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CRIMINAL NEGLIGENCE IN THE AGE OF AUTONOMOUS VEHICLES: REINTERPRETING MENS REA UNDER INDIAN CRIMINAL LAW

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ABSTRACT

The rise of self-driving cars has raised issues pertaining to the relevance of principles of mens rea and negligence within the Indian context. The concept of mens rea and criminal negligence was developed within the context of a human-oriented criminal justice paradigm where the actions of offenders were directly attributed to deliberate human decision-making, human intention, and human behavior. On the other hand, autonomy in driving shifts the decision-making process to computer technology and machine learning, thereby making the occurrence of an adverse outcome dependent on programming defects, unforeseen machine behavior, or machine malfunctions. The purpose of the paper is to critically assess the inefficacy of the provisions of Indian criminal law in tackling the problem of autonomous vehicles. In doing so, the paper explores the doctrine of mens rea, negligence, causation, and foreseeability within the Bharatiya Nyaya Sanhita, 2023 in view of the shortcomings arising out of autonomy in mobility. The research paper proposes that the advent of self-driving cars requires the rethinking of the crime of criminal negligence through the formulation of a hybrid form of mens rea that considers technological monitoring, risk management at a systemic level, and accountability of algorithms. Further, it mentions that there is no comprehensive legal framework that regulates the autonomy of transport in India and raises constitutional issues regarding public safety, fairness, and transparency under Article 21 of the Constitution of India. Using the doctrinal and comparative approach, the research paper analyzes emerging regulations for autonomous mobility in the international community, especially in Europe and technologically advanced nations.

Keywords: Autonomous Vehicles; Criminal Negligence; Mens Rea; Artificial Intelligence; Machine Learning; Criminal Responsibility.

I. INTRODUCTION: AUTONOMOU MOBILITY AND THE CRISIS OF TRADITIONAL CRIMINAL LIABILITY

A. Introduction

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The development of driverless cars has resulted in a change in the interconnection between technology, human intervention, and criminal liability. Driverless cars rely on artificial intelligence rather than human intervention to achieve environmental awareness and make decisions in real time. As such, driverless cars pose unique problems for negligence and mens rea in Indian criminal jurisprudence. Jurisprudence of crimes is fundamentally grounded on the belief that an act of wrongdoing stems from the acts of a conscious human being. Mens rea, which is based on the notion that there must be an intent, knowledge, recklessness, or negligence on the part of a natural person to make him criminally liable, reinforces the link between criminal liability and consciousness.[2] The issue takes on added importance in India, given that there is no existing legislative structure to regulate self-driving technologies. Current legislation like the Motor Vehicles Act, 1988 and Bharatiya Nyaya Sanhita, 2023 still define the notion of negligence according to anthropomorphic criteria. This approach becomes increasingly difficult in an environment where technological autonomy shifts some responsibility away from humans and onto machines.[3] Autonomous car collisions pose additional problems regarding evidence and constitutionality. Machine learning technologies tend to utilize complex computational methods, which are often referred to as "black box." As a result, the courts will face complications when determining causality, foreseeability, and criminal intent using established laws.[4] Moreover, culpability in the context of autonomous systems is generally shared between various parties, such as manufacturers, software designers, programmers, and regulators.This research paper posits that with the advent of autonomous mobility, there is an urgent need to revisit the concept of mens rea and criminal negligence within the Indian legal framework. As the shift occurs from human-centered liability to algorithm-based liability, there is a need for criminal jurisprudence to transcend traditional human-centric approaches.

B. Evolution of Autonomous Vehicle Technology

Self-driving vehicles have been developed due to advances in artificial intelligence, robotics, sensing systems, and machine learning. Modern self-driving automobiles rely on a connected infrastructure that utilizes technologies like LiDAR sensors, radars, cameras, cloud computing, and predictive algorithms to analyze the surroundings in real-time. Automobiles have been categorized according to their automation level from Level 0 to Level 5 by the Society of Automotive Engineers.[5] The level of automation directly influences the extent of the transition from human control to computer-based control mechanisms. Several countries including the USA, Germany, and Europe have initiated frameworks to regulate challenges in autonomous driving and responsibility in artificial intelligence. Likewise, there has also been an effort in India to implement artificial intelligence-based mobility through initiatives like smart mobility programs and digital

[2] H.L.A. Hart, *Punishment and Responsibility: Essays in the Philosophy of Law* (Oxford University Press 1968) 136.
[3] Bharatiya Nyaya Sanhita 2023; Motor Vehicles Act 1988.
[4] Frank Pasquale, *The Black Box Society* (Harvard University Press 2015) 3.
[5] Society of Automotive Engineers, 'Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles' (SAE Standard J3016, 2021).

