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Critical Analysis Autonomous Vehicles in India under Section 112 & 185 of MV Act 1988

[1]Ravikumar Vellingiri, [2]Professor. Dr.Mohd.Saleem

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Abstract: The advent of autonomous vehicles (AVs) has introduced a paradigm shift in transportation, posing new challenges and opportunities for legal compliance under traffic laws. This article explores the critical analysis & application of Sections 112 of the Motor Vehicles Act, 1988, in the context of both autonomous and manual vehicles. Section 112 mandates adherence to speed limits, while Section 185 prohibits driving under the influence of alcohol or drugs. The study compares the compliance and enforcement mechanisms for both vehicle types, assessing AVs' potential to minimize speed violations and eliminate DUI-related incidents due to their AI-driven operations.Through empirical analysis, including accidental reports from government agencies, the article evaluates the effectiveness of AV technology in reducing legal violations and enhancing road safety. It also examines the challenges of attributing liability in cases of AV violations and the readiness of the legal framework to accommodate these technological advancements. Finally, the article proposes policy recommendations to integrate AVs into the regulatory ecosystem, ensuring equitable accountability while leveraging their capabilities to transform traffic enforcement and public safety.

Keywords: *autonomous vehicles, motor vehicle act, laws for autonomous vehicles, legal provisions for driverless cars, legality of driverless cars.*

1. Introduction

In India, manual vehicles are the dominant mode of transport, and Sections 112 and 185 are frequently enforced to regulate driver behavior. Over speeding and driving under the influence are two of the most common causes of road accidents, contributing significantly to fatalities and injuries. According to data from the Ministry of Road Transport and Highways (MoRTH), over speeding accounts for more than 60% of road accidents, while driving under the influence is responsible for around 5-10% of fatal crashes. These figures highlight the critical importance of enforcing these sections in manual vehicles. Manual vehicles dominate Indian roads, and their operation depends entirely on human behavior, making them susceptible to violations of Sections 112 and 185. Over speeding remains a major issue, with human drivers often ignoring speed regulations, leading to accidents. Similarly, driving under the influence of intoxicants significantly compromises safety, as impaired judgment and reaction times contribute to fatal crashes. Addressing these violations requires strict law enforcement and public awareness campaigns.

In contrast, autonomous vehicles, equipped with advanced technologies such as AI, machine learning, and sensor-based navigation, are designed to adhere to traffic rules by default. Their capability to operate without human intervention offers a potential solution to over speeding and intoxicated driving. However, AVs also present unique legal and practical challenges, such as software malfunctions, accountability for violations, and interpretation of road signs, which may affect compliance with Sections 112 and 185. The introduction of autonomous vehicles (AVs) marks a significant technological advancement in the transportation sector, potentially revolutionizing road safety, mobility, and traffic law enforcement. However, the integration of AVs into the existing legal framework, particularly in relation to road safety laws, remains a critical challenge. In India, the Motor Vehicles Act, 1988, governs road traffic, with key provisions—Sections 112 and 185—targeting speed limits and driving under the influence (DUI) respectively. While manual vehicles have been the focus of enforcement for these sections, the advent of AVs requires a fresh examination of their application.

1.1. Abbreviations and Acronyms

Autonomous Vehicle (AV), Electric Vehicle (EV), Artificial Intelligence (AI), Autonomous Electric Vehicles (AEV),

1.2. Background

The rapid evolution of transportation technology has introduced autonomous vehicles (AVs) as a transformative force, presenting both opportunities and challenges in adapting existing legal frameworks. In India, the Motor Vehicles Act, 1988, governs road traffic laws, with Sections 112 and 185 playing a pivotal role in ensuring road safety. Section 112 mandates adherence to prescribed speed limits to reduce the risk of accidents caused by over speeding, while Section 185 prohibits driving under the influence of alcohol or drugs, addressing one of the leading causes of road fatalities. These provisions are primarily designed for manually operated vehicles, but the advent of AVs

necessitates a reevaluation of their applicability and enforcement mechanisms.

This article explores the real-world implications of these sections for both manual and autonomous vehicles, examining how each type of vehicle complies with and challenges the enforcement of traffic laws. This paper explores the real-world application of these legal provisions in the context of both manual and autonomous vehicles, highlighting the comparative effectiveness of enforcement, the challenges posed by AV technology, and the policy adjustments required to integrate AVs into the Indian legal framework while ensuring road safety.

