

The Role of Intellectual Technologies and Digital Control Tools in Road Safety: Uzbekistan and International Practice

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Abstract

This article explores the effective use of intelligent technologies and digital control tools in ensuring road traffic safety. The causes of road traffic accidents are analyzed, with particular attention paid to the application of GPS, sensors, Advanced Driver Assistance Systems (ADAS), and digital platforms in traffic management. Drawing on international best practices, the paper discusses prospects for integrating such systems in Uzbekistan's road infrastructure and legal framework. The importance of mobile applications, web platforms, and automated intervention systems in enhancing driver awareness and reducing risks is emphasized.

Keywords: road safety, intelligent transport systems, GPS, sensors, digital monitoring, ADAS, automated traffic control, traffic policy, legal framework.

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Introduction.

The use of modern technologies in ensuring road safety has become a global trend in the world. Information and communication technologies and digital control tools play an important role not only in regulating traffic, but also in preventing offenses and raising the legal awareness of citizens [6]. In developed countries, such capabilities as traffic flow management, load distribution, traffic risk forecasting, and automatic responsibility calculation are being effectively implemented through intelligent transport systems (ITS). The use of vehicles currently covers almost all sectors of the national economy, and organizing their work at a high level of quality and efficiency is considered one of the most important and necessary tasks. The use of automobiles currently covers almost all sectors of the national economy, and the high-quality and effective organization of their work is considered one of the most important and necessary tasks. On highways, all vehicles must comply with traffic regulations, road signs, road markings, and general traffic rules and regulations. Vehicles on the roads are driven by different people, and each of them chooses a convenient route, order, and method of driving. The driver does not take into account the fact that he creates certain dangerous effects for other participants in the path of his movement[1]. The greater the traffic volume, the greater the interaction of vehicles in road traffic. As a result of violations and non-compliance with the rules by drivers, a large number of road

traffic accidents (RTA) occur. Accidents caused by drivers mainly occur in dangerous situations and at conflict points. Dangerous situations exist on roads with high traffic intensity, and the increasing number of vehicles requires increased attention from the driver, skills in safe movement, and high-quality knowledge [3].

LITERATURE ANALYSIS AND METHODOLOGY

In general, the safe organization of traffic on highways is a system of measures aimed at ensuring a safe traffic regime and high throughput capacity on various sections of the road, maximizing the flow of vehicles using the geometric dimensions of the road. K. Kh. Azizov's textbook "Fundamentals of Organization of Traffic Safety" provides detailed information on a number of procedures, rules, and methods for organizing traffic safety [1]. The organization of traffic safety is becoming increasingly relevant today. The Main Directorate for Road Safety of the Ministry of Internal Affairs of the Republic of Uzbekistan published statistical data on road accidents on the republic's roads as of November 2021 [2]. According to him, a total of 7,681 road accidents occurred during the past 10 months of the year. In them, 1,964 people died, and 6,886 people received injuries of varying severity. He also clarified the causes of this accident. 1,782 road accidents occurred due to improper traffic management or road malfunctions. This represents 23.2% of all road accidents. In 1,705 cases, pedestrians crossed the road in an undesignated place (22.2%) due to the lack of a pedestrian crossing. 1,221 accidents (15.9%) occurred due to exceeding the speed limit. As can be seen from the data, in 7.6% of cases, that is, in 584, pedestrians were hit at pedestrian crossings.

CONSIDERATION

The driver driving the car is tired for a long time due to noise vibrations and toxic gases from the engine, and loses control efficiency and attention to a certain extent. One of the main reasons for this is the noise and vibration of the engine. Because almost all cars moving on the streets today run on petroleum fuels and alternative fuels. Naturally, in this case, the noise and vibrations in the engine will be high. To prevent such situations, it is necessary to increase the percentage of electric vehicles in the composition of street transport, and in the future, it is necessary to completely switch to electric vehicles. Today, along with the increase in the number of electric vehicles, modern technologies that provide drivers with information about the state of traffic on the road, general information about the road (turns, intersections, traffic lights, and pedestrian crossings) are becoming increasingly popular. In particular, global space navigation systems (GPS - Global Positioning System, GLONASS - Globalnaya Navigatsionnaya Sputnikovaya Sistema) used in modern vehicles are systems that allow determining the geographical location, direction, and speed of objects moving at any point of the day. In addition, through this system, it is possible to determine the exact time with an accuracy of 1 nanosecond (0.000000001 sec). The system was developed for military purposes in the 1970s on behalf of the US Department of Defense, but in 1983 it was permitted to be used in other areas. In 1991, the acquisition of GPS technologies by the republics of the former USSR was permitted. In the mid-90s, the system was fully operational. The main element of the GPS navigation system is 24 satellites, located in 6 different orbits at an angle of 60° to each other. One orbit of each satellite around the globe takes 12 hours. Each satellite weighs 800 kg and has a length of more than 5 m (including solar panels). Indeed, when visiting unfamiliar areas or driving on unknown roads, we need GPS guidance to know the area and road map. We can find this system in all mobile communication applications. Its operation is as follows: It transmits precise microwave signals, and using artificial satellites, the system allows the GPS receiver to determine its location, speed, direction, and time. [7][10]

RESULTS

In international practice, countries such as the USA, South Korea, and Singapore have achieved significant results in the field of automatic traffic control, immediate hazard warning, and automation of statistical analysis through intelligent transport systems[8][9].