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infrastructures. However, the legislative frameworks in India still revolve around traditional manual vehicles without considering algorithmic liability.

C. Research Problem

The main issue raised by this research is the inefficiency of the conventional doctrines of criminal negligence in managing harm arising from autonomous vehicles. In its current state, Indian criminal law operates under the assumption that any fault must be attributable to a specific individual or individuals, and there must be direct control over the operations of the autonomous vehicle. However, in cases where harm occurs due to technical faults like errors in the programming algorithms or cybersecurity risks, it is unlikely that criminal negligence was involved.

D. Scope, Methodology and Significance

The research employs a doctrinal approach in examining autonomous vehicles, criminal negligence, and the legal position of India with regard to these two concepts. Sources of law, case laws, policy documents, and international regulatory frameworks have been used. Some comparative analysis was carried out based on countries such as EU, Germany, and the USA because of their growing legal framework in autonomous mobility. This research is important as it provides a new paradigm in which autonomous vehicles pose a significant challenge to the existing criminal law jurisprudence. The old principles of law that are based on the theory of personal culpability have become inadequate when dealing with technological decisions and harm distribution. The project makes an invaluable contribution to Indian legal studies through the formulation of a model for the reformation of the mens rea doctrine in artificial intelligence contexts.

II. THEORETICAL FOUNDATIONS OF CRIMINAL NEGLIGENCE AND MENS REA UNDER INDIAN CRIMINAL LAW

A. Introduction

Criminal negligence holds a unique place in criminal jurisprudence since it allows for criminal liability despite lack of intent to commit an act. Unlike crimes that require intent or knowledge, criminal negligence results from lack of adherence to requisite standards of care. It is thus a reflection of the wider goal of criminal laws to safeguard the general public from unreasonable and dangerous behavior.[6] Autonomous vehicles pose a major threat to criminal negligence since all doctrines were formulated within the context of humans acting alone. Criminal liability always entails human conduct, awareness, and actions that are within human capacity to foresee. However, the advent of autonomous technology threatens to alter this paradigm by shifting accountability from humans to machines. This chapter analyzes the doctrines behind mens rea, criminal

[6] Andrew Ashworth, *Principles of Criminal Law* (7th edn., Oxford University Press 2013) 157.

negligence, foreseeability, and causation according to Indian criminal laws and their inadequacies when applied to autonomous technology.

B. Concept of Mens Rea in Criminal Law

Mens rea is one of the basic elements of criminal law. The principle, "actus non facit reum nisi mens sit rea," indicates that a criminal charge normally necessitates not only a crime but also the guilty mind.[7] Criminal punishment is thus warranted only in cases where forbidden acts exhibit moral culpability. There are several different mental states in Indian criminal law, including intention, knowledge, recklessness, rashness, and negligence.[8] The term "intention" denotes intentional and goal-oriented behavior, whereas "knowledge" indicates awareness of probable consequences. Recklessness is marked by conscious neglect of anticipated harm, and negligence is characterized by the lack of proper attention required under the specific circumstances.[9] This principle serves an essential restrictive role by helping to differentiate criminal acts from accidents and tortious behavior. Nevertheless, it becomes problematic when applied to independent systems, which lack consciousness and intentions as per classical definition.

C. Criminal Negligence under Indian Criminal Law

Criminal negligence is an offense where there is a complete disregard of care to an extent where the behavior results in a threat to human life. Unlike civil negligence whose main focus is to seek damages, criminal negligence results in penal sanctions since the behavior is viewed to be blameworthy enough to deserve punishment. Courts of law in India have always made a distinction between criminal negligence and simple carelessness. As per the case of Jacob Mathew vs State of Punjab, the Supreme Court stated that criminal negligence involves gross and culpable negligence and not simply negligence by mistake of judgment.[10] Similarly, in Kurban Hussein Mohamedalli Rangawalla v State of Maharashtra, the Court emphasized the necessity of direct nexus between negligent conduct and resulting harm.[11] This doctrine generally consists of four elements: First, Duty of care; Second, Breach of the duty of care; Third, Direct cause of harm; and Fourth, Foreseeability of consequences.[12] This doctrine was established based on the actions of humans who exercise operational control. However, the existence of autonomous vehicle systems makes each of the above elements complex, since harm can occur as a result of an algorithm rather than human actions.