1.3. Overview of the Motor Vehicles Act, 1988

The Motor Vehicles Act, 1988, is the principal legal framework governing road transport in India. Among its many provisions, Section 112 addresses speed limits, requiring vehicles to adhere to designated speed restrictions to prevent accidents and ensure safe road usage. Section 185 prohibits driving under the influence of alcohol or drugs, one of the leading causes of road accidents and fatalities. These two sections are foundational to road safety, targeting human error as the primary cause of traffic violations. However, the transition to autonomous vehicles—equipped with artificial intelligence (AI) and sensors—complicates the straightforward application of these laws, especially when considering issues of liability and accountability.

Section 112. Limits of Speed

(1) No person shall drive a motor vehicle or cause or allow a motor vehicle to be driven in any public place at a speed exceeding the maximum speed fixed for the vehicle under this Act or by any authority authorized in this behalf by the Central Government or a State Government.

(2) The Central Government or a State Government may, having regard to the condition of roads, bridges, and vehicles, the nature of traffic, and any other consideration it deems fit, by notification in the Official Gazette, fix such maximum speed limits for different classes or descriptions of motor vehicles or for different roads or classes or descriptions of roads, and may specify different speed limits for different areas or roads.

(3) No person shall drive a motor vehicle or allow it to be driven in any public place at a speed that is dangerous to the public, having regard to all the circumstances, including the nature, condition, and use of the place where the vehicle is driven and the amount of traffic which actually is at the time or which might reasonably be expected to be in the place.

ILLUSTRATION: Section 112 of MV Act aims to minimize accidents caused by excessive speed. It mandates that vehicles must not exceed the speed limits specified by traffic authorities, which are designed to match road conditions, weather, and the vehicle's capabilities. However, the enforcement of speed limits in India is inconsistent. A combination of factors, including poor infrastructure, ineffective surveillance, and lack of driver awareness, often results in over speeding being a common violation. Speeding is particularly prevalent in urban areas with dense traffic, as drivers often push the limits of their vehicles to keep up with fast-moving traffic or reduce travel time.

Section 185. Driving by a Drunken Person or by a Person under the Influence of Drugs

Whoever, while driving or attempting to drive a motor vehicle,

(a) has, in his blood, alcohol exceeding 30 mg per 100 ml of blood detected in a test by a breath analyzer, or

(b) is under the influence of a drug to such an extent as to be incapable of exercising proper control over the vehicle,

shall be punishable for the first offence with imprisonment for a term which may extend to six months, or with a fine which may extend to ten thousand rupees, or with both; and for a second or subsequent offence, if committed within three years of the commission of the previous similar offence, with imprisonment for a term which may extend to two years, or with a fine which may extend to fifteen thousand rupees, or with both.

ILLUSTRATIONS: Section 185 of MV Act**,** which deals with driving under the influence of alcohol or drugs, is another area where manual vehicles contribute to high accident rates. Drunk driving significantly impairs a driver's ability to react to road conditions, judge distances, and control the vehicle, which can lead to fatal accidents. Despite laws and penalties designed to deter such behavior, enforcement remains a challenge. Corruption, lack of proper breathalyzer testing equipment, and social attitudes toward drinking and driving contribute to the widespread occurrence of this violation.

In manual vehicles, compliance with Sections 112 and 185 largely depends on the driver’s adherence to the law. However, factors such as human error, emotional state, and external pressures often lead to violations. Law enforcement agencies continually monitor traffic through patrols, speed cameras, and checkpoints, but these methods are resource-intensive and may not always be effective in preventing violations. The penalties prescribed under Sections 112 and 185, while stringent after the 2019 amendment to the MV Act, need to be paired with widespread public awareness campaigns.

2. Road Safety across the world- A View

In 2021, there were an estimated 1.19 million road traffic deaths worldwide, corresponding to a rate of 15 deaths per 100,000 population. Excessive speed is identified as a major risk factor for road traffic injuries and fatalities. In **Europe-** 2023, around 20,400 people were killed in road crashes in

the European Union. In Kenya 2023, road fatalities rose significantly from 2,965 in 2018 to 4,579, indicating a concerning trend. The WHO's report highlights the critical need for comprehensive speed management strategies to reduce road traffic fatalities. While specific data on fatalities directly attributed to over speeding is limited, the report underscores the importance of addressing speed-related risks to enhance global road safety.

