Towards Designing Collocated User Interfaces for Autonomous Vehicles

Jessica R. Cauchard
Interdisciplinary Center Herzliya
Herzliya, Israel
jcauchard@acm.org

Position paper submitted to CHI 2018 workshop "Interacting with Autonomous Vehicles: Learning from other Domains"

Abstract
The last few years have seen the emergence of autonomous vehicles on the consumer market. In the near future, one can imagine these vehicles bringing people from point A to point B. Passengers will then simply enjoy the ride, while the autonomous vehicle will combine the advantages of today's public and private means of transport. Yet, as vehicles become increasingly autonomous, researchers foresee many years of partial autonomy. This will then require mediation between people and machines. In the case of a partially autonomous vehicle, who will then be in charge of making the decisions? Will the vehicle's behavior be a result of the machine's artificial intelligence, to its owner's preferences, or to its current user's choices? In this position paper, I describe how the notions of ownership and autonomy can be intertwined and suggest avenues of future research in designing appropriate human-computer interfaces with autonomous vehicles.

Author Keywords
autonomous devices; robots, drones, anthropomorphism; human-robot interaction

Introduction
Autonomous devices and vehicles are increasingly present in our environments. They can be found in the home,

such as conversational agents and smart devices; or outside, such as drones and cars. Despite this increasing autonomy, we envision that in the next few decades devices will only be semi-autonomous. This will be a time where people will develop an understanding of what it means to have autonomous devices in our environment; a time to discuss and legislate around their usage.

A key element to successfully integrating autonomous vehicles in our societies is to design appropriate interfaces that people can understand. In the past, technology has been rejected for several reasons, such as: its advantages not superseding its drawbacks, because it was not acceptable, and sometimes even for political gain. For example, supersonic flights with the Concorde plane were stopped from operating for several political and economical reasons. This took us 20 years back in terms of revolutionizing the way we fly. Google glass is another example of rejected technology where non-users felt uncomfortable with the notion that the wearer could be recording them without their knowledge or consent.

For autonomous vehicles to be accepted, it is paramount to develop adapted user interfaces; where people can understand what is happening and retain some level of control. We cannot allow a future where cars end up blocking streets because passengers do not know how to work out the interface!

This position paper describes how the autonomous vehicles' user interface needs to consider both ownership and level of autonomy in the context of collocation.

Ownership and Autonomous Devices

Three types of devices' ownership are being considered below: Primary, Shared, and Public. These relate to the device's use and not its digital content.

- Primary ownership: e.g., a person mobile phone with a sole user.
  The owner should havethe opportunity to learn how to best use the autonomous device through a user manual or tutorial. S/he should understand its abilities, at least some of its functionalities, and also be able to personalize it. In case of difficulties, the owner can contact the customer service to ask for support.

- Shared ownership: e.g., a TV shared amongst family members [2, 4].
  Decisions around the device might be taken by one or several co-owners, resulting in similar conditions than with primary ownership. We can envision multi-user personalization such as with a car seat with multiple preset positions.

- Public property: e.g., a city bike that can be rented for the hour or the day [7].
  This would be the case when a person leases an autonomous car. In this situation, what could the renter do with the car? What would be acceptable compare to if it was their own vehicle? Could they ask the car to go and pick up another person? Would it be rude in their society to ask the car to do so, or even rude to the person waiting [5]? Prior work shows that people are concerned with politeness when talking to robots and drones [1]. Could a polite or welcoming vehicle make a difference?

One major difficulty in terms of acceptability is the situation when a person is confronted with an autonomous device they are not familiar with. We define this as potential unwilling interactions.

(Un)willing Interactions

In most of today's human-machine interaction, the human initiates the communication. This means that the user makes a conscious decision to go and interact with a piece of technology. The device can be their own mobile phone, an ATM, or even an autonomous cab. In the case of autonomous devices, we imagine situations where a person may not want to interact with the technology but has to. Today, this happens when a person calls a phone service and is constrained to deal with an automated voice system.