D. Rashness, Recklessness, and Negligence

[7] Glanville Williams, *Criminal Law: The General Part* (2nd edn., Stevens & Sons 1961) 30.
[8] Bharatiya Nyaya Sanhita 2023.
[9] H.L.A. Hart, *Punishment and Responsibility: Essays in the Philosophy of Law* (Oxford University Press 1968) 136.
[10] *Jacob Mathew v State of Punjab,* (2005) 6 SCC 1.
[11] *Kurban Hussein Mohamedalli Rangawalla v State of Maharashtra,* AIR 1965 SC 1616.
[12] Jonathan Herring, *Criminal Law: Text, Cases and Materials* (8th edn., Oxford University Press 2018) 478.

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In Indian law, rashness, recklessness, and negligence are classified according to varying degrees of fault. "Rashness means dangerous conduct committed with knowledge of possible consequences but lacking sufficient care." "Recklessness is characterized by intentional ignorance of significant dangers," while "negligence means the omission to foresee risks that an ordinary person could foresee."[13]

The typical transportation-related crimes have always been based on human interference with machines. In most cases, culpability will be assessed with reference to speeding, drunkenness, breaking traffic laws, or failure to respect public safety precautions.[14] However, the advent of self-driving vehicles upends this equation since the actions performed by such machines rely heavily on algorithms. The cause of danger in such instances is bound to be flawed programming, sensor failure, or computation, and not necessarily human rashness.

E. Foreseeability and Causation

Foreseeability plays an important part in criminal negligence since there cannot be criminal liability in the absence of foreseeable harm.[15] Causation is yet another aspect of criminal negligence that is similar to foreseeability in that there must be a link between the behavior in question and the harm caused. The presence of autonomous vehicles presents several challenges related to both foreseeability and causation since the accidents happen due to technical failures related to many aspects of software development, including machine learning. In other words, it becomes difficult to assign responsibility to any individual since accidents occur due to complex interactions of many factors.[16]

F. Limits of Traditional Criminal Jurisprudence

The current criminal law system is inherently anthropocentric due to its foundational belief in human reasoning and morality.[17] The concepts of guilt, blameworthiness, and negligence are founded on human behavioral psychology. Autonomous machines pose challenges to the above beliefs in that artificial intelligence lacks individual conscience and intentionality. On the other hand, excluding technology from considerations in criminal matters poses the risk of failing to address any culpability in cases of technologically induced harm. As such, a number of writers have proposed more comprehensive approaches based on algorithmic responsibility, corporation culpability, and distribution of responsibility respectively.[18]

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[13] Kenny's *Outlines of Criminal Law* (19th edn., Cambridge University Press 1966) 34.
[14] *Bhalchandra Waman Pathe v State of Maharashtra,* AIR 1968 SC 1319.
[15] Hart and Honoré, *Causation in the Law* (2nd edn., Oxford University Press 1985) 104.
[16] Ryan Calo, 'Robotics and the Lessons of Cyberlaw' (2015) 103 *California Law Review* 513.
[17] Alan Norrie, *Crime, Reason and History: A Critical Introduction to Criminal Law* (3rd edn., Cambridge University Press 2014) 98.
[18] Woodrow Barfield and Ugo Pagallo (eds.*), Research Handbook on the Law of Artificial Intelligence* (Edward Elgar Publishing 2018) 212.

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G. Conclusion

The underlying basis of criminal negligence and mens rea in India continues to be heavily based on the assumption of direct human agency and fault. Autonomous vehicles upend such an assumption, given the role of algorithms, machine learning, and technological responsibility in autonomous cars. Negligence, foreseeability, and causation doctrines thus face considerable difficulties in autonomous contexts. Such issues require new interpretations of criminal liability that can account for autonomous conduct without undermining legal and constitutional norms.

