

Certain issues of road traffic safety liability

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Abstract. Monocycles have become a means of micromobility and an environmentally friendly alternative in urban environments, but their design and operation challenge traditional traffic rules intended for conventional vehicles. There is a need for clear and adapted traffic regulations in the modern landscape of transport systems that consider the unique characteristics of unicycles. The research aims to explore the specifics and justify the importance of establishing road safety rules specifically for monowheels based on a comparative analysis of the laws and best practices of the United States, the European Union and Ukraine. The necessity of creating comprehensive guidelines that would consider the presence of monowheels on roads, bicycle paths and sidewalks is discussed in the article. The absence of special rules creating safety problems for both monowheel users and pedestrians is noted. The problems are identified, and potential solutions are proposed. The crucial role of adapted traffic rules in promoting safe and efficient coexistence in the modern transport ecosystem is emphasised. The author analyses the regulatory documents of the USA, the European Union and Ukraine regarding the legality of using electric unicycles and the responsibility of their owners and compares them. The problems encountered by monowheel users and other road users are identified and their comprehensive solution is proposed. The author highlights the areas which can be influenced to improve road safety for monowheel users in Ukraine and also suggests specific options for possibly borrowing of practical experience of the USA and the European Union countries regarding the traffic rules for monowheel users. The practical significance of the article lies in promoting the safe and informed use of electric unicycles by streamlining the legislative framework, establishing clear rules of operation, and conducting fiscal discussions and educational activities. The study can be a valuable asset for owners and users of electric unicycles, as well as for government agencies and legislators

Keywords: electric unicycles; traffic rules; micromobility; electric transport; urban transport; safety

Introduction

Road safety is a critical issue in any country, as it directly affects the well-being and lives of citizens. Ukraine, like many other countries, faces numerous challenges in terms of road safety and minimising the number of accidents and fatalities on the roads. One of the key aspects in addressing this issue is the correct allocation of responsibility for road safety violations (Choudhary *et al.*, 2020). However, in Ukraine, this issue raises several separate questions that need to be addressed and resolved. First and foremost, there is a lack of clarity and

consistency in the legal framework governing road traffic violations and related penalties (Horobrih, 2023). Current legislation often does not contain precise definitions of offences, leading to ambiguity and confusion among motorists and law enforcement agencies. This lack of clarity can impede effective enforcement and administration of justice. Ukrainian lawmakers need to create a comprehensive and well-defined set of laws that clearly outline offences, their consequences, and the appropriate penalties.

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Another significant problem is the inconsistency in the application of penalties and prosecution of offenders. The effectiveness of any legal system depends on its ability to enforce penalties consistently and without bias. In Ukraine, there are cases where the penalties for similar offences can vary significantly depending on the region or personal circumstances of the offender. This inconsistency undermines not only the deterrent effect of punishment but also public confidence in the justice system. It is important to establish uniform sentencing guidelines and ensure that they are applied fairly and consistently across the country.

In addition, addressing the issue of liability for traffic offences requires a comprehensive approach involving many stakeholders. It is advisable to consider these aspects in the example of the rules for the use of monowheels in Ukraine, considering the experience of the United States and the European Union in this regard. Establishing road safety regulations for monowheels is crucial for improving road safety. These regulations promote responsible driving behaviour, reducing the risk of accidents involving monowheel users and other road users (Pazzini *et al.*, 2022). They also help to integrate monowheels into existing transport systems, ensuring harmonious coexistence with other modes of transport.

The research aims to investigate and highlight the importance of establishing comprehensive road safety regulations specifically for unicycles using the example of the United States and the European Union for Ukraine, to identify gaps and opportunities in road safety for unicycle owners, which will ultimately contribute to increased mobility in cities and reduce accidents involving unicycles.

