



INTELLIGENT TRANSPORT SYSTEMS AS A TOOL FOR SPEEDING PREVENTION

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Abstract: Car traffic on the road network is increasing every year, which leads to accompanying problems with compliance with traffic rules. Road accidents in Bulgaria are an annual unwanted event, which leads to significant material and financial losses, both for individuals and businesses, but burden society with unnecessary costs. The largest number of accidents remains due to incorrect actions of drivers (about 6 thousand on an annual basis), with approximately 28% of them being due to excessive and inappropriate speed.

The state, represented by the Traffic Police under the Ministry of Interior (Republic of Bulgaria), carries out periodic actions (with some dubious success) to deal with the constantly increasing number of road accidents. The statistics of constantly increasing road accidents are not a precedent only for Bulgaria, but are noticeable on a global scale. Various events are being held in different countries around the world to deal with this negative trend. One of the most promising methods for dealing with this significant problem are intelligent transport systems. Creating innovative transport solutions for sustainable mobility can allow users to reach their destination conveniently, on time, safely, efficiently and with minimal environmental impact. The main directions and goals of implementing ITS in road transport are to achieve safe and secure transport.

Keywords: traffic accidents, fatalities, speeding, intelligent transportation systems.

1. INTRODUCTION

Car traffic on the road network is growing faster than the infrastructure itself is developing. To cope with the dwindling capacity of the roads, it is necessary to increase the average speed. However, the higher speed of driving vehicles leads to concomitant problems with compliance with traffic rules on the roads. During national or other holidays, when more than two days off are combined during the weekend, a large part of the population undertakes trips from their places of residence to nearby resorts, and from Western Bulgaria they undertake a trip to Greece. The city of Sofia (the capital of Bulgaria) is closer to the Greek Sea than to the Bulgarian Black Sea coast. During these trips on holidays, but not only, a significant number of traffic violations are committed, namely systematic speeding.

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2. STATISTICAL OVERVIEW

Road accidents in Bulgaria are an annual unwanted event, leading to significant material and financial losses, both for individuals and businesses, but also burdening society with unnecessary costs. In 2022, about 5,400 road accidents were registered on Bulgarian roads, resulting in 427 deaths and 7,300 injuries. Compared to the previous year, the number of road accidents increased by 6.5%, the number of deaths by 21%, and the number of injuries by 7%. The number of accidents due to incorrect actions of drivers remains the highest, with approximately 28% of them due to excessive and inappropriate speed.

Table 1. Road traffic accidents, deaths and injuries caused by drivers of road vehicles according to the violations committed (Statistical Yearbook of the Republic of Bulgaria, 2023)

Violations	Road accident		dead		wounded	
	number	%	number	%	number	%
Total	5409	100	427	100	6782	100
deprivation of the right of way of a pedestrian	631	11.7	23	5.4	646	9.5
deprivation of another advantage	782	14.5	33	7.7	1074	15.8
improper overtaking	106	2	9	2.1	152	2.2
incorrect maneuvers	1221	22.6	87	20.4	1527	22.5
entering oncoming traffic	251	4.6	45	10.5	422	6.2
excessive and inappropriate speed	1517	28	158	37	1932	28.5
use of alcohol or other intoxicants	91	1.7	6	1.4	133	2
other violation	810	15	66	15.5	896	13.2

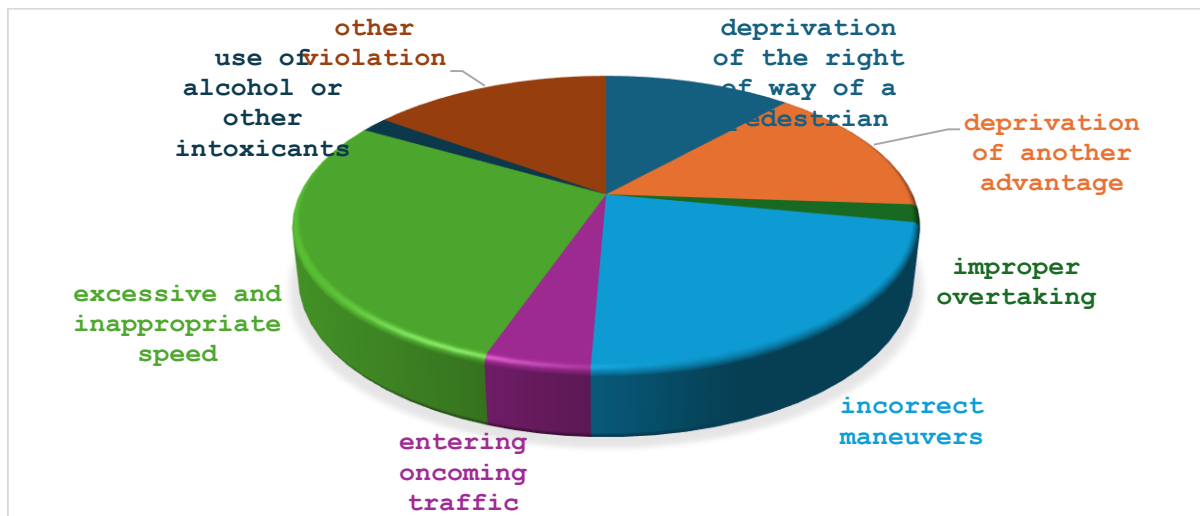


Figure 1. Road traffic accidents, deaths and injuries caused by drivers of road vehicles according to the violations committed (Statistical Yearbook of the Republic of Bulgaria, 2023)