The WHO's **Global Status Report on Road Safety** states that speeding is a major risk factor for road traffic injuries and fatalities globally. It highlights that higher speeds increase the likelihood of collisions and the severity of injuries. Speeding is identified as a leading cause in over 50% of fatal road accidents worldwide. The World Health Organization (WHO)'s Global Status Report on Road Safety 2023 provides a comprehensive overview of global road traffic fatalities and their contributing factors.

2.1. Road Safety India- Common factors:

The ministry's annual reports often highlight that over speeding accounts for a significant majority (above 60%) of total road accidents and deaths. In the 2022 report, over speeding was identified as the cause of approximately: From, 3,55,000 accidents (out of the total recorded road crashes), there are Over 85,000 deaths (nearly 60.2% of all road fatalities). Accidents caused by over speeding result in higher fatality and injury rates due to the increased impact force during collisions. While over speeding remains the leading cause, drunken driving is also a significant contributor, accounting for 1.9% of total road crashes and over 2,300 deaths annually. The combination of over speeding and alcohol impairment increases crash severity exponentially.The National Highways Authority of India (NHAI), in collaboration with the Ministry of Road Transport and Highways (MoRTH), monitors and reports on road safety across India's national highways. While NHAI focuses on infrastructure development and maintenance, MoRTH publishes comprehensive annual reports detailing road accident statistics, including those related to over speeding, as governed by Section 112 of the Motor Vehicles Act, 1988. Over speeding remains a predominant cause of road accidents and fatalities on national highways.

2.1. Road Safety USA- Common factors:

The National Highway Traffic Safety Administration (NHTSA) reports that speeding has been a significant factor in road fatalities in the United States. Speeding contributed to 29% of all traffic fatalities in 2021, highlighting its critical role in road safety statistics. In 2021, speeding has contributed to 29% of all traffic fatalities, resulting in over 12,300 deaths. Speeding increases crash severity, reduces reaction time, and compromises vehicle control, leading to higher fatality risks. Alcohol-impaired driving remains another significant factor in U.S road deaths. In 2021, 37% of all traffic-related fatalities (approximately 13,384 deaths) involved at least one driver with a blood alcohol concentration (BAC) of 0.08% or higher. Drunken driving fatalities disproportionately affect younger age groups, with 25-34-year-olds accounting for the largest share. When combined, over speeding and alcohol impairment present an even greater risk, as impaired judgment and reduced reaction times from alcohol exacerbate the dangers of speeding. NHTSA studies show that drivers under the influence are more likely to speed, further increasing the likelihood of fatal crashes.

3. Speeding and Drunken Driving & Regulatory Gaps

Speeding is one of the leading causes of road traffic accidents and fatalities worldwide, and India is no exception. According to the Ministry of Road Transport and Highways (MoRTH), over 60% of road fatalities in India are attributed to speeding, with manual vehicles being a major contributor. Data from MoRTH's annual reports consistently show that speeding accounts for a significant percentage of accidents. For example, in the 2021 report, speeding was responsible for 72.3% of road accidents and 71.2% of fatalities. The situation is exacerbated on highways and high-speed zones, where the risk of fatal crashes is much higher. Data from the National Crime Records Bureau (NCRB) indicate that speeding leads to approximately 40,000 deaths annually, accounting for around 20% of all road fatalities in India. In 2020, speeding was identified as the cause of 72,000 accidents resulting in 33,000 fatalities.

The regulation of speeding and drunk driving in manual vehicles has been a persistent challenge in India due to a combination of infrastructural, behavioural, and enforcement-related issues. Despite the enactment of strict laws under Section 112 (Speeding) and Section 185 (Drunk Driving) of the Motor Vehicles Act, 1988, road safety remains a significant concern, particularly in the context of manual vehicles. This section explores the various obstacles faced by authorities in enforcing these laws effectively, supported by relevant data and case studies

3.1.**Lack of Strict Enforcement**:

One of the main challenges is the lack of adequate speed enforcement mechanisms. Despite the presence of speed cameras and radar guns, their deployment is often limited to high-risk areas. Many regions still rely on manual intervention, which is susceptible to human error and inefficiency.

