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Optical and/or audible signals in DAS and ADS vehicles

Assessment of the safe deployment of automated vehicles: human factors

Submitted by the International Federation of Pedestrians (IFP)

1. The issue discussed in this paper was brought to the attention of WP1 by Germany and the GRE Task Force on “Automated Vehicle Signaling Requirements (AVSR)” in the informal document 13 of March 2020. The question raised was: Is there a safety requirement for automated vehicles to indicate their status and to communicate their intended actions? If so, should this signal be visual, audible, or both? In the present document, the IFP expresses its positions on this issue.
2. Signals allowing automated vehicles (AV) to communicate their intended actions to other road users have often been tested with pedestrians. Different types of communication interfaces have been proposed and trialed. Such interfaces include: text messages displayed on the vehicle windscreen or projected on the roadway (e.g. “walk” or “I’m waiting for you to cross”), use of symbols (green man/red man, smileys), use of colored LED lighting, projection of a green path in front of the vehicle, etc.
3. A first important question here is whether the pedestrian will always be able to convert the intent signal to its related message. Is it possible to develop a signal as intuitive to understand as an orange blinking turning light? We are not convinced that the few examples of signals that have been developed so far are intuitive or clear enough. As raised by a [study realized for the European Commission](#) and examining this issue: text messages in a specific language or alphabet will not be universally understood; the possibility to use other colors than white or yellow for headlights is restricted in many countries; and (as previously raised at the WP1 by Dr. Mehler), using green for “go” and red for “stop” can confuse as to who is to go and who is to stop. If we are not 100% sure that the chosen signal will not be misinterpreted, we put an enormous financial and organizational burden on the education and training of the whole population (as everyone is a pedestrian at some point of time). This seems neither feasible nor preferable to us.
4. Even if the above issue is solved (i.e. if a perfectly intuitive and unambiguous intent signal is developed), complex traffic situations will remain problematic. The above-mentioned communication interfaces have generally been trialed in simple settings (one pedestrian interacting with one AV) and/or in artificial conditions (virtual reality, private roads). Real world situations are different and often more complex. It is not uncommon that

several pedestrians interact with several vehicles, or that pedestrians need to cross several lanes in intersections with some vehicles going straight and others turning right and left. In such situations, the cognitive burden to decipher and interpret various intent signals communicated by multiple vehicles will become very fast overwhelming. When, on top of that, pedestrians must deal with dynamically changing signals (going from “you can proceed” to “don't proceed”) in a road environment where AV mix with conventional vehicles, all this at night or in bad weather conditions... the cognitive burden becomes such that even fully abled people can get confused and overwhelmed by this information overload. Obviously, this situation is even worse for children, elderly and people with lower physical, intellectual or sensory capabilities.

5. Additionally, in such complex traffic situations, a message “you can proceed” formulated by an AV can bring pedestrians to believe that it is safe for them to cross, while vehicles in an adjacent lane might still be moving. As raised by the European Commission study: “vehicles should not be telling pedestrians (or indeed any road users) that it is safe for them to proceed when it may not be.”^[1]_[SEP]

6. Finally, there are also ethical questions at stake: if new regulations enable drivers to be relieved of their duty of vigilance when the automated driving system is on, is it fair to add a cognitive burden on pedestrians? The introduction of AV in traffic should improve road safety for all, not create further complications for some to handle (amongst whom particularly vulnerable people).

7. In conclusion, the IFP is opposed to the introduction of signals (optical or audible) indicating AVs' intended actions to pedestrians. The IFP is not opposed to signals indicating the status of the vehicle (whether the autonomous mode is on or not) as long as pedestrians are not expected to change their behavior in the presence of this signal.