Scientific research on the organization of traffic safety has revealed that satellite navigation technology

has a positive impact on road safety. The availability and accuracy of the Global Positioning System (GPS) serves to ensure high efficiency and security for vehicles using highways, streets, and public transit systems. The GPS system is widely used throughout the world today, it provides information about the location of vehicles and provides information on all directions of movement during vehicle movement. GPS location technology, systems capable of displaying geographical information, automatically transmitting data to display screens or computers, are very effectively used in freight and passenger transport. The use of the GPS system in vehicles improves the driver's movement in unknown places, increases vigilance, and reduces stress levels. An international study showed that using a GPS device reduces the number of miles traveled by 16 percent and reduces travel time in an unknown area by 18 percent. In addition, it provides information on the location of service points, maintenance and emergency services, the level of traffic congestion on road sections, etc. The GPS system alerts drivers through a constantly updated database on primary school buildings, the location of security cameras, and other dangerous road sections on highways. At the same time, it warns drivers in advance about the possibility of violating traffic rules and informs about conflict points that cause road accidents. The GPS system helps protect drivers from various dangers and accidents by warning about radar cameras that monitor high speeds. Mobile applications and web platforms play an important role in helping to improve road safety. With their help, users can receive information about road traffic, plan road routes, and ensure their safety during road traffic processes. Mobile applications offer capabilities such as obtaining traffic data, tracking routes, temporarily changing traffic conditions, assessing the level of road success, and showing routes to other users using a road map. Web platforms, on the other hand, help to ensure safety when providing traffic information in a browser or when processing or replenishing data through websites and applications. This includes SSL (Secure Sockets Layer), HTTPS (Secure Layer Protocol), and encryption.

By all means, mobile applications and web platforms are important tools for improving road safety, and their use plays an important role in ensuring road safety. The automatic response system is designed to study the quality of road traffic and respond automatically when necessary. These systems can automatically interact by tracking incidents that occur on the road, such as accumulations, accidents, short-distance transportation, and other actions. These systems use many similar technologies, such as radio beacons, sensors, GPS, and cameras, capable of detecting road incidents. In addition, with the help of data analysis algorithms and mechanical decision-making systems, the response system can respond appropriately to road events, for example, increase in hypothetically valuable time, automatically accurately construct external errors, and be prepared for such processes as warning drivers and pedestrians. Such automatic response systems play a major role in increasing the safety of pedestrians, activating traffic, and minimizing transportation time. In addition, they can be used as important methods for highlighting interest in processes occurring on the road, managing new messages and similar information, as well as traffic optimization and process training. Sensors and cameras play a crucial role in improving road safety in cars and vehicles. These technologies are used to monitor vehicle traffic, identify nearby objects, monitor queues on the road, and assess the vehicle's environment.

Sensors are located on the right and left sides of vehicles and detect any changes that occur on the road. Through them, you can obtain information such as rear proximity, front surplus, and vehicle speeds. Cameras are used to capture the surrounding environment of the car. Through them, it is possible to identify objects in front of the vehicle, monitor changes occurring on the road, and explain road signs or signals. All this information is sent to the car control system, and the car control system adapts the car's movement. For example, if a car detects nearby objects or senses changes occurring on the road, this system can help stop the car or tire it back. These methods play a significant role in improving road traffic safety, and automotive technologies are expected to be important for other time and energy allocations and pedestrian safety in the future. Automation and control systems play a very important role in the automatic control of road traffic for cars and vehicles.

These systems help perform various functions to control vehicle movement, ensure automatic vehicle movement, and improve road traffic safety.

1. Visual Vehicle Systems (ADAS): These systems evaluate the vehicle's movement and required state through sensors and cameras that improve vehicle control. These systems are used to identify objects in front of the vehicle, control redundancy, queues on the road, and perform other important operations.
2. Automatic parking systems: These systems help to automatically pass the car. They include the necessary navigation practices for determining free space on the road and parking the car using specific sensors. This will help to speed up traffic and land on the roadside.
3. Assistance systems: These systems help detect changes occurring on the vehicle's path and maintain the vehicle in good condition. For example, you can help ensure a car's speed matches the speed of other cars.
4. Safety systems: These systems play an important role in improving vehicle safety. These include application systems, fading lighting systems, alarms for rare and unpleasant situations, stopping systems, and others.

These systems help to respond to any incidents that occur on a safe, efficient, and developed road for cars and vehicles. Their use makes vehicle control easy and reliable, and ensures mutual safety, sensitivity, and good visibility of road traffic.

The widespread use of intelligent technologies and digital control tools leads to a new stage in ensuring road safety. Although the legal framework in this area has been created in Uzbekistan, it is necessary to fully implement them in practice, bring them closer to international standards, and ensure institutional solutions and public participation. This will lead to a reduction in offenses, an increase in public safety, and an increase in the level of protection of human life.

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