3.2.**Road Infrastructure Issues**:

India's road infrastructure often encourages speeding. Poorly marked roads, lack of road signs, and inadequate barriers contribute to speeding incidents. For instance, national highways (which make up a substantial portion of

Indian roads) are often inadequately equipped to prevent drivers from speeding, especially on long, straight stretches.

3.3.Enforcement Inconsistencies & Corription

While Breathalyzer tests and sobriety checkpoints are used to catch drunk drivers, their implementation is often inconsistent, especially in rural and remote areas. In many states, alcohol testing is conducted sporadically, leading to a reduced deterrence effect. Instances of corruption among law enforcement officials further complicate the regulation of drunk driving. In some cases, officers may not follow proper protocols for alcohol testing, or they may accept bribes to avoid issuing fines or arrests.

3.4.**Inadequate Punishments**:

For instance, under Section 185, the fine for a first offense is relatively low, and repeat offenders are often not penalized stringently enough. The enforcement of these laws is frequently hindered by resource constraints and staff shortages in law enforcement agencies, making it difficult to monitor and penalize speeding and drunk driving on a wide scale.

The challenges in regulating speeding and drunken driving in India, particularly in the context of manual vehicles, are multifaceted. They stem from infrastructural limitations, cultural attitudes, enforcement inefficiencies, and legal inadequacies. While speeding and drunk driving laws exist, their effectiveness is hampered by inconsistent enforcement and a lack of public awareness. To address these challenges, India needs a more **integrated approach** that combines stronger enforcement, improved road infrastructure, stricter penalties, and comprehensive public education campaigns.

4. Evolution of AVs in tact with Sections 112 and 185 of Motor Vehicle Act

Autonomous vehicles, equipped with AI-driven systems, represent a paradigm shift in road safety and compliance. Unlike manual vehicles, AVs are designed to follow traffic laws meticulously by default, as their operation is based on predefined algorithms, sensors, and real-time data processing. These vehicles promise to address several issues related to Sections 112 and 185, such as over speeding and drunk driving.

4.1. Speed Limit Compliance (Section 112)

One of the primary advantages of AVs is their ability to adhere to speed limits with unprecedented accuracy. Unlike human drivers, who may choose to speed based on personal judgment or external pressures, autonomous vehicles are programmed to maintain a safe speed, adjusting in real time based on road conditions, traffic density, and legal speed limits. The integration of GPS and sensor technology allows AVs to continuously monitor and adjust their speed, ensuring that they comply with speed restrictions without human intervention.

Furthermore, AVs can benefit from the implementation of smart road infrastructure, such as connected traffic signals and real-time speed monitoring systems. This would allow AVs to adapt to changing conditions on the road, including temporary speed reductions due to roadwork, adverse weather, or accidents. With their ability to process vast amounts of data instantaneously, AVs could offer significant improvements in speed compliance compared to manual vehicles.

4.2. Driving Under the Influence (Section 185)

Section 185, which aims to prevent drunk driving, becomes less relevant in the context of autonomous vehicles. Since AVs do not rely on human drivers to operate, the issue of driving under the influence is effectively eliminated. Autonomous systems are not susceptible to impairment from alcohol or drugs, thus drastically reducing the risk of accidents related to intoxication.

However, challenges remain in determining responsibility and liability in the case of an accident involving an AV. For instance, if an AV were to violate traffic laws or cause an accident, questions would arise regarding whether the blame lies with the vehicle's AI, the manufacturer, or the owner/operator. This raises complex issues about accountability and the need for updates to the existing legal framework, as current laws are designed with human drivers in mind.

4.3. Challenges in Implementing AV Compliance with Sections 112 and 185

While AVs offer clear advantages in terms of speed compliance and the elimination of DUI-related accidents, several challenges must be addressed before they can fully integrate into India’s regulatory system.