III. AUTONOMOUS VEHICLES AND THE TRANSFORMATION OF CRIMINAL RESPONSBILITY

A. Introduction

The advent of self-driving cars has caused a rethinking of the concept of criminal responsibility as it has moved away from human-driven operational controls to artificially intelligent control systems. The development of transportation law was based on the premise that cars are simply tools controlled directly by people. In such instances, criminal liability was contingent upon human error, whether reckless behavior, rashness, intoxication, or negligence.[19] However, with the introduction of automated systems, decisions are made via machine learning algorithms that can independently analyze their surroundings and make real-time decisions. Such a process can cause adverse consequences without any involvement of a person.

B. Nature of Autonomous Vehicle Systems

Driverless cars represent a highly complex cyber-physical system that combines artificial intelligence, sensor technology, cloud computing, and machine learning.[20] Such automobiles depend on radar technology, LiDAR sensors, cameras, GPS mapping, and predictive modeling to sense their environment and make decisions. While conventional autonomous systems do not have adaptive learning capacities, today's autonomous vehicles do have that ability. Autonomous machines can learn and adjust their behavioural patterns through environmental interaction and data analysis.[21] As such, the role of autonomous systems is shifting more towards being a decision-making unit as opposed to just a mechanical one. Automation of vehicles is categorized by the Society of Automotive Engineers into five levels, where higher levels imply lower human involvement.[22]

[19] Jonathan Herring, *Criminal Law: Text, Cases and Materials* (8th edn., Oxford University Press 2018) 478.
[20] Woodrow Barfield and Ugo Pagallo (eds.), *Research Handbook on the Law of Artificial Intelligence* (Edward Elgar Publishing 2018) 212.
[21] Mireille Hildebrandt, *Law for Computer Scientists and Other Folk* (Oxford University Press 2020) 244.
[22] Society of Automotive Engineers, 'Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles' (SAE Standard J3016, 2021).

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C. Algorithmic Decision-Making and Criminal Liability

The fundamental feature of autonomous vehicles is based on algorithmic decision-making. An AI system consistently analyzes and responds to the environment using probabilistic calculations.[23] This poses a serious problem for criminal law since algorithms lack intentionality, consciousness, or ethical considerations in a conventional sense. Thus, harm inflicted by autonomous vehicles may be due to software failures, unforeseeable consequences of machine learning, or simply computation errors rather than a consequence of negligent behavior by a conscious person. The problem arises when the situation requires an unavoidable choice between two harms that have to be assessed algorithmically. Such decisions made by autonomous vehicles bear a resemblance to moral judgments usually made by human beings.[24] However, criminal law presupposes a human mind.

D. From Driver-Centric Fault to Distributed Liability

Transportation crimes under the traditional system presuppose the presence of human involvement in the operation of the vehicle. The emergence of autonomous mobility technology complicates this situation by placing the blame on various players such as producers, programmers, data processors, maintenance service providers, and government agencies.[25] Autonomous car accidents can occur due to flawed programming, lack of enough training data, hacking, sensor failures, and software upgrade problems. Technological responsibility becomes a more significant factor in such cases than the personal liability of an individual motorist. This is a problem for the traditional doctrine of criminal negligence in India.[26]

F. The "Black Box Problem"

One of the significant problems posed by self-driving cars is known as algorithmic opacity or the "black box problem." The machine-learning model will create an output using computational processes inside the machine that are hard to understand even for developers.[27] This is problematic since traditional legal analysis involves reconstructing human behavior, intentions, and foreseeability. However, analyzing such aspects in relation to self-driving machines would become more complex if the investigator finds it hard to establish the reason behind a certain algorithm generating a particular operational output.[28]

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[23] Frank Pasquale, *New Laws of Robotics: Defending Human Expertise in the Age of AI* (Harvard University Press 2020) 91.
[24] Patrick Lin, Keith Abney and Ryan Jenkins, *Robot Ethics 2.0: From Autonomous Cars to Artificial Intelligence* (Oxford University Press 2017) 71.
[25] Ryan Calo, 'Robotics and the Lessons of Cyberlaw' (2015) 103 *California Law Review* 513.
[26] Andrew Ashworth, *Principles of Criminal Law* (7th edn., Oxford University Press 2013) 157.
[27] Frank Pasquale, *The Black Box Society* (Harvard University Press 2015) 3.
[28] Danielle Keats Citron and Frank Pasquale, 'The Scored Society' (2014) 89 *Washington Law Review* 1.

