

Application of Augmented Reality Warnings to Improve the Safety of Cyclists and Vehicles Interaction: a Driving Simulator Study

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Keywords: Vehicle-Cyclist interaction, Augmented Reality, Driving simulation, Road safety, Driving performance

More than half of global traffic deaths concerns pedestrians, cyclists, and motorcyclists who are still and quite often being neglected in many countries' road traffic system designs. Globally, cyclists represent 3% of all deaths with the highest percentage in those areas, such as in Europe (8%), where cycling is now considered as an actual alternative mode of transport. Among the causes of such dramatic numbers, the drivers overtaking bike riders are one of the main causes of death among cyclists, especially on rural roads. This study presents a new Augmented Reality (AR) application for connected vehicles, which aims to improve the safety of the interaction between vehicles and cyclists, especially during the overtaking maneuvers, providing the driver with additional visual virtual information and improving driver's risk perception and assessment of safe distances from the cyclists. A driving simulator study was carried out to test the effectiveness of the proposed AR system and assess the ability of drivers to safely overtake a cyclist with and without AR warnings, in a rural road scenario. Three different virtual warning configurations were tested over a sample of forty-six drivers: 1) a yellow safety area around the cyclist; 2) a colour-changing safety area that switches from red to green as the driver has a safe lateral space for overtaking the cyclist; 3) the same colour-changing safety area with an additional audible warning. Significant positive effects of AR warnings on driving performance and road safety were observed during both the approaching phase and the overtaking. In fact, with AR warnings, it was found that the driver adopted longer distances from the cyclist and invaded less frequently the opposing lane, with an improvement in the risk of collision with the cyclist and frontal crash with the oncoming vehicles.