The following methods were used: analysis, synthesis, and comparison for the review of scientific sources, including articles and reports, to gain an understanding of the current state of road safety for unicycles in different countries, including the United States, the European Union, and Ukraine. According to a search in the Scopus and Web of Science databases, a total of 2,814 publications were found using the query “unicycle”. Analysis of the data by year shows a stable interest of scientists in this topic. In 2020-2023, 597 articles were published, but only 16 of them, or 3%, dealt with traffic management (search query “traffic”). Of these 16 articles, the majority relate to engineering, mathematical, computer, and software improvements to the unicycle itself, its sets/groups, and the transport environment.

L. Cavanini *et al.* (2021) discussed the use of LPV-MPC (linear model predictive control with parameter variation) for path planning in autonomous vehicles, in particular in road junction scenarios. H. Eqab *et al.* (2023) discussed the design and implementation of an algorithm developed for mobile robots that can be used for unicycle applications. X. Shang and A. Eskandarian (2023) investigated the design and implementation of a collision avoidance and mitigation system for vehicles. The publication of G. Zhao and M. Zhu (2022) is devoted to the development of distributed algorithms for motion planning in the context of multiple robots. S. Kim *et al.* (2023) focused on an empirical study related to the creation and improvement of the driving environment for personal mobility vehicles.

Only two studies address the topic of legal regulation of traffic rules for unicycles. N. Milas (2022) directly addresses the amendments to the Road Traffic Safety Act of the Republic of Croatia in 2022, with a special focus on new categories of

vehicles, including electric scooters. The second source was not used in the article as it focuses on two- or three-wheeled vehicles). Therefore, this area is promising for research.

The sources used in this article can be divided into the following groups: rules and laws on electromobility in Europe (Slootmans, 2021; Volavc, 2023; EUncycles, n.d.); congestion and mobile solutions (Zhenbing, 2017; Fanchao, 2021; Avestisyan, 2022); rules for the use of electric scooters (Escareno & Biagi, 2020; García-Valle Pérez, 2022; Urbancik, 2023); safety and traffic rules in Ukraine (Fines in Ukraine, n.d.; Committee of Ukraine’s Road Safety, n.d.; Committee on Ukraine’s Integration into the European Union, 2021; Draft Law of Ukraine No. 8172..., 2022); specific topics on road traffic and safety (United Nations Economic Commission for Europe, 2022; “For safe roads” campaign, n.d.; Regulation (EU) 2022/1280..., 2022); research and study of micromobility (University of Arizona, 2012; National Transportation Safety Board, 2019; Motor Vehicles and Traffic, 1992-2022). Together, the study of these sources provides a holistic picture of compliance with traffic safety rules by owners and users of electric unicycles.

Traffic problems involving electric unicycles and measures to address them

Establishing road safety regulations for unicycles is important for several reasons. Safety of unicycle owners: just like cyclists and pedestrians, unicycle owners are vulnerable road users. Adherence to safety rules ensures their protection while travelling on the roads; traffic management: monowheels can share roads with other vehicles. Clear regulations help to manage traffic flow and prevent accidents involving monowheel users; public awareness: road safety regulations raise awareness among monowheel users of the potential risks they may face and the precautions they should take; pedestrian safety: monowheels are often used on sidewalks. Regulations can help define when and how unicycles can be used on footpaths to prevent pedestrian collisions; integration into transport systems: as unicycles and other micromobility devices become more popular, setting rules allows for better integration into existing transport systems; liability and enforcement: the rules provide a legal basis for liability in the event of accidents. Law enforcement can use these rules to enforce traffic laws; Infrastructure planning: road safety rules can inform urban planners (developers) about the need for dedicated lanes or parking spaces for monowheelers, improving overall urban infrastructure; International best practices: studying established road safety practices for similar devices, such as electric scooters, can help formulate effective rules for monowheelers (Urbancik, n.d.).