4.3.1. Liability and Accountability:

One of the major challenges in applying Sections 112 and 185 to AVs is determining liability in the event of a violation or accident. If an AV is found to be in violation of speed limits or involved in an accident, who is responsible? The manufacturer? The software developer? The vehicle owner? This issue requires legal clarity and the potential modification of the Motor Vehicles Act to accommodate autonomous technology.

4.3.2. Technology Limitations:

While AVs are designed to follow traffic laws, their technology is not foolproof. Issues such as sensor malfunctions, software bugs, and limitations in AI decision-making could result in violations of speed limits or other traffic laws. For instance, an AV might misinterpret a speed sign or fail to react appropriately to road conditions, potentially leading to an accident. These technological challenges highlight the need for robust testing, regulation, and monitoring of AVs on Indian roads.

4.3.3. Regulatory Framework:

The current Motor Vehicles Act, 1988, does not account for autonomous vehicles. AVs present unique legal and ethical issues that require new laws and policies. For example, who should be held responsible for an AV's actions if a violation occurs, and how should AVs be integrated into the existing system of traffic law enforcement? Policymakers will need to develop a regulatory framework that addresses these new challenges while promoting the safe and efficient use of autonomous technology.

5. Autonomous Vehicles: A New Era in Road Safety

The rise of autonomous vehicles (AVs) marks a transformative moment in the world of transportation. These self-driving cars, equipped with sophisticated technologies such as Lidar (Light Detection and Ranging), radars, and cameras, are poised to redefine road safety across the globe. While still in the developmental and regulatory stages, AVs have shown promise in addressing several major road safety issues. The main question, however, is whether these vehicles can significantly reduce traffic accidents, fatalities, and injuries, as well as how they fit into current road safety laws. Autonomous vehicles are designed to operate with minimal or no human intervention. They rely on an array of sensors, artificial intelligence (AI), and machine learning algorithms to navigate roadways. One of the major advantages of AVs is their ability to **eliminate human error**, which is the leading cause of traffic accidents.

Human Error in Road Safety: According to the World Health Organization (WHO), over 90% of road traffic accidents are attributed to human error. Speeding, distractions, impaired driving (due to alcohol or drugs), fatigue, and poor decision-making are all human factors that contribute to accidents. AVs, on the other hand, operate without being influenced by these factors, leading to a significant reduction in road traffic injuries and fatalities.

5.1. Data on Road Safety Improvements through AVs

Studies suggest that autonomous vehicles could dramatically improve road safety. According to a report from the U.S. National Highway Traffic Safety Administration (NHTSA), 94% of serious crashes involve human error. If AVs can replace human drivers, they have the potential to reduce these crashes drastically. Furthermore, a study by the RAND Corporation estimates that autonomous vehicles could reduce traffic fatalities by up to 90% if fully implemented.

For instance, a 2018 report from the Edison Electric Institute estimated that autonomous vehicles could reduce road deaths by 25,000 to 50,000 annually in the United States alone once the technology is widespread. The same report highlighted the importance of vehicle-to-vehicle communication (V2V), where AVs communicate with each other to avoid collisions, further enhancing safety.

5.2. Reduction in Specific Types of Accidents

5.2.1. Drunk Driving: One of the major causes of accidents globally is drunk driving. In the U.S., the NHTSA reported that in 2020, 11,654 people died in alcohol-impaired driving crashes, accounting for 30% of all traffic fatalities. Autonomous vehicles are programmed to never drive under the influence of alcohol, eliminating drunk driving as a risk factor.

5.2.2.Speeding: Speeding is another major cause of traffic fatalities. According to the WHO, speeding is responsible for nearly 30% of global traffic deaths. AVs are equipped with GPS and sensors that can monitor and regulate speed according to the road conditions and speed limits, significantly reducing the likelihood of speeding-related crashes.

5.2.3 .Distracted Driving: Distracted driving due to texting, phone calls, or other distractions is a serious issue, especially among younger drivers. According to the Centers for Disease Control and Prevention (CDC), 9 people are killed every day in the U.S. due to distracted driving. Since AVs operate independently of human input, they completely eliminate the risks associated with distractions behind the wheel.

5.2.4. Fatigue: Drowsy driving is another contributing factor to accidents. According to the National Sleep Foundation, sleep-deprived drivers are more likely to be involved in accidents. Autonomous vehicles would not suffer from fatigue, thereby further reducing crash risks.

