

Abstract

The subject of this dissertation is an examination of the behavior of pedestrians and drivers in the vicinity of crosswalks from the perspective of road traffic safety, with a focus on crosswalks without traffic lights, which are among the highest-risk locations for traffic accidents.

This thesis addresses issues related to road safety in Poland, both currently and from a historical perspective. It presents concepts related to safety, as well as issues concerning the costs of traffic accidents, and the goals and directions adopted by the Polish government regarding safety, particularly for vulnerable road users. The paper includes information on Poland's statistics compared to other European Union countries in terms of road safety. It addresses issues related to threats and risks concerning road safety. A series of studies was conducted to understand and evaluate the behavior of both drivers and vulnerable road users, such as pedestrians and cyclists. As a result of these studies, an innovative adaptive system was developed to enhance the safety of both pedestrians and vehicle drivers. This system is designed for use at pedestrian crossings without traffic lights.

The conducted research included comprehensive analyses of the current behaviors of drivers and vulnerable road users, in the form of extensive observational studies, followed by eyetracking studies aimed at analyzing perception. Additionally, the impact of fatigue on the behavior of drivers approaching pedestrian crossings was analyzed. Furthermore, studies were carried out using reflective elements and examining their impact on drivers' behavior toward vulnerable road users. The next stage of the research included in-depth and comprehensive studies in the field of accident statistics analysis based on data from the Accident and Collision Register, together with an analysis of studies conducted by the authorities of the Capital City of Warsaw. Direct questionnaire-based surveys were also conducted on a group of 555 individuals and subsequently on a group of 336 respondents, involving traffic police officers, professional drivers, court experts, university employees, employees of the Motor Transport Institute, and other participants. These studies concerned the impact of the use of electronic devices and changes in regulations concerning pedestrians (June 1, 2021 - change in pedestrian right-of-way at unsignalized pedestrian crossings), as well as public awareness in the context of road safety. Research was also conducted using a driving simulator with 6 degrees of freedom, which is one of the most advanced devices of this type in Poland. The simulator studies were carried out as part of research conducted at the Motor Transport Institute in Warsaw.

One of the key stages was field research using eye-tracking glasses. The scope of the study included experiments conducted with the participation of drivers and pedestrians

approaching and crossing unsignalized pedestrian crossings in normal road traffic. Based on the conducted research and analyses, the most important determinants of pedestrian crossing safety were identified. For this purpose, calculations of the significance of individual determinants were carried out using the AHP multicriteria method. As a result, a method for assessing pedestrian crossing safety was developed and validated. The entire research was carried out as part of the “implementation doctorate no. DWD/5/0590/2021 funded by the Ministry of Education in cooperation with DR-TECH Sp. z o.o. and the Silesian University of Technology. Additionally, part of the work was carried out in cooperation with the Motor Transport Institute in Warsaw. The result of the implementation work was the creation of a prototype system supporting the safety of unprotected road users, preceded by a series of trials, studies, tests, and analyses aimed at determining the validity of using individual technical elements and theoretical assumptions used to create the system in question.