Therefore, road safety regulations for e-scooters are important to protect riders, improve road safety and integrate these devices safely into transport systems. They also help to clarify legal responsibilities and promote responsible riding behaviour. In general terms, unicycles are not generally recognised as a separate category of vehicle in the US legal framework. Under traffic laws, unicycles are often considered recreational equipment rather than vehicles. In the EU, there is no uniform regulation for unicycles, and the legality of unicycles as vehicles varies across the European Union. In Europe, electric unicycles are often considered sports equipment rather than vehicles. Consequently, the recognition of electric unicycles as vehicles is not unconditional in EU

member states. At the same time, some countries have special rules, and in the EU, monocycles are not recognised as vehicles (Williamson, 2021; Volavc, 2023; EUnicycles, n.d.).

There is no comprehensive list of countries where unicycles are officially recognised as vehicles. In most jurisdictions, monowheels are generally considered niche personal transport or sports equipment rather than traditional vehicles. While some countries may have specific regulations for electric unicycles (EUCs) and similar devices, the recognition of unicycles as vehicles is not widespread. For example, in the European Union, EUCs are allowed if they are limited by design to a certain speed, usually 20-25 km/h (Volavc, 2023). And in Paris, for example, micromobility vehicles for hire are prohibited (Yanatma, 2023).

The rules for electric unicycles, especially electric unicycles, are often unclear or non-existent. This causes several problems. Firstly, there is a lack of regulation in many places, leading to confusion about where e-scooters are allowed and how they should be used. Secondly, the lack of regulations can lead to safety issues, such as uncontrolled riding on sidewalks or roads without proper precautions, which can be dangerous for both drivers and pedestrians. In addition, unicycles may not fit well into existing road infrastructure, potentially endangering the safety of drivers and other road users. Owners and drivers of electric unicycles may unintentionally violate traffic rules because there are no specific instructions for them. In some countries, fines are imposed for driving monowheels on certain routes or without insurance, which creates a financial burden for drivers. Finally, it can be difficult for law enforcement to enforce the rules and distinguish between unicycles and other vehicles due to the lack of clear regulations.

These issues highlight the need for clear and adapted road traffic regulations that address the unique characteristics of monowheels in modern transport systems. Resolving the problems associated with unclear or non-existent traffic regulations for monowheels, especially electric ones, requires a combination of regulatory adaptation and awareness campaigns. Several countries have taken steps to address these issues: The United States – establishing proper parking regulations for electric bicycles and other micro-mobility devices to prevent improper parking (Aveitryan *et al.*, 2022); European Union – presenting thematic reports on personal mobility devices to guide road safety professionals (Slootmans, 2021); Ukraine – promoting driver education and awareness of the unique challenges associated with electric unicycles to ensure safe integration into the road traffic (Why electric unicycles are better..., n.d.); globally – expanding bicycle and bus infrastructure, eliminating tax distortions and ensuring equitable access to safe micromobility solutions (Zhengbing, 2017; Fanchao & Goncalo, 2021); city-level initiatives – conducting pilot evaluations of e-scooters (as a means) to assess equitable (uniform) access to neighbourhoods and affordable transport solutions (Marshall & Ferenchak, 2019; Escareno & Biagi, 2020).

These examples highlight efforts to create clear and adapted road regulations for monowheels and to address the safety and operational issues associated with their unique characteristics. Although the sources analysed do not provide specific information on monowheel-related traffic offences, general principles of traffic law may apply. In some countries, such as Ukraine, riding a monowheel on public roads may be subject to similar rules as bicycles or other

non-motorised vehicles. For example, violations of traffic laws, such as failing to stop at red lights or yielding to pedestrians, can result in fines. Laws are being updated to cover various forms of micromobility, including electric scooters and unicycles. In Ukraine, legislation may increase liability for traffic offenders, but there are few specific details on monowheels (Fines in Ukraine..., n.d.; Cherednichenko & Bohdanets, n.d.). Therefore, the legislator faces an important task – to develop individual traffic rules specifically for monowheels. And for this purpose, it is worth paying attention to the experience of other countries.