3. PERIODIC ACTIONS (WITH A CERTAIN DUBLIN SUCCESS) TO DEAL WITH THE CONSTANTLY INCREASING NUMBER OF ROAD ACCIDENTS

To ensure smooth operation and without unnecessary congestion of traffic flows, adequate traffic regulation is necessary to comply with local traffic regulations, such as speed limits at all times of the day.

The state, represented by the Traffic Police under the Ministry of Interior of the Republic of Bulgaria, carries out periodic actions (with some dubious success) to deal with the constantly increasing number of road accidents resulting from failure to comply with road restrictions or

driving at an inappropriate speed. To establish speeding violations, various devices are used to measure the instantaneous speed of individual motor vehicles. Known under the general name automated technical means and speed systems (ATSS). ATSS are devices designed to control compliance with speed limits on the road network in the Republic of Bulgaria and are generally divided into stationary and mobile.

The operation of the ATSS does not require direct service from a law enforcement officer, except for the initial positioning and adjustment of the equipment. All other processes from speed measurement to the preparation of the relevant photo or video material are performed by the device without the participation of a Ministry of Interior officer.



Figure 2. Movable stationary camera for instantaneous speed detection

According to the Ministry of Interior of the Republic of Bulgaria, road control throughout the country is carried out by 173 ATSS (Ministry of Interior, 2025):

- 15 stationary speed systems - Functional capabilities of the system are: it works stationary, allows measurement in both directions in day and night mode, allows recording of vehicles. The principle of speed measurement is based on the Doppler effect. In the control calculation, the path that the vehicle has traveled during the time between the two photos in one measurement is determined by photometric processing of the reduction of the license plate. The speed value can be calculated based on this path and the time between the two recordings;

- 148 mobile systems - They are characterized by exceptional functionality and efficiency. Unlike stationary technical means, which can control one or two parameters of automobile traffic simultaneously, mobile technical means have relatively unlimited capabilities;



Figure 3. Stationary camera for instantaneous speed detection ([бул. „Пејо К. Яворов“ - Google Maps 2024](#))

- 8 stationary systems - The stationary system for measuring speed in both directions, which further facilitates the clear identification of the violation through range control on multi-lane roads;
- 1 unit of automatic speed detection system - This is a radar with a wide beam angle, capable of tracking a large number of vehicles simultaneously. The radar used monitors several lanes simultaneously at a distance of up to 150 m in depth. Vehicles are tracked within the radar range and their movement is analyzed;
- 1 piece of average speed control system - This is a radar with a large beam angle, with the ability to track a large number of vehicles simultaneously. The radar used monitors several lanes simultaneously at a distance of up to 150 m in depth. Vehicles are tracked within the radar range and their movement is analyzed.

4. DEVELOPMENT

Technologies used in intelligent transport systems range from simple management measures, such as cameras to measure instantaneous speed, to applications for detecting stopped vehicles or automatic incident detection.

Globalization and digitalization of the new era have changed a number of traditional industries and forms of communication (Kolev & Ananiev, 2019).

In 2025, after long discussions, a tentative move was made to use the built infrastructure of stationary cameras of the "National Toll Administration" at the Road Infrastructure Agency.

The "National Toll Administration" is a specialized unit at the Road Infrastructure Agency, created with the introduction of an electronic system for collecting road fees based on distance traveled for vehicles with a total technically permissible maximum mass over 3.5 tons (TOL) and based on time for passenger cars with a total technically permissible maximum mass up to or equal to 3.5 tons - electronic vignette (National Toll Administration, 2025).

Initially, road vehicles were charged for using the road network of the Republic of Bulgaria through the purchase of vignette stickers. The stickers on the windshields of motor vehicles were replaced with electronic vignettes for all participants in traffic on the Republican road network. Since March 2020. Toll fees replaced electronic vignettes and the charging of vehicles with a total technically permissible maximum mass of over 3.5 tons based on distance traveled.

In order to use the built infrastructure of the "National Toll Administration", it is necessary to make regulatory changes to the Bulgarian legislation. It is envisaged that average speed violations can be established by the bodies of the Ministry of Interior (Republic of Bulgaria) through the technical means of the electronic system of the Road Infrastructure Agency.