6. Regulatory and Legal Implications of Autonomous Vehicles

The introduction of autonomous vehicles presents significant legal and regulatory challenges. Governments must address issues related to liability, insurance, safety standards, and driver responsibilities. For instance, if an autonomous vehicle is involved in an accident, it remains unclear who would be held liable: the manufacturer, the software developer, or the owner of the vehicle. In India, where road safety is a significant concern, the Motor Vehicles Act, 1988 will require amendments to accommodate the operation of AVs. There is also a need for developing comprehensive frameworks to monitor and regulate autonomous driving technologies, ensuring their safety and effectiveness on Indian roads. For instance, in 2019, the Indian government released the National Policy on Autonomous Mobility, which outlines regulatory measures and safety standards for AVs in India. However, this is still in its nascent stages, and further reforms and advancements in policy are necessary to facilitate AV adoption.

7. Challenges in Regulating Autonomous Vehicles in India

Autonomous vehicles represent a new era in road safety, offering the potential to drastically reduce the number of traffic accidents, injuries, and fatalities. By eliminating human error, AVs could tackle many of the persistent issues such as speeding, drunk driving, distracted driving, and fatigue. However, the road to full implementation is fraught with challenges, including technological limitations, legal and regulatory hurdles, cybersecurity risks, and ethical concerns.

As the technology matures and regulatory frameworks evolve, autonomous vehicles have the potential to revolutionize road safety on a global scale. To fully realize their benefits, continued investment in research, public education, and infrastructure will be crucial. While obstacles remain, the potential for AVs to create safer roads and save lives is undeniable, marking a significant shift in how we view transportation and road safety. The country's infrastructure, legal framework, public perception, and technological readiness are all key factors that will influence how well autonomous vehicles can be integrated into India's roads.

7.1.Infrastructure Limitations in India

India's road infrastructure presents a significant challenge to the safe deployment of autonomous vehicles. The country has a diverse road network, ranging from high-speed highways to poorly maintained rural roads, which may not be equipped with the necessary infrastructure to support AV technologies. Autonomous vehicles rely heavily on high-definition mapping, real-time data exchange, and smart traffic management systems to function effectively. In India, many roads, especially in rural areas, lack clear lane markings, traffic signals, and consistent road signs—features that are essential for AVs to navigate safely. Additionally, the quality of roads varies significantly across states and regions. According to a report by the Indian Ministry of Road Transport and Highways (MoRTH), nearly 30% of Indian roads are in poor condition, which presents challenges for AVs that rely on precise environmental data to function optimally.

7.2.Lack of Clear Legal Framework

India's Motor Vehicles Act, 1988 and its amendments have been designed to regulate traditional, human-driven vehicles. However, these laws do not account for the complexities of autonomous vehicles. While the Indian government has begun to explore regulatory frameworks for AVs, there is no comprehensive law that governs their testing, deployment, and use on public roads. In 2019, the Indian government released a National Policy on Autonomous Mobility, aiming to pave the way for AV deployment in the country. The policy highlights the need for international standards and safety measures but leaves many unanswered questions about the liability and accountability in case of accidents involving autonomous vehicles. For instance, if an autonomous vehicle is involved in an accident, it remains unclear whether the responsibility lies with the manufacturer, the software developer, or the vehicle owner. Furthermore, AVs raise new questions about insurance policies. In the current system, human drivers are liable for accidents. But when a machine is in control, the framework for liability and insurance needs to be redefined. India's current insurance laws do not account for such cases, which poses a challenge for AV manufacturers and consumers.

7.3.Technological Gaps and Cybersecurity Risks

Although autonomous driving technology is advancing rapidly, it is not without its challenges. The reliance on complex software systems, AI algorithms, and real-time data collection leaves autonomous vehicles vulnerable to cybersecurity threats. In 2020, a report from the Indian Cyber Crime Coordination Centre (I4C) highlighted the growing risk of cyber-attacks in the transportation sector. Hacking and data breaches in AVs could not only lead to accidents but also pose national security risks if AVs are hacked for malicious purposes. Another technological challenge is the lack of universal standards for autonomous vehicle operation. While countries like the U.S. and the EU have developed certain standards for AV testing and deployment, India still lacks a unified framework for ensuring the safety of these vehicles. This leads to regulatory uncertainty and delays in bringing autonomous vehicles to market.

