Poster: Preliminary Study - People's Opinion on Social Robots for Traffic Orchestration

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***Abstract*—Vehicle-to-Everything (V2X) communication enables vehicles to exchange information with other road users and infrastructure to improve road safety and traffic efficiency. However, how Vulnerable Road Users (VRUs), can effectively benefit from this technology remains an open question. One emerging concept is the use of social robots equipped with V2X capabilities to support traffic orchestration and interaction with VRUs. While technically promising, such systems raise important human-centered questions, particularly regarding public acceptance. In this work, we present a first step toward understanding societal attitudes by conducting a qualitative preliminary study. Through interviews with pedestrians, we explore their perceptions of using a V2X-enabled social robot in traffic context.**

***Index Terms*—V2X, VRU, Traffic Robot, User Study**

I. Introduction

Vehicle-to-everything (V2X) communication offers great potential for improving road safety. However, one remaining question is how Vulnerable Road Users (VRUs), such as pedestrians and cyclists, can benefit from vehicular communications. One possible approach is the use of a social robot. V2X-equipped social robots are a suitable interface to convert digital to natural communication understandable by VRUs. A prototype of such a system is illustrated in Fig. 1. In [1], we present an approach to test the interaction of such a social robot with pedestrians in virtual reality. Whenever social robots are to be used in society, it is important to understand the ethical implications and opinions of the general population and stakeholders regarding such a technology. For example, [2] analyze people's attitude towards robots used in elderly care, and [3] study the ethical acceptability of the use of social robots with children on the autistic spectrum. In this work we present a preliminary qualitative study aimed at getting the people's opinion on social robots for traffic orchestration as preparation for a full scale study.

II. Study

A. Design

In order to get the people's opinion on the use of a traffic robot, we designed a set of five questions: *What experience do you have with robots and technology in general? What is your impression of the traffic robot? What concerns do you have about such a robot being deployed on the road? What possibilities do you see for using such a robot? Is there anything else you would like to say on this topic?* We recruited 15 people at the Karlsruhe Institute of Technology (KIT) campus. Participants were interviewed either alone or in groups of up to three people. Demographic information was not collected. Participants were shown a short video showing a demonstration of a robot orchestrating a pedestrian[1]. We then asked participants the five questions described earlier. Following their responses, they were invited to ask any questions of their own. The results of the interviews were clustered and are reported below.

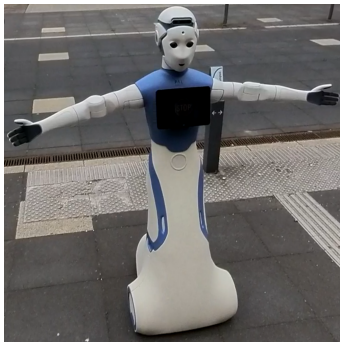

Fig. 1. V2X enabled social robot blocking the path for pedestrians.

B. Results

1) Experience with Robots and Technology: All participants where either students or graduates of technology affine study programs, e.g. computer science, mechanical- and electrical engineering. A small share had experience in robotics such as programming or even teaching robotics to children.

2) Purpose & Practicality: After watching the short video, the purpose of the robot was not entirely clear to all participants. While some correctly guessed that its purpose was to orchestrate traffic, some commented that the purpose was not entirely clear at first glance and they only understood after the robot moved. Another one asked if the robot has the role of a traffic police officer. They wondered if it could also stop

[1]https://www.youtube.com/watch?v=s8kehs05W_I

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vehicles. They also commented that they "didn't expect the robot to be there" and that they "didn't know what to do". When it comes to practicality, the use case was not clear to the participants. One commented that the existing traffic solutions are already sufficient. A typical question was why not just use a traffic light instead. Overall, the practicality was a concern, e.g. "it doesn't feel practical", and "it's too much work". One participant's comment was that we are "far away from deployment". Another concern that was raised was the added value vs. the price, also including the effort of maintenance e.g. parts that need to be oiled or repaired/replaced.