Figure 4. Infrastructure of the National Toll Administration ([E80 - Google Maps](#), 2024)

The main directions and goals of the implementation of ITS in road transport are to achieve safe and secure transport. New driver assistance and safety systems have a preventive effect, since more than 90% of road accidents occur due to human error (Nikolova 2017).

Modern cars are equipped with active and passive safety systems while driving. When a motor vehicle enters a section where average speed control is carried out, the tablet in the car displays information about the relevant restriction imposed by road signs and calculates the average speed from the moment of entering this section until leaving it.

The cameras of the National Toll Administration calculate an average speed for the entire section and assume that the movement of motor vehicles is a constant value, while the average speed in the vehicle is calculated every second.

In this way, a driver could monitor his safe movement in a given section. If at a certain moment the maximum permissible (current) speed was exceeded, he could regulate the passage through the second camera by reducing his speed in the remaining measured section.

The calculation of average speed is made only in one place in Bulgaria on the Struma motorway between Sofia (the capital of Bulgaria) and the city of Pernik (a satellite city of Sofia). Every day thousands of workers travel between the two settlements. Figure 5 shows an example of calculating average speed in a vehicle.

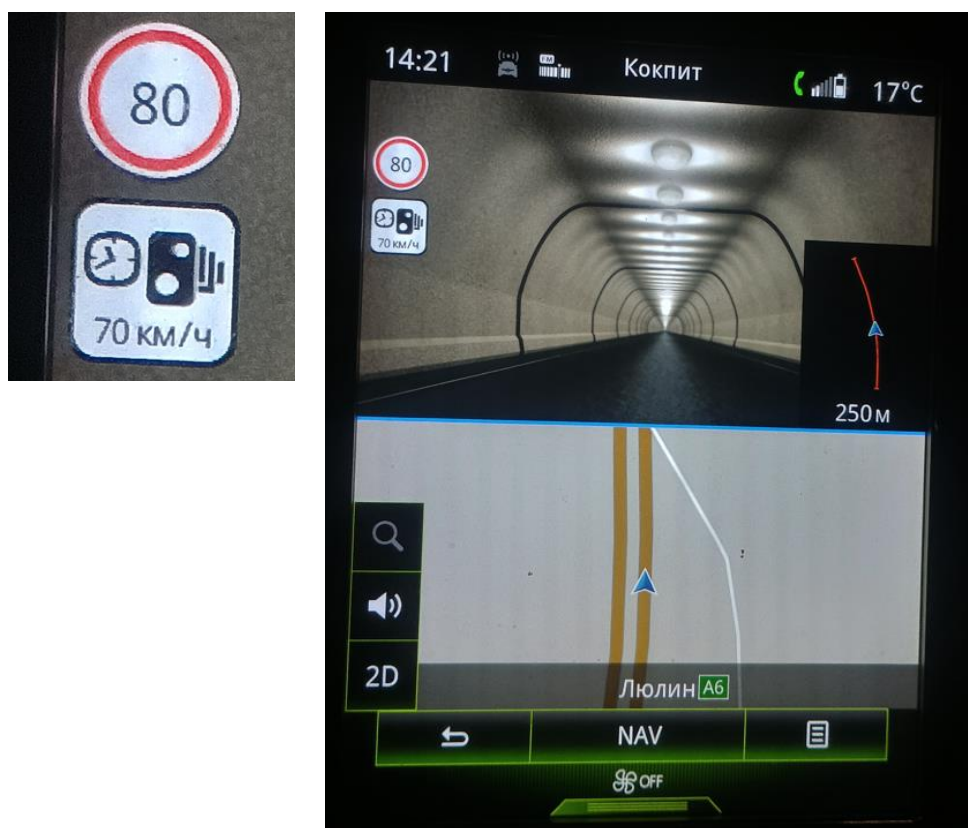


Figure 5. Intelligent transport system on board the vehicle (photo of the author from his personal vehicle)

5. CONCLUSION

Excessive speed is the cause of most fatal accidents, which is why it is extremely difficult for traffic control authorities to effectively manage excessive speed using traditional approaches.

Prioritizing mobility safety through the use of modern technologies is one of the key factors in reducing road accidents.

For adequate prevention of excessive speed, it is necessary to involve not only the Ministry of Interior (Republic of Bulgaria), but also other state bodies that have certain capabilities and capacity (built with public funds). Such a body is the Road Infrastructure Agency with its division National Toll System.

Connecting vehicles to the transport infrastructure for constant data exchange is the next step in the development of a safe road network not only at the national level, but also globally.

Road safety is built on the following components:

- training of candidate drivers;
- acquired skills by drivers;
- high technologies in the construction of road infrastructure;
- high technologies in automotive manufacturing;
- effective control by the relevant state authorities.

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