7.4.Lack of Skilled Workforce and Research

Another challenge to the widespread adoption of AVs in India is the shortage of skilled workforce capable of handling the technical demands of AV technology. Most of the skilled work-forces are moving to Developed Countries for better life, India left limited sources of skill power. The development of autonomous driving systems requires expertise in fields like artificial intelligence (AI), machine learning, robotics, and cybersecurity, areas where India is still in the nascent stages of development. Although Indian universities like the Indian Institute of Technology (IIT) and the Indian Institute of Science (IISc) are making strides in research, the country needs more investment in education and training to ensure a skilled workforce for AV manufacturing and maintenance.

8. Opportunities in Autonomous Vehicles in India

While India faces several challenges in regulating autonomous vehicles, such as infrastructure issues, legal ambiguities, public skepticism, and technological limitations, the opportunities AVs present for road safety, efficiency, and economic growth cannot be ignored. With

the right regulatory frameworks, technological investments, and public awareness campaigns, India can successfully navigate the complexities of autonomous vehicle deployment. If implemented thoughtfully, autonomous vehicles have the potential to transform transportation in India, leading to safer, more efficient, and environmentally sustainable roads.

8.1. Increased Efficiency and Reduced Traffic Congestion

Autonomous vehicles are equipped with advanced algorithms and vehicle-to-vehicle communication (V2V), allowing them to communicate with other AVs and manage traffic more effectively. This capability could lead to smoother traffic flow, reduced congestion, and fewer traffic jams in cities. According to a report by the Indian Ministry of Urban Development, traffic congestion in Indian cities costs the economy around $22 billion annually. AVs could play a significant role in reducing this cost by optimizing traffic management and reducing delays.

8.2. Potential for Innovation and Economic Growth

The development and deployment of autonomous vehicles in India offer significant opportunities for economic growth and technological innovation. India's automobile industry is already one of the largest in the world, and the introduction of AVs could spur growth in sectors such as AI, machine learning, electric vehicles (EVs), and robotics. The government's Make in India initiative could benefit from AV-related advancements, creating job opportunities and boosting local manufacturing capabilities.

8.3. Environmental Benefits

Autonomous vehicles, particularly those powered by electricity, offer a pathway to reducing carbon emissions in India's transportation sector. India is one of the largest emitters of greenhouse gases in the world, and transportation contributes a significant portion of these emissions. A McKinsey report predicts that autonomous electric vehicles could reduce CO2 emissions by up to 50% in urban areas by 2030. This presents a significant opportunity for India to transition towards a more sustainable and eco-friendly transportation system.

9. Legislative Framework to regulate AV in India

9.1. Amendments to the Motor Vehicles Act, 1988

The Motor Vehicles Act, 1988 (MV Act) is the primary legislation governing road safety and traffic regulation in India. While the act covers various aspects of traffic management, it is largely outdated when it comes to addressing autonomous vehicles. One of the main challenges in AV legislation is determining liability in the event of accidents. Amendments to the MV Act should establish clear frameworks for determining the liability of manufacturers, vehicle owners, and software developers in case of crashes or failures. This includes provisions for automobile insurance tailored to AVs.

9.2. Development of Smart Infrastructure to Support Autonomous Vehicles

Indian legislative efforts should focus on developing smart road infrastructure that facilitates the seamless integration of AVs. Indian roads should be equipped with smart traffic signals, road sensors, and communication systems that allow AVs to communicate with traffic management systems. This would enable real-time adjustments to traffic flow, enabling safer and more efficient driving for AVs. India must standardize road signs, lane markings, and traffic signals to accommodate the precise needs of autonomous vehicles. AVs rely heavily on these cues for navigation, so consistent, high-quality signage is essential.

9.3. Regulating Mixed Traffic Conditions

During the transition period, manual and autonomous vehicles will share the same roads. Regulations may need to be implemented that limit the speed of manual vehicles around autonomous vehicles, as AVs will adhere strictly to speed limits and may drive at slower speeds in some cases. Legislation should address how manual drivers should interact with autonomous vehicles on the roads, including rules for overtaking, lane changes, and avoiding collisions in mixed traffic situations. Policies could promote the adoption of driver-assistance technologies in manual vehicles to ensure smoother interactions between human-driven and autonomous vehicles.