Regulatory and legal legislation on the use of electric unicycles

Regulatory documents in the United States that address road safety and potential liability for e-scooter owners include micromobility, which provides a comparison of micro-mobility vehicle regulatory practices and policies related to their movement (Bondarenko *et al.*, 2021); parking and Transportation Regulations: These regulations give university police officers the authority to issue citations for violations of state law that may apply to the use of e-scooters on campus (University of Arizona, 2012); conclusions of the Cornell Law School on the adaptation of US vehicle and traffic laws to new modes of transport (Martin, 2022); findings from the National Transportation Safety Board's (2019) cyclist safety report: focused on bicycles, highlighting the risks of bicycle crashes and safety on US roads; the Arlington County Code, which covers rules and regulations for drivers, including provisions governing traffic and driving behaviour (Motor Vehicles and Traffic, 1992-2022). These sources provide an overview of the legal landscape for road safety in the United States, but specific regulations for unicycles may vary by state and local jurisdiction.

Regulation (EU) 2019/2144 of the European Parliament and of the Council (2019) is one of the legal instruments that regulates liability for road safety violations and applies to monowheels in Europe. It establishes a framework for advanced driver assistance and road safety systems in the EU (Pernice & Debyser, 2023). The Institute for European Traffic Law (IETL) informs professionals about European traffic law (Official website of the Institute..., n.d.). Although no specific information on e-scooters is mentioned, the existing knowledge base can provide a general understanding. Electric scooters in Spain are subject to a legal framework regarding liability for accidents (García-Valle Pérez, 2022). There are key legal documents in categories such as road traffic regulations and transport regulations that address road safety (United Nations Economic Commission for Europe, 2022). While these sources provide information on road safety and related regulations, clear information on unicycle-specific regulations may require a review of the general road traffic laws of individual countries.

The legal documents and relevant initiatives that regulate liability for road safety violations and apply to monowheels in Ukraine include: The Law of Ukraine "On Road Traffic" (1993), Article 2 of which outlines the state administration in the field of road safety; a list of typical traffic violations and fines issued to drivers in 2022 (Fines in Ukraine..., n.d.); "For safe roads" campaign (n.d.), which advocates for changes in state policy on road safety in Ukraine); Regulation (EU) 2022/1280 of the European Parliament and of the Council (2022), which establishes certain

rules allowing the recognition of Ukrainian driving licences in Europe; prevention of criminal offences in passenger road transport, which focuses on state regulation and control over the creation of safe conditions for road transport (Rudyk *et al.*, 2022); official test questions for the driver's licence exam in Ukraine, including questions on categories of driving licences and civil liability insurance (Student driver written exam in Ukraine, 2023); micro-mobility: provides a comparison of micro-mobility vehicle regulation and policy (Bondarenko *et al.*, 2021); a draft law granting witnesses the right to record traffic violations: proposes the right of witnesses to record violations using mobile devices and send them to the police (Committee on Ukraine's Integration into the European Union, 2021); Draft Law of Ukraine No. 8172 (2022), which defines a monowheel as a light personal electric vehicle. These documents and initiatives collectively contribute to the regulatory framework for road safety and establishing a level of liability for unicycles in Ukraine.

The legality of unicycles, especially electric unicycles (EUCs), varies from state to state in the United States. While some states allow them to be used on roads and bike paths, others consider them illegal. Rules are often determined by state and local laws, and age restrictions may apply. Some states allow EUCs on roads and bike paths as long as they follow the rules of the road, while others restrict their use to sidewalks or separate paths. It's important to familiarise yourself with the rules of your particular state and locality before riding your e-scooter or EUC in public (EUCs are illegal in all 50 US states, 2021). Some states may require registration or licensing of certain types of electric unicycles (Lee, n.d.; Atwell, 2021; 8 Interesting California bicycle law..., n.d.).

