
On the Road with Autonomous Vehicles: Interactions of Driver, Passenger, and Other Road Users

Erik Vinkhuyzen, PhD

Nissan Research Center Silicon
Valley
1215 Bordeaux
Sunnyvale, CA 94089
Erik.Vinkhuyzen@nissan-usa.com

Melissa Cefkin, PhD

Nissan Research Center Silicon
Valley
1215 Bordeaux
Sunnyvale, CA 94089
Melissa.Cefkin@nissan-usa.com

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Abstract

Autonomous vehicles promise to transform not just the experiences of people inside the car cabin, but also that of other users of the road. Driving/riding experiences are known to afford particular kinds of interactions with each other and the surroundings. As driving shifts from controlling to supervising to riding, what new opportunities for connections and interaction are enabled? We see an opportunity to shape the behavior of the autonomous vehicles and to design technologies, focused on external HMI, that make their intentions transparent to other road users.

Author Keywords

Autonomous Vehicles; External HMI; road-user interactions; socially acceptable autonomous driving; ethnography, HCI

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction

The promise of autonomous vehicles is that they will make traffic safer and more convenient, changing drivers to passengers, and have potentially far-reaching impact on the economy, quality of life, and the environment. Not only will the inside experience of the car be affected by increasingly autonomous driving, but

the experience of other road users will be impacted as well. At Nissan Research the Human Understanding and Design group (HUD) is helping to design the autonomous vehicle's behavior and communications so as to assure that autonomous driving is socially acceptable in a variety of real world contexts.

Actions by the autonomous car must adhere to the laws of the road – which can differ from state to state, country to country. Equally important, it must participate effectively given social norms that go beyond the laws of the road that invariably underspecify and under-constrain road users' actions. To make matters even more complicated, these social conventions are contingent on the local culture, and differ by time and place.

We are each bringing years of user experience and social-technical research in the context of high-tech and digital system design to the development of autonomous vehicles. We are using a mixture of research methods, including video ethnography, to study traffic situations and road user behavior. We are trying to discern the methods road users use to move around and communicate to other road users. These methods have shown that especially in self-organized intersections such as four-way stops, conflicts that arise between drivers, pedestrians, and bicyclists are often resolved by way of direct communication to establish the order in which they can traverse the intersection.

We believe that both laws and social conventions will adapt and adjust as autonomous driving develops. Some questions we are grappling with are: how will road use practices change? How will the design of

autonomous vehicles shape our 'driving' experience? How will AVs affect people's relationship with their cars? What impact will AVs have on the business models of car manufacturers, public and private transportation services, car rental organizations, etc.?

We recognize the limitations of autonomous vehicles to interact directly with other road users, but see an opportunity to shape the behavior of the autonomous vehicles to make their intentions transparent to other road users. We call this external Human-Machine Interaction (HMI) to contrast it with internal HMI, which concerns the way an autonomous vehicle communicates with its driver/passenger. We have developed and are currently testing early prototypes of an intention indicator, a technology that communicates to other road users that the autonomous vehicle's sensors have noticed them, and to indicate the action the autonomous vehicle is about to take, whether this be yielding, planning to go, or going.

Our particular interest in this workshop lies in exploring the interface between the inside-the-car experience and its connection to the outside world. Driving/riding experiences are known to afford particular kinds of interactions with each other and the surroundings. As driving shifts from controlling to supervising to riding, what new opportunities for connections and interaction are enabled? What 'old' practices and experiences are at risk of being lost and in what ways can we and should we be mindful of how those experiences are being disrupted?

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