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Gesture-based trafficator to improve driver to traffic communication

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1. Abstract

The way we communicate between vehicles has not much changed in the last hundred years. We still use very simple means such turn signals, horns and high beams. However, Today's roads are crowded and these limited communication means lead to complicated traffic situation and accidents. In this paper we present a design for improved communication between vehicle and traffic participants.

[Figure 1] We designed an actuated side-mirror to improve communication with other traffic participants.

2. Introduction

Worldwide, the number of cars are still steadily increasing and various personal electric vehicles are now appearing on the road, making the traffic situations more complicated. Road accidents are common place and in 2015 led to over 5000 fatalities in South Korea.

The early headlight or trafficator appeared in the 1900s , used physical arrows or simple light-signs to indicate vehicle's orientation or direction. However, this basic form of the trafficator has not been changed so far, and let people communicate in an ad-hoc manner. We expect their communication experience will be improved by embedding user-centered interaction as an input for future trafficator. With turn lights, high-beam and horns, people react and communicate in an ad-hoc manner, and we think communication can be improved with a new design.

Inspired on the rich way people communicate with hand gestures and given the fact that the side mirror is replaced with camera display systems, we appropriate the mirror as a means for communication. As shown in Figure 1, we introduce an actuated mirror.

3. Related work

Efforts are made by various car companies to enhance the experience of communication between human and vehicle. For example, shown in Figure 2, Mercedes Benz made F500-concept car's employs a rear LED display to display messages to other traffic participants.

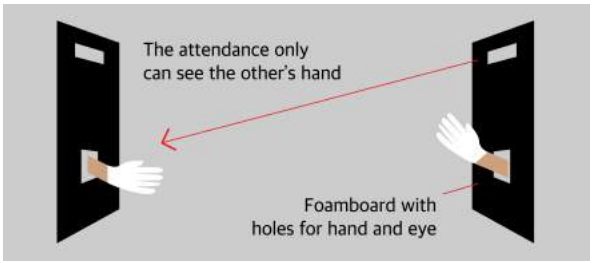
[Figure 2] Previous works related to vehicle interaction

Several design projects applied anthropomorphism to facilitate interaction between human and machine. For instance, Ashisi, S. and James, E. used servo actuated tail to deliver the emotion of robot vacuum cleaner.

From the studies into Disney's animal and human motion research, we understand that, living creature's expressions are direct and easy to recognize since they interact within subconscious area. These expressions are appropriate to be used in traffic situations, because judgements during traffic situations need to be fast and accurate.

4. Formative Study

With an online questionnaire with 19 participants, and offline interview with 3 drivers, We identified two traffic situations, that are regarded as the most significant among drivers : 1) Situations of traffic lane changing 2) Encountering pedestrian and cyclists on intersections.

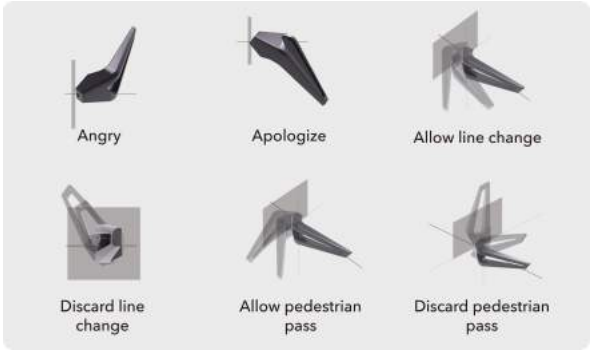


[Figure 3] Bodystorming process for motion study

Then we conducted a bodystorming workshop with 6 participants, and asked the participants to playact two traffic situations identified above only with their hands (Figure 4). The entire study was recorded with hand-held video camera.

[Figure 4] The scene of bodystorming

We analyzed the observed gestures with corresponding quotes, and discovered the following six motions. The Figure 5 illustrates how those motions can be applied on our prototype.



[Figure 5] Motions according to their situations

5. Design

[Figure 6] The view of prototype

Based on the results of the body storming workshop, we designed an actuated side mirror. We capture hand gestures in the car with a camera and show the same gesture outside the car with the actuated side mirror part. The side mirror is mounted on a pan-tilt-roll platform and has 3 degrees of freedom. Since the function of side mirrors is replaced with cameras and in-car display we could revise the physical design according to the following guidelines:

- Bended, organic shape to symbolize hand or ear
- Hollow and narrow shape to reduce air drag force
- Proper shape at the position of side mirror

In our prototype implementation, the driver wears a glove with an inertial measurement unit (IMU). This device records movement of hand, and deliver this 3-axis movement information to an Arduino. The Arduino moves 3 servo motors according to the movement of driver's hand.

6. Future work and Conclusion

With the prototype we plan to perform a user study in the lab. We will simulate several traffic situations, shown on a projector in front of the participant, who will drive a car in the driving simulator by using steering wheel. We let participants make gestures and record their movements, and we show animations of the actuated mirror and ask drivers for the meaning.

The final design deliverable should be made under the criteria of 1) It should successfully replace the side mirror with interactive feature, fine aerodynamics, and well integrated camera-side mirror system. 2) The movements of the product should be very clear, and very fast to be understood. 3) Having a possibility of adding several features such as colored LED to support it's function.

Also for autonomous driving cars this product might be useful. Instead of the traditional blink and horn to interact with human drivers, this new interaction method will be more familiar to human and able to deal with much more various situations.

We presented the design implementation for driver-traffic interaction inspired by hand gestures. We hope that this design improves communication and contributes to traffic safety.

8. Acknowledgement

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