In European countries, monowheels and electric unicycles are subject to different traffic regulations. There is a lack of pan-European regulations for unicycles. The legal status and use of electric unicycles often depend on whether they are classified as vehicles, sports equipment, or pedestrian equipment. While there is no single rule for all countries, here are some general trends: in many European countries, unicycles are generally considered sports or pedestrian equipment rather than a vehicle; laws governing EUCs vary, with some countries allowing them on sidewalks or bike paths; there is an emphasis on following local laws and traffic regulations when riding unicycles and EUCs in European countries, ensuring safety for yourself and others.

In Ukraine, monowheels and electric scooters are recognised as vehicles. There are rules and traffic regulations for their use. These rules include wearing a helmet for safety,

following the safety rules on roads and sidewalks, and following the rules of the road. In Ukraine, the use of electric scooters and monocycles on sidewalks is restricted, and violations of traffic rules can result in fines. Recognising these vehicles as legal means of transport is a step towards regulating their use in the country. Drivers need to be aware of these rules and follow them to ensure safety and legal compliance when using monowheels in Ukraine.

Liability for traffic violations for owners of unicycle

Addressing the issue of liability for road traffic offences requires a comprehensive approach involving many stakeholders. In Ukraine, different agencies and institutions are responsible for different aspects of road safety, including law enforcement, road infrastructure, driver training and vehicle inspection. However, there is often a lack of coordination and cooperation between these organisations, leading to inefficiencies and gaps in enforcement. Improving communication and cooperation between the relevant authorities is crucial to creating a comprehensive and effective system for bringing offenders to justice.

In addition, public awareness and education play an important role in establishing rules for responsible road behaviour. Many drivers in Ukraine may not be fully aware of the possible consequences of their actions or the importance of following the rules of the road. The introduction of comprehensive road safety education programmes can help to raise awareness of the risks associated with road traffic offences and promote responsible driving. Such initiatives should not only target motorists but also pedestrians and cyclists, as they also contribute to road safety.

In summary, the issue of liability for road safety offences in Ukraine encompasses several distinct problems. Lack of clarity in the legal framework, inconsistency in the application of penalties and the need for cooperation between relevant stakeholders are critical aspects that need to be addressed. By addressing these issues and implementing comprehensive measures, Ukraine can improve road safety, reduce the number of accidents, and promote a culture of responsible driving. It is imperative that the government, law enforcement agencies and the public work together to create a safe environment for all road users.

Liability for road safety offences is a major concern for both Ukraine and the European Union. Although both jurisdictions are committed to road safety, there are similarities and differences in the respective legislation (Table 1).

Table 1. Comparative analysis of Ukrainian and EU legislation on liability for offences

Comparison area	Similar	Different
Clarity and definition of offences	Both Ukrainian and EU legislation recognise a wide range of offences and provide definitions for different violations. Offences such as speeding, drunk driving, failure to wear seat belts and running red lights are usually dealt with in both jurisdictions.	EU legislation has developed more detailed and standardised definitions of offences, providing clear guidelines and classifications for different types of offences. In contrast, Ukrainian legislation is often not precise and leaves room for interpretation, leading to ambiguity and inconsistency in application.
Punishment and classification of offences	Ukrainian and EU legislation establishes penalties for traffic offences to deter offenders and promote responsible driving behaviour. Common penalties include fines, licence suspension, mandatory educational programmes, and community service.	The EU tends to have more standardised and severe penalties, with a greater emphasis on differentiated penalties based on the seriousness of the offences and the presence of aggravating factors. Ukrainian legislation often allows for greater discretion in determining fines, resulting in inconsistencies across regions and cases.