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G. Predictability and Machine Learning

Criminal negligence traditionally relies on foreseeability. Criminal liability is usually attributed to individuals based on the principle that harmful effects were reasonably foreseeable and could have been prevented with reasonable caution.[29] Autonomous vehicles add an additional twist to this concept since machine learning algorithms might create unforeseeable behavioural tendencies in the operation of the machine. Programmers and manufacturers would fail to foresee all possible responses that the vehicle's behavior would generate from its algorithms.[30] This creates difficulties for criminal liability requirements as well.

H. Crisis of Human-Centric Criminal Jurisprudence

Conventional criminal law is inherently anthropocentric since it presupposes reasonableness, consciousness, and moral agency of human beings.[31] Technological autonomy poses a threat to these premises as it involves shifting control of the decision-making process to technological agents. The point here is not about punishing artificial intelligence directly, but rather about making criminal law work in an environment that exhibits technological autonomy without losing its essence. Some academics have come up with several alternatives such as corporate liability theory, algorithmic accountability, and distributed responsibility.[32]

I. Conclusion

Autonomous cars radically alter the prevailing paradigms of criminal culpability through the incorporation of algorithmic decision making, technological liability, and machine learning. Traditional frameworks of criminal negligence and mens rea continue to rely extensively on the element of human control and human fault, making them less suitable to be applied in autonomous contexts. Challenges presented by the autonomous realm highlight the need for rethinking criminal liability that would take into account technologically mediated harm without disregarding constitutional requirements.

IV. REINTERPRETING MENS REA FOR AUTONOMOUS VEHICLE CRIMES IN INDIA

A. Introduction

The doctrine of mens rea serves as the ethical basis for criminal law through its focus on culpable mental states that make one liable, such as intention, knowledge, recklessness, and negligence.[33]

[29] Hart and Honoré, *Causation in the Law* (2nd edn., Oxford University Press 1985) 104.
[30] Brenner M. Fissell, 'Autonomous Vehicles and Criminal Responsibility' (2020) 105 *Iowa Law Review* 1613.
[31] Alan Norrie, *Crime, Reason and History: A Critical Introduction to Criminal Law* (3rd edn., Cambridge University Press 2014) 98.
[32] Lawrence Solum, 'Legal Personhood for Artificial Intelligences' (1992) 70 *North Carolina Law Review* 1231.
[33] H.L.A. Hart, *Punishment and Responsibility: Essays in the Philosophy of Law* (Oxford University Press 1968) 136.

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The development of autonomous vehicles presents a challenge to this theory since any potential harm may come as a result of algorithmic computation rather than human intention or control. Criminal legal theory assumes that a rational agent is capable of anticipating and taking measures not to produce harm. However, the application of artificial intelligence poses difficulty for this idea since the process of computing is different from human reasoning. Hence, existing theories of mens rea fail to apply to autonomous vehicle-caused harm cases. This chapter considers the relevance of a revised theory of mens rea and new concepts of algorithmic negligence and distributed agency.

B. Crisis of Traditional Mens Rea

Mens rea, according to conventional criminal law, refers to the subjective mental state possessed by the natural person.[34] Criminal intent requires the presence of awareness and voluntary acts of commission or omission. The autonomous systems have no consciousness or moral sense or any legal entity on their own. Accidents caused by autonomous vehicles can occur due to errors in software programming, malfunctioning sensors, biases in training datasets, cyber security vulnerabilities, or machine learning unpredictability but not because of reckless behavior on the part of humans. It is tough to establish the conventional guilty mind in such scenarios. Criminal law in India, as laid down in the Bharatiya Nyaya Sanhita, 2023, uses human-oriented conceptions of mens rea like intent, knowledge, rashness, and negligence.[35]

C. Algorithmic Negligence

Algorithmic negligence is an attempt to rectify deficiencies that emerge due to autonomous technological mechanisms. As opposed to negligence that takes into account the actions of individuals, algorithmic negligence deals with faults in software engineering, machine learning programming, data training processes, security measures, and autonomous systems.[36] Hence, liability could arise in situations in which manufacturers or programmers do not apply proper measures to counter technological risk that could emerge from autonomous technological machines. Instead of considering individual actions as the cause of harm, liability would be on the technological aspect of autonomous machines. Algorithmic negligence shifts the element of time when considering criminal wrongdoing. Negligence could have occurred prior to the harmful result during the process of programming or algorithmic training of technologies.[37]

