that focuses on understanding and improving the interaction between humans and AI-driven technologies, including autonomous vehicles, robot technologies and learning systems. The objective is to create intuitive, safe, and efficient systems that foster trust and empower users while ensuring seamless integration of human oversight. As autonomy becomes more prevalent, such systems must support human decision-making while maintaining safety, efficiency, and usability.

In an increasingly automated world, trust between humans and autonomous systems is critical for successful integration of these systems into our daily lives. In particular, for autonomous systems to work cooperatively with humans, they must be able to sense and respond to the trust of the human. This inherently requires a control-oriented model of dynamic human trust behavior. In this paper, we describe a gray-box modeling approach for a linear third-order model that captures the dynamic variations of human trust in an obstacle detection sensor. The model is parameterized based on data collected from 581 human subjects, and the goodness of fit is approximately 80% for a general population. We also discuss the effect of demographics, such as national culture and gender, on trust behavior by re-parameterizing our model for subpopulations of data. These demographic-based models can be used to help autonomous systems further predict variations in human trust dynamics.

Automated vehicles will change the trucking industry as human drivers become more absent. In crossing scenarios, external communication concepts are already evaluated to resolve potential issues. However, automated delivery poses unique communication problems. One specific situation is the delivery to the curb with the truck remaining partially on the street, blocking sidewalks. Here, pedestrians have to walk past the vehicle with reduced sight, resulting in safety issues. To address this, we conducted a literature survey revealing the lack of addressing external communication of automated vehicles in situations other than crossings. Afterwards, a study in virtual reality (N = 20) revealed the potential of such communication. While the visualization (e.g., arrows or text) of whether it is safe to walk past the truck only played a minor part, the information of being able to safely walk past was highly appreciated. This shows that external communication concepts carry great potential besides simple crossing scenarios.

➢ **Key Insights**

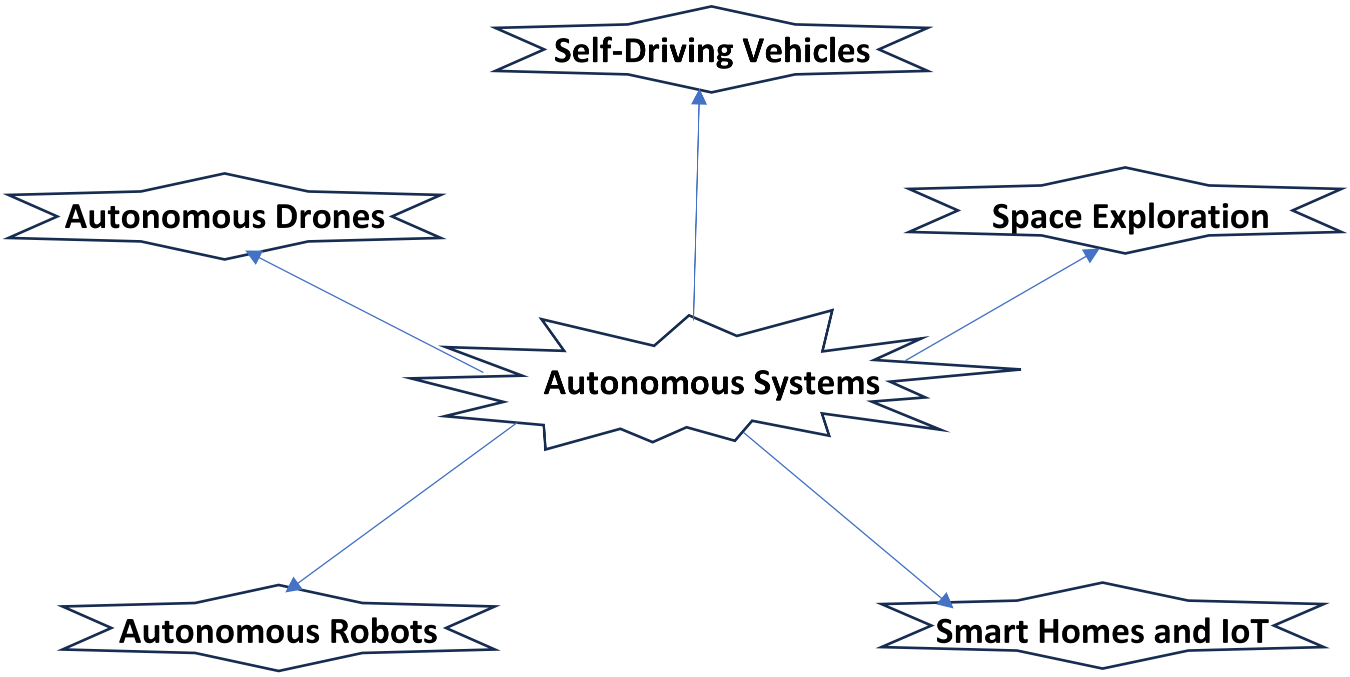
Supervisory Control and Interaction Design in Autonomous Vehicles:

As vehicles become autonomous, the driver's role shifts from direct control to supervisory oversight, which requires new approaches in HCI and interaction design. This shift presents opportunities for research into how users transition between automated and manual control, share authority with the system, and develop trust.

Expanding Research to Other HCI Domains: While automated vehicle interaction has received significant attention, insights from other HCI fields—such as human-robot interaction (HRI), aerospace, space exploration, conversational agents, and smart devices—offer valuable lessons. These fields have explored human-automation collaboration for decades, providing knowledge about key interaction challenges, including managing control transitions, fostering trust, and addressing ethical considerations.

The workshop brings together experts to exchange ideas across these domains and address design challenges in autonomous driving. In addition, keynote speakers will explore topics such as trust building, ethics, user experience, and control transition, applying insights from various disciplines to develop innovative design solutions.

Types of Autonomous Systems



II. METHODOLOGY

III. CONCLUSION AND FUTURE WORK

IV. ACKNOWLEDGEMENT

REFERENCES:

[1] Gligor, V., Wing, J.M.: Towards a Theory of Trust in Networks of Humans and Computers. In: Christianson, B., Crispo, B., Malcolm, J., Stajano, F. (eds.) Security Protocols 2011. LNCS, vol. 7114, pp. 223–242. Springer, Heidelberg (2011). [Available Online: https://link.springer.com/chapter/10.1007/9 78-3-642-25867-1_22].

[2] Akash, K., Hu, W.L., Reid, T., Jain, N.: Dynamic modeling of trust in human-machine interactions. In: 2017 American Control Conference (ACC), pp. 1542–1548. IEEE (2017). [Available Online: https://ieeexplore.ieee.org/document/7963172]

[3] Yong Wu, Journal of Information & Knowledge Management, 2022 [Available Online: https://www.worldscientific.com/doi/10.1142/S0219622019300052?srsltid=AfmBOooc3oJxwvqwtHMATKTR45zYnBpBCOAQkG-YPcToxn3_Zr935cHb]