Table 1, Continued

Comparison area	Similar	Different
Application and liability	Ukrainian and EU legislation focuses on imposing penalties and holding offenders accountable for their actions. Law enforcement agencies in both jurisdictions are responsible for monitoring traffic, conducting inspections, and issuing fines or court decisions.	The EU generally demonstrates a more consistent and effective enforcement system. European countries often use advanced technology, such as automatic speed cameras and red-light cameras, which makes it easier to detect and punish offences. Ukraine faces challenges related to inconsistent enforcement practices, limited resources, and the need for greater coordination between law enforcement agencies.
Driver education and public awareness	Both Ukraine and the EU recognise the importance of driver education and public awareness in promoting road safety. Both jurisdictions have programmes and initiatives aimed at educating drivers, pedestrians and cyclists about road rules, risks, and responsible behaviour.	The EU pays considerable attention to driver training, requiring mandatory driver training courses and strict testing procedures. In contrast, while Ukraine has similar goals, the implementation of driver education programmes is not as standardised or widespread. Efforts to improve public awareness and education in Ukraine are ongoing but require further development and support.

Source: developed by the authors

Thus, when comparing Ukrainian and EU legislation on liability for road safety offences, several similarities and differences are revealed. Both jurisdictions recognise a wide range of offences and seek to bring offenders to justice. However, the EU generally demonstrates more standardised and strict measures, including clearer definitions of offences, differentiated penalties and consistent enforcement. In contrast, Ukraine faces challenges related to unclear legislation, inconsistent penalties and enforcement practices. Strengthening Ukrainian legislation to provide clearer definitions, establish uniform penalty guidelines and improve enforcement practices would contribute to a more effective and consistent system of holding violators accountable. In addition, a greater emphasis on driver education and public awareness in Ukraine would align the country's efforts with the comprehensive approaches seen in the EU, leading to improved road safety outcomes.

Improving road safety for unicycles in Ukraine

Several areas can be improved to improve road safety for unicycle owners in Ukraine, based on the examples of how these issues are addressed in the United States and the European Union. Changes are needed in the legislative framework of Ukraine. Clear and comprehensive legislation on e-scooters should be created, similar to the way the US and EU countries have developed regulations on micromobility. This includes defining the classification of unicycles, permissible areas of use, and safety requirements. In addition, Ukraine needs to continue developing specialised infrastructure. Using the experience of the EU and the US, Ukraine can invest in special infrastructure, such as bike lanes and paths, designed to move monowheel users safely, reducing their interaction with motor vehicles and using creative approaches. Public awareness campaigns should be conducted on an ongoing basis. Public awareness campaigns emphasising the importance of road safety for mobility scooter users are effective. These campaigns can educate motor vehicle drivers and monowheel users about the unique issues and regulations associated with monowheels. Focus on safety standards. Safety standards should be developed for monowheels and related equipment, encouraging the use of helmets and reflective clothing, reflectors, etc. The area of data collection and analysis also needs to be improved. Following the example of the US and EU, data related to unicycle accidents and

incidents should be carefully collected and analysed. This information can guide evidence-based policy adjustments in this area. Next, mechanisms for enforcing road safety rules for monowheel users, including penalties for violations, need to be strengthened. Lastly, it is important to cooperate with international organisations and neighbouring countries to share best practices and harmonise regulations for monopoles as this mode of transport becomes more widespread.

By focusing on these areas, Ukraine can significantly improve road safety for monowheelers by aligning its practices with those of the United States and the European Union, ultimately reducing the number of accidents and increasing overall road user safety. Ukraine could consider borrowing the following traffic regulations from the US and the European Union for unicycles, which dedicated lanes for unicycles. Similar to the bike lanes that exist in many EU countries and some US states, Ukraine could create dedicated lanes or tracks specifically for unicycles. These lanes should be separated from regular traffic to increase safety for monowheel users; safety education, inspired by the EU Advisory Mission Ukraine's initiative to teach children, for whom riding a monowheel is a positive physical (Guthold *et al.*, 2020) and cognitive (Weber *et al.*, 2019) activity, about road safety, Ukraine could develop educational programmes targeting monowheel users. These programmes should focus on safe riding techniques, the importance of protective equipment such as helmets, and general road safety awareness; regulation and classification: Ukraine could establish clear regulations and classification for unicycles, distinguishing between different types such as electric (depending on power) and non-electric. This could help in establishing specific safety standards and usage guidelines for different categories of monowheels. By implementing these measures, Ukraine can improve road safety for monowheel riders by aligning its practices with those of the United States and the European Union and by promoting safe and responsible use of monowheels on its roads.

