УДК 004

APPLICATION AND DEVELOPMENT OF UNMANNED VEHICLE TECHNOLOGIES, AND THEIR IMPACT ON THE TRANSPORTATION SYSTEM

Kruhlik Ilya A., student
Rashchynkin V.S., student
Scientific supervisor – Slesaryonok E.V., senior lecturer
English language department №1
Belarusian National University of Technology
Minsk, Republic of Belarus

The modern transport sector is experiencing an era of technological revolution, where innovation is becoming a driver of global change. One of the most significant breakthroughs in recent years has been the emergence of self-driving cars, intelligent systems that can function without direct human control. These machines are complex engineering complexes that combine lidar sensors, radar modules, high-resolution cameras and neural networks that process terabytes of data in real time to analyze the traffic situation.

Thanks to machine learning algorithms, such cars not only plot routes, but also predict the behavior of other road users, minimizing the risk of accidents. The introduction of such technologies into mass production can transform not only the logistics of cities, but also revise the concept of personal transport as such [1].

Although fully autonomous cars are still a rarity on public roads, investment in this area is growing exponentially. According to analysts, by 2023, the volume of the global market for unmanned vehicles has exceeded 20 million units annually, and 60% of developments are funded by alliances of automakers and IT corporations. For example, such giants as Waymo (a subsidiary of Alphabet), Cruise (a division of General Motors) and Zoox (owned by Amazon) are actively testing their solutions in closed polygons and individual cities with adapted infrastructure. In parallel, the governments of 15 countries, including Germany, Japan and the UAE, are developing legislative initiatives to integrate autonomous vehicles into the overall traffic by 2030 [2].

A special place in this race is occupied by Tesla, a company that has made autonomous driving a key element of its philosophy. Its flagship

Autopilot 4.0 system uses Tesla Vision 360-degree cameras, 12 ultrasonic sensors, and an advanced FSD Chip processor to process 2,300 frames per second. However, statistics from the US National Highway Traffic Safety Administration for 2022-2023 are controversial: 70% of accidents involving autonomous systems occurred with Tesla cars [3].

The design features of Autopilot deserve special attention. Unlike competitors who use lidars, Tesla relies on optical technology and artificial intelligence. HydraNet's neural network architecture, trained on 4D video from millions of cars, allows the system to recognize road signs through the rain, predict the trajectory of pedestrians, and even interpret cyclists' hand signals. However, it should be particularly stressed that technological limitations remain a significant challenge not only for expert but also for conventional people. Even the most advanced algorithms face the "edge case problem" – situations not described in the training but still remaining undiscovered data that requires further comprehensive considerations. Thus, in conclusion it is worth noting the striking example of the incident occurring in 2023 in San Francisco, when a self-driving car mistook the glitter of wet asphalt for a traffic light. Experts emphasize: to achieve the 5th level of autonomy (the complete absence of a steering wheel and pedals), it is necessary not only to improve software, but also to create a 'smart' road infrastructure with V2X communication, where cars will exchange data with traffic lights and traffic cameras [4].

References

1. Road Vehicle Automation (Lecture Notes in Mobility). Eds. G. Meyer, S. Beiker. – Heidelberg, New York, Dordrecht, London: Springer International Publishing, 2014.

2. Автопилот Теслы. – URL: https://1gai.ru/publ/515588-avtopilot-tesly-5-osobennostey-novoy-tehnologii.html (date of access: 26.03.2025).

3. Automated vehicles for safety. – URL: https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety (date of access: 26.03.2025).

4. Беспилотный автомобильный транспорт – URL: https://www.gtlk.ru/press_room/drone/#slide2-2 (date of access: 26.03.2025).