Figure 1: A search-and-rescue drone looking for a missing person asks a hiker for information. This is an unexpected interaction for the hiker, who should be willing to help.

In the future, we can foresee new unexpected interactions with technologies. For instance, in a search-and-rescue context, a person could have to interact with a drone in order to inform the rescue team of their presence (Figure 1). The person might have preferred to interact with another human being, yet they will likely be willing to interact with the flying robot.

However, there might be situations in which people will be unwilling to interact with such technologies, to the extent that they could seek to destroy it. For example, we have recently seen destructive behaviors with people shooting down drones [6]. This could have happened because the person felt threatened, did not understand its purpose, or who it belonged to.

Such behaviors are led by a lack of interaction between the device and people around it. Providing adaptive user experiences catered for non-users and short impromptu interactions will prevent such incidents from happening.

Collocated Interactions

Most human-machine interfaces are developed with the primary user in mind, regardless of ownership. In the future, we will need to design interfaces for collocated interactions with autonomous objects. Researchers and practitioners should consider both willing and unwilling users. Future research questions include: How can technology convey information about its goals and activities? How can an autonomous device operate safely (Figure 2)? How can a person ask an autonomous device for help or support?

The occurrence of such situations will increase with the added autonomy in devices. One of the biggest challenges in integrating autonomous vehicles into the everyday environment is going to be around impromptu collocated interactions. For example, in 2016, an autonomous safety robot hit a child at the Stanford shopping center [3]. It is most likely that the robots' designers focused on the monitoring task and did not take into consideration the behavior of excited children. By creating adapted interfaces between people, robots, and vehicles, we will be able to cater for impromptu usages and serendipity.

Figure 2: An autonomous car needs to take in consideration people around them. Photo: Volvo Car [8].

Conclusion

The successful adoption of autonomous vehicles will depend on how well people understand these technologies. People need to interact with the devices regardless of their ownership status. Researchers, designers, and practitioners need to take in consideration the ecosystem in which the autonomous vehicles will operate. This includes considerations around Accountability, Trust, Understanding of Intent, Respect, Privacy, and Usability. As the research and the adoption of such technology evolves, we can look forward to different habits forming around semi-autonomous devices.

References

[1] Cauchard, J. R., E, J. L., Zhai, K. Y., and Landay, J. A. Drone & me: an exploration into natural human-drone interaction. In *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing - UbiComp '15*, ACM Press (New York, New York, USA, 2015), 361–365.

[2] Gruning, J., and Lindley, S. Things We Own Together: Sharing Possessions at Home. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16*, ACM Press (New York, New York, USA, 2016), 1176–1186.

[3] Knowles, H. Stanford Shopping Center: Mall docks robot cops after kid hit, 2016. https://www.mercurynews.com/2016/07/12/stanford-shopping-center-mall-docks-robot-cops-after-kid-hit/.

[4] Krumm, J., and Inkpen, K. M. Yours, mine and ours? sharing and use of technology in domestic environments. In *Proceedings of the 9th international conference on Ubiquitous computing*, Springer (2007), 109–126.

[5] Salem, M., Ziadee, M., and Sakr, M. Marhaba, how may i help you?: effects of politeness and culture on robot acceptance and anthropomorphization. In *Proceedings of the 2014 ACM/IEEE international conference on Human-robot interaction - HRI '14*, ACM Press (New York, New York, USA, 2014), 74–81.

[6] Schneier, B. Is it OK to shoot down a drone over your house? - CNN, 2015. https://edition.cnn.com/2015/09/09/opinions/schneier-shoot-down-drones/index.html.

[7] Tomaras, D., Boutsis, I., and Kalogeraki, V. Lessons Learnt from the analysis of a bike sharing system. In *Proceedings of the 10th International Conference on PErvasive Technologies Related to Assistive Environments - PETRA '17*, ACM Press (New York, New York, USA, 2017), 261–264.

[8] Volvo Car France. Volvo Car Group presente la voiture qui se gare toute seule, 2013. https://www.media.volvocars.com/fr/fr-fr/media/pressreleases/49569.