3) Embodiment & Look: In general, the participants commented in a positive way on the robot. They were commenting that it looks cool, fancy or funny. One participant laughed when seeing the robot making a gesture. One participant criticized the robot's face as looking creepy. Two participants criticized the visibility, stating that it shouldn't be white and that it's not bright enough. Some of the participants mentioned the humanoid form of the robot, and asked about the purpose of the humanoid form.

4) Gestures & Interaction: While, in general, participants understood that the robot was interacting with the pedestrian, some participants commented that they did not understand: e.g. "not clear that the robot wants something from you", and "it didn't look active". However, even for the participants that understood that the robot was interacting with the pedestrian, some commented that the interaction needs to be clearer. For example, they stated "I didn't understand the gestures" and "I wouldn't understand what it wants". One participant criticized that the robot can not interact properly because it's not agile, another one commented that it's too slow.

5) Authority & Trust: One common concern was that the robot would lack authority and would not be assertive enough. For example, participants commented: "it has no authority", "it won't be taken seriously", "people will just ignore it, the police can actually stop people", and "You can just walk around it". Closely related to authority, the participants also commented on the trustworthiness. One participant was worried that the robot could lie, highlighting concerns about trust and reliability contrasting another stating that they are not afraid of getting wrong information from the robots, since they have sensors. Multiple participants commented that such a robot needs to be highly trusted in order to be deployable. One participant commented that they would not feel comfortable with a robot blocking the way.

6) Concerns: A major concern participants raised was the possibility of malfunctions like "wrongly giving a passing sign", "the robot entering the street because the detection failed" and "special cases not recognized". They also mentioned that technology usually makes less errors than humans, but even if this is the case the technology needs to be "really safe". One participants mentioned the danger of flammable batteries in the case of an accident. One concern that was mentioned was the requirement of such a robot would face moral decisions similarly as AV's do. Another comment was that "people need to be aware of what such a complex device can do", since otherwise this can lead to "possible confusion". Lastly, multiple participants mentioned the danger of the robot being vandalized or stolen.

7) Possibilities: Multiple participants highlighted the mobility and flexibility of the robot as an advantage: e.g. "just put the robot where it needs to be", "can be deployed 24/7", and "can be adapted to traffic better than a traffic light". They commented that the robot "if well implemented is less error prone than humans". Some participants also mentioned that the robot would not be subjective e.g. discriminating. In general they mentioned application scenarios for exceptional traffic cases like changed traffic routing, accidents etc. They saw particular usage "in front of schools", for "traffic trainings", as "city guide" or "transport" e.g. for elderly. Also the possibility to offer audio service for blind people was mentioned. Further, the possibility to use the robot in crowd control instead of traffic was mentioned multiple times.

8) Connectivity: After the interview questions, participants where introduced to the idea of having the robot integrated into vehicular communications. In general, the participants reacted positively to this idea and commented e.g. "this use case is much clearer". However, they raised a concern that connected cars are far in the future and that 100 % market penetration would be required for a successful deployment of such a connected robot. One participant mentioned the idea that such a robot could be used in closed areas where AV's are tested. Two participants mentioned that greatly increased connectivity would be required to make the robot useful, i.e. that the robot should be connected to jurisdiction and be part of the infrastructure to be able to check driver's licenses and license plates.

III. Conclusion

We present the findings of interviews aimed at understanding the human-factor challenges involved in deploying a social robot for traffic orchestration. One drawback of our study is that the sample of participants is not a representation of the general population, and in particular older people, and people with low affinity for technology are missing. Another drawback is that for space reasons we merely present the results without discussing ideas and possible misconceptions (e.g. subjectivity of the robot or the requirement of 100 % market penetration) of the participants. Nevertheless, these results offer a great starting point to inform a full scale study with the goal of understanding human-factor challenges related to deploying a social robot in traffic as a next step.

References

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