9.3. Insurance and Compensation Laws

As AVs reduce the number of accidents caused by human error, the insurance industry needs to be restructured to account for automated driving. Establishing new models of insurance that consider the reduced risk of AVs, while also addressing liability in cases where accidents occur due to software malfunction, system failure, or external factors. In the case of AV-related accidents, especially those that may involve issues like software errors, data malfunctions, or communication breakdowns, compensation schemes should be designed to ensure victims are adequately compensated.

10.Conclusion

The introduction of autonomous vehicles offers significant potential to improve road safety by ensuring strict compliance with speed limits and eliminating the risk of driving under the influence. However, the application of Sections 112 and 185 of the Motor Vehicles Act, 1988, to AVs requires careful consideration of new legal and technological challenges. While manual vehicles depend on human behavior and are subject to various violations, autonomous vehicles provide an opportunity to mitigate many of the human errors that lead to accidents. Nonetheless, AVs bring their own set of complexities

related to liability, accountability, and technological limitations.

The integration of autonomous vehicles (AVs) into India's transportation system has the potential to significantly reduce accidents caused by human errors such as over-speeding, drunken driving, and distracted driving. However, to achieve this, Indian legislators need to create a robust framework that adapts to the technological innovations posed by AVs. Key areas of development include amendments to the Motor Vehicles Act, the creation of new safety standards, investment in smart infrastructure, and the establishment of clear liability and insurance regulations. These legislative efforts, alongside public education and cybersecurity measures, will help ensure that autonomous vehicles contribute to safer, more efficient transportation in India.

To effectively integrate autonomous vehicles into India's road safety laws, updates to the Motor Vehicles Act will be necessary, along with ongoing research, technological improvements, and legal adaptations. As AV technology continues to evolve, the legal framework must evolve with it, ensuring that both manual and autonomous vehicles can coexist on Indian roads safely and efficiently.

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Author contributions

Ravikumar Vellingiri & Dr. Mohd. Saleem:

Conceptualization, Methodology, Software, Field study, Writing-Original draft preparation, Software, Validation., Field study

Conflicts of interest

The authors declare no conflicts of interest.

References

[1] National Road Traffic Accident Report, Ministry of Road Transport & Highways, India (2021).

[2] Traffic Safety Facts 2020, U.S. Dep't of Transp. (2020).

[3] Vehicle Automation and the Law, 53 *IEEE Spectrum* 24 (2016).

[4] Autonomous Vehicle Technology: A Guide for Policymakers, RAND Corporation (2018).

[5] Global Status Report on Road Safety, World Health Organization (2018),

[6] India's Road Safety Year 2020 Report, Ministry of Road Transport & Highways (MoRTH), Govt. of India (2021).

[7] Autonomous Vehicles and their Potential Impact on Traffic Law Enforcement, 18 *Harvard Law Review* 203 (2018).

[8] Statistical Overview of Road Accidents in India (2020), Ministry of Road Transport & Highways, Government of India.

[9] Traffic Safety in Autonomous Vehicle Era, American Bar Association (2020).

[10] NHTSA's Role in Autonomous Vehicle Safety Testing, U.S. Dep't of Transportation (2021).

[11] Indian Ministry of Electronics & IT, Emerging Technologies and Ethics: AI in Transport, MEITY.GOV.IN (2022).

[12] National Transport Development Policy Committee, Final Report, Gov't of India (2022).

[13] Kalra et al., *Driving to Safety: How Many Miles of Driving Would It Take to Demonstrate Autonomous Vehicle Reliability?*, 94 TRANSP. RES. PART A 182 (2017).

[14] Smith, *Automated Driving and Product Liability*, 50 U.C.D. L. REV. 1741 (2017).

[15] Thierer & Hagemann, *Removing Roadblocks to Intelligent Vehicles and Driverless Cars*, 5 WAKE FOREST J. L. & POL'Y 339 (2015).

[16] World Health Organization, Global Status Report on Road Safety 2023, WHO.INT.

[17] Motor Vehicles Act, No. 59 of 1988, INDIA CODE.