With transport systems constantly changing, it is becoming increasingly clear that there is an urgent need to develop clear and tailored traffic regulations that recognise the unique characteristics of unicycles. Electric unicycles, especially electric variants, are rapidly emerging as viable solutions for micromobility, offering environmentally friendly alternatives in urban environments. The research conducted

in this paper fits well within the context of the global research effort for comprehensive guidelines that specifically address the presence of monowheels and other newer vehicles on roads, bike paths and sidewalks. This article is in line with other researchers' opinion that the lack of specialised regulations creates safety risks for both monowheel users and pedestrians (O'Hern & Oxley, 2019). The results also once again confirmed the importance of developments in the field of traffic automation and algorithmisation. In this context, it is worth paying attention to recent studies that echo the main points of this study.

In particular, important results were obtained by L. Cavanini *et al.* (2021), who investigated advanced methods for the safe and efficient driving of autonomous vehicles through complex road junctions. This research addresses the development of algorithms and strategies that allow autonomous vehicles to make real-time decisions and navigate complex intersections, contributing to the development of autonomous transport systems. H. Eqab *et al.* (2023) developed an algorithm specifically for source-finding tasks, where mobile robots are tasked with locating and navigating to a specific target. The paper discusses the details of the algorithm design, its application, and the performance of mobile robots when using this algorithm for source-finding tasks. The paper contributes to the field of robotics and automation by improving the capabilities of mobile robots in various applications. X. Shang and A. Eskandarian (2023) investigated the use of model predictive control (MPC) and artificial potential function (APF) methods to improve vehicle safety in emergencies. The study delves into the development and integration of these control strategies to enable vehicles to avoid collisions and minimise the severity of accidents. The paper contributes to the field of intelligent transport systems and vehicle safety by providing insight into advanced collision avoidance methodologies.

G. Zhao and M. Zhu (2022) focused on achieving near-optimal motion planning strategies that can effectively scale with the number of robots involved. This study contributes to the field of robotics and automation by addressing the problem of coordinating and optimising the movements of multiple robots simultaneously, which has applications in various fields including autonomous robotics, logistics, and automation. S. Kim *et al.* (2023) outlined a case study and analysis of factors that influence the design and adaptation of environments to accommodate personal mobility vehicles such as electric scooters, bicycles, or other small modes of transport. This research is valuable for urban planning and transport infrastructure development, aiming to improve the usability and safety of these vehicles in different urban environments.

N. Milas (2022) provides an insight into the legal framework, regulations and safety measures for electric scooters and their use on roads. His publication interprets the law and its relationship with emerging transport, particularly in the context of electric scooters. It is important to note that the article focuses on legal aspects and may be of interest to individuals and professionals involved in law enforcement, safety, and transport regulation.

Therefore, the urgency of establishing specific road safety rules for monowheels is a priority. It is important to adapt traffic rules to the evolving transport landscape and advocate comprehensive recommendations that prioritise the safety and effective coexistence of all road users in an

era when monowheels play an increasingly prominent role in urban mobility. Through comparative analysis and case studies, it proposes ways to create a safer and more harmonious transport environment, ensuring the well-being of unicycle owners and the general public.

Conclusions

The necessity of establishing and legislating clear and adapted traffic rules, considering the unique characteristics of unicycles in modern transport systems, is identified and explored in the article, with a focus on safety, education and policy coherence. Through comparative analysis and case studies, it proposes ways to create a safer and more harmonious transport environment, ensuring the well-being of unicycle owners and the general public.

