Pedestrian-Vehicle Communication Displays in the Context of Autonomous Driving: A Scoping Review

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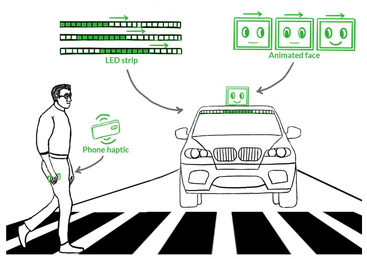
Background and Objective

1. Background

- One of the major challenges that autonomous vehicles are facing today is the interaction with pedestrians.
- Designers of autonomous vehicle technologies have proposed multiple types of displays, including LED lights, screen and voice instructions to communicate with pedestrians.



2. Objective

- This project aims to provide an overview of the pedestrian-vehicle communication displays in the context of autonomous driving.

Method

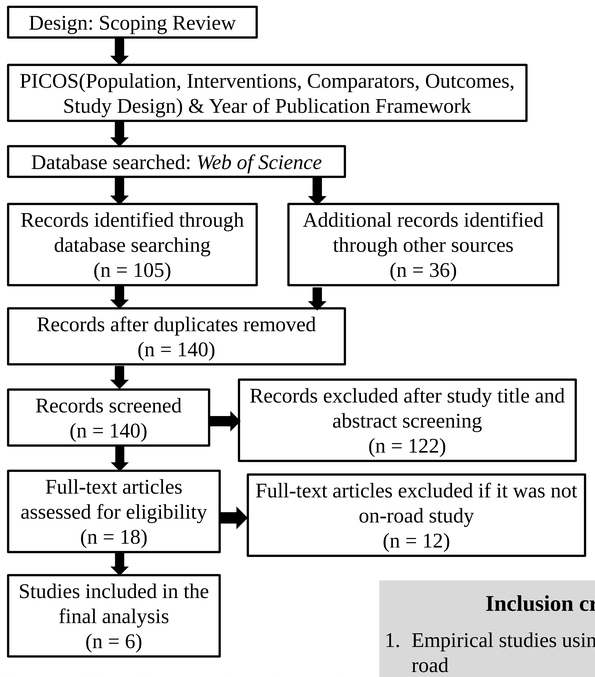


Figure 1. Flow diagram of scoping review

Inclusion criteria

1. Empirical studies using real vehicle on road
2. Description of display and experimental methods

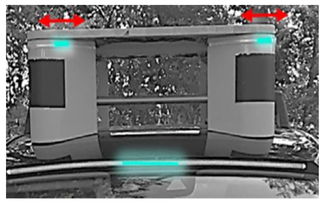
Results

1. What communication displays were tested in these studies?

TABLE 1. Classification of the communication displays in these studies

Studies	Displays			Information					Interface
	Visual	Auditory	Haptic	Status	Perception	Intention	Advice	Speed	
Faas et al., 2020	√			√	√	√			• LED light strips
de Miguel, 2019	√				√		√		• Images(eyes & colors) showed on a screen
Mahadevan, 2018	√	√	√		√	√	√		• An LED strip • a speaker • LED lights • a screen (eyes) • an Android phone
Clamann, 2017	√						√	√	• A LCD screen
Matthews, 2017	√	√			√		√		• LED word display • Speakers • strobe light
Burns, 2019	√					√		√	• Projectors • LED light strips

TABLE 2. Illustration of some visual displays

Interfaces	Images	Details
LED light strips (Faas et al., 2020)		• Steady lights: status • Flash and move along the strips : perception • Slow flash: yield • Fast flash: plan to go
A screen (Clamann, 2017)		• A dynamic display indicating when it was safe or not to cross • A dynamic display presenting the speed of the vehicle
A projector (Burns, 2019)		• Projected striped lines indicating intention • “bunch” together: slow or stop • Expand away: accelerate • Flex to right or left: turn a corner • A large blue arrow: the position to turn

3. The effectiveness of these displays

- Generally, any kind of communication displays support the interaction.[1, 2, 3, 5] But, vehicle motion patterns such as speed and distance are still the most crucial cues.[3, 4, 5, 6]
- Visual display is the primary way for communication. Auditory cues may be cacophony in the real world.[3]
- Intention information is more helpful supplementary information than perception information.[1, 3]
- The effectiveness oaf anthropomorphic cue especially the eye gaze still remains uncertain.[2, 3]

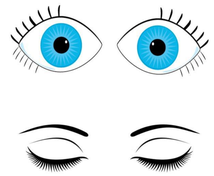


Figure 3. the eye gaze showed on a screen

Recommendations

- Among the 6 studies, only 2 used auditory display and 1 used haptic display. More forms of displays should be included and tested in the future.
- Designers should consider diverse pedestrian populations, such as elderly people and people with color blindness.
- It’s important to find a balance between informing and information overload.

Reference

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