D. Distributed Criminal Responsibility

[34] Glanville Williams, *Criminal Law: The General Part* (2nd edn., Stevens & Sons 1961) 30.
[35] Mireille Hildebrandt, *Law for Computer Scientists and Other Folk* (Oxford University Press 2020) 244.
[36] Frank Pasquale, *New Laws of Robotics: Defending Human Expertise in the Age of AI* (Harvard University Press 2020) 91.
[37] Brenner M. Fissell, 'Autonomous Vehicles and Criminal Responsibility' (2020) 105 *Iowa Law Review* 1613.

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Autonomous vehicles entail multiple agents like manufacturers, programmers, data analysts, maintenance technicians, and regulatory officials.[38] Harm may arise due to accumulated technological malfunction within interconnected networks. Traditional criminal law relies heavily on personal culpability and actual causality. Autonomous systems pose a dilemma to this framework since there is a possibility that not one agent may have exclusive operational control over any harm. Collective responsibility is premised on the notion that liability in autonomous systems could be shared among all agents.[39] Liability will thus fall on all involved in creating technological hazards. This framework should, however, align with the principle of due process and avoid being arbitrary.

E. Corporate Criminal Liability and Autonomous Systems

Autonomous mobility greatly enhances the importance of corporate criminal liability because artificial intelligence-based transport solutions are mostly designed and controlled by corporations that exert significant control over their development, design safety protocols, and deployment process.[40] Corporations' decisions about testing, data gathering, cybersecurity, and deployment to the marketplace can actually affect public safety. Corporate criminal liability can thus occur in cases where a corporation releases a dangerous technology negligently or is aware of its possible defects. However, some states have begun thinking about regulation that would stress corporate responsibility.[41] India's law on this issue is poorly developed.

F. Foreseeability and Machine-Learning Unpredictability

The principle of foreseeability is important to criminal negligence because predictability is critical in determining liability.[42] In this regard, the presence of autonomous systems poses challenges for the foreseeability concept since the machine-learning software can develop patterns that go beyond what would be reasonably anticipated by humans. While foreseeing all possible effects may not always be achievable, one can foresee the risks posed by such technologies, such as software defects, biased data, and computing errors.[43] Thus, there can be criminal negligence when proper preventive measures for foreseeable technological risks have been ignored.

G. Towards a Hybrid Theory of Mens Rea

[38] Ryan Calo, 'Robotics and the Lessons of Cyberlaw' (2015) 103 *California Law Review* 513.
[39] Woodrow Barfield and Ugo Pagallo (eds.), *Research Handbook on the Law of Artificial Intelligence* (Edward Elgar Publishing 2018) 212.
[40] Celia Wells, *Corporations and Criminal Responsibility* (2nd edn., Oxford University Press 2001) 87.
[41] European Commission, 'Proposal for Harmonised Rules on Artificial Intelligence' COM (2021) 206 final.
[42] Andrew Ashworth, *Principles of Criminal Law* (7th edn., Oxford University Press 2013) 157.
[43] Vincent C. Müller (ed.), *Fundamental Issues of Artificial Intelligence* (Springer 2016) 301.

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The shortcomings of classical mens rea theories indicate the necessity of developing a mixed theory of mens rea that can account for autonomous technological settings.[44] This theoretical construction should uphold human responsibility while acknowledging the importance of algorithmic systems in producing negative consequences.Possible features of the mixed model are: Moral duty to take technological responsibility; Systemic risk assessment that is foreseeable; Legal liability for deploying hazardous artificial intelligence; and Mandatory explanations to provide algorithmic clarity. This theory denies granting artificial intelligence legal personality and instead stresses the responsibility for designing, monitoring, and controlling autonomous technology.

H. Conclusion

The advent of self-driving vehicles brings into focus several shortcomings of the conventional doctrines relating to mens rea and criminal negligence. Conventional doctrines continue to rely excessively on human intent and subjective negligence, which make them less effective in an algorithmic milieu. New concepts like algorithmic negligence, distributed culpability, and corporate technological liability will be essential components of any future criminal law system. This requires that the criminal law of India be updated in such a way that mens rea becomes more inclusive.