As driving automation advances and micromobility solutions become more widespread, ensuring road safety for various vehicles, including monowheels, remains extremely important. It is proposed to introduce clearly defined rules and standards that will facilitate the safer coexistence of electric unicycle owners with other road users. It is emphasised that educational initiatives on electromobility training can provide users with the opportunity to drive responsibly and should be conducted on an ongoing basis. The need to strengthen cooperation between governments, researchers and institutions is recognised, which will contribute to effective public policies that consider different modes of transport. For sustainable urban mobility, considering the interaction between new technologies and existing infrastructure is key. The importance of developing comprehensive regulations and education to ensure the safe and efficient integration of monowheels into modern transport systems is emphasised.

Thus, the critical need for individual road safety rules for e-scooter owners can be met by considering the legislative framework and best practices in the United States, the European Union, and the best practices already used in Ukraine. A study of these regions revealed differences in approaches to micromobility regulation. It is the development of special rules for monowheels that are important to address unique problems on the road, ensuring the safety of both owners and other road users. In addition, it is proposed to strengthen international cooperation and information exchange to develop comprehensive and effective road safety guidelines for new modes of transport, such as monowheels. This study contributes to safer urban mobility, and its results will help reduce the number of accidents and increase the level of road safety awareness among monowheel owners.

Areas for future research could include studying the experience of different countries and their concepts of e-scooting and researching urban transport systems and road safety regulations. Identifying best practices to reduce accidents and injuries. Developing rules for the use of electric unicycles on public roads. Studying the economic impact of the use of electric unicycles, including the impact on the functioning of urban transport, congestion, etc. Development and improvement of the educational aspect and information policy on the safe use of electric unicycles.

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Conflict of interest

None.

Introduction

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Окремі питання відповідальності у сфері безпеки дорожнього руху

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Анотація. Моноцикли стали засобом мікромобільності та екологічною альтернативою в міських умовах, однак їхній дизайн і режим роботи кидають виклик традиційним правилам дорожнього руху, призначеним для традиційних транспортних засобів. У сучасному ландшафті транспортних систем існує потреба в чітких і адаптованих правилах дорожнього руху, які враховують унікальні характеристики моноколес. Мета статті – дослідити особливості та обґрунтувати важливість встановлення правил безпеки дорожнього руху спеціально для моноколес, спираючись на порівняльний аналіз законодавств та передової практики США, Європейського Союзу та України. У статті йдеться про необхідність створити вичерпні вказівки, які б враховували присутність моноколес на дорогах, велосипедних доріжках і тротуарах. Зазначено, що відсутність спеціальних правил створює проблеми з безпекою як для користувачів моноколес, так і для пішоходів. Виявлено проблеми та запропоновано потенційні рішення. Підкреслено вирішальну роль адаптованих правил дорожнього руху в сприянні безпечного та ефективного співіснування в сучасній транспортній екосистемі. Проаналізовано нормативно-правові документи США, Європейського Союзу та України щодо законності користування моноколесами, відповідальності власників, здійснено їхнє порівняння. Визначено проблеми, які виникають у користувачів моноколес та інших учасників дорожнього руху і запропоновано їх комплексне вирішення. Виокремлено сфери впливу на які може підвищити безпеку дорожнього руху для власників моноколес в Україні, а також запропоновано конкретні варіанти можливого запозичення практичного досвіду США та країн Європейського Союзу щодо правил дорожнього руху для власників моноколес. Практичне значення статті полягає в просуванні безпечного та обізнаного використання моноколеса шляхом впорядкування законодавчої бази, встановлення чітких правил експлуатації, проведенням фіскальних обговорень та навчальних заходів. Дослідження може стати цінним надбанням для власників і користувачів моноколес, а також для урядових органів і законодавців

Ключові слова: моноколеса; правила дорожнього руху; мікромобільність; електротранспорт; міський транспорт; безпека