V. EVIDENTIARY, CONSTITUTIONAL, AND REGULATORY CHALLENGES IN AUTONOMOUS VEHICLE CRIMES

A. Introduction

The use of autonomous vehicles poses substantial issues with regards to evidentiary concerns, procedures, and constitutionality within the realm of criminal law. The criminal justice process developed in an environment in which criminal activity could be determined by the reconstruction of human behaviour through eyewitnesses, tangible evidence, and human actions. With the advent of autonomous vehicles, such an approach no longer suffices due to the involvement of algorithms, machine learning, and digital networks in the decision-making process.[45] As such, the new paradigm raises numerous questions with respect to evidence, causality, liability, and due process. Existing legislation within India was never intended to govern autonomous behaviour and is ill-equipped for the task at hand.

B. Digital Evidence and Autonomous Vehicle Investigations

Autonomous vehicles constantly collect data through sensors, cameras, GPS technologies, and other means.[46] Some data can pertain to how the vehicle applies its brakes, navigates, maps the

[44] Alan Norrie, *Crime, Reason and History: A Critical Introduction to Criminal Law* (3rd edn., Cambridge University Press 2014) 98.
[45] Ryan Calo, 'Robotics and the Lessons of Cyberlaw' (2015) 103 *California Law Review* 513.
[46] Mireille Hildebrandt, *Law for Computer Scientists and Other Folk* (Oxford University Press 2020) 244.

environment, maintains speed, and executes algorithms. Researching an accident involving autonomous vehicles requires data collected by machines rather than witnesses' observations.[47] Yet, there is no doubt that data presents numerous challenges as AI systems are technologically complicated and often impenetrable to the average legal mind. The machine learning system may also develop its operation patterns over time, thereby making it challenging to identify whether the negative consequences arose due to faulty programming, software errors, or changes in the algorithmic behavior of the computer. Furthermore, the lack of digital forensics tools for autonomous vehicles in India makes it challenging to investigate these crimes.

C. Admissibility of Machine-Generated Evidence

Under the Bharatiya Sakshya Adhiniyam, 2023, the use of electronic records is considered an admissible form of evidence under legal protection.[48] The use of autonomous vehicles would mean that evidence will be collected in a manner much more technologically complex than traditional forms of electronic evidence. One issue which is faced is that of opacity or "black box". This could make it hard for courts to decipher evidence.[49] There is also the question of authenticity and reliability. Digital evidence can become corrupt or tampered with through software corruption, cyber security attacks, or manipulation of data.[50] Chain of custody and evidence integrity will thus become more and more problematic in such a system. Currently, there are no guidelines for the explainability or auditability of AI-based evidence in India.

D. Procedural Challenges under Indian Criminal Law

Automated systems highlight the limitations present within the current criminal process framework. For example, the Bharatiya Nagarik Suraksha Sanhita, 2023 still functions under a procedural framework that caters to human-based crimes.[51] Law enforcement organizations may not have the technological knowledge required to comprehend the machine learning algorithms, computation errors, and log files used by the automated system. It could also be challenging to use traditional investigation techniques like questioning witnesses or reconstruction in an autonomous setting. Another problem that can emerge from this is jurisdictional issues because autonomous systems often depend on transnational digital networks that require foreign service providers and servers.[52]

E. Constitutional Concerns and Article 21

[47] Woodrow Barfield and Ugo Pagallo (eds.), *Research Handbook on the Law of Artificial Intelligence* (Edward Elgar Publishing 2018) 212.
[48] Bharatiya Sakshya Adhiniyam 2023, ss 61–63.
[49] Frank Pasquale, *The Black Box Society* (Harvard University Press 2015) 3.
[50] Stephen Mason and Daniel Seng, *Electronic Evidence* (5th edn., Institute of Advanced Legal Studies 2021) 71.
[51] Bharatiya Nagarik Suraksha Sanhita 2023.
[52] Danielle Keats Citron, *Hate Crimes in Cyberspace* (Harvard University Press 2014) 97.

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Constitutional rights related to life, safety, and due process of law, under Article 21 of the Constitution of India, have been violated by autonomous vehicles.[53] There is a duty on the part of the State to ensure that new technology does not affect public safety. Non-regulation of the autonomous mobility system can lead to a violation of the rights provided under Article 21 of the Constitution of India related to life and liberty. Algorithms can result in discrimination based on biased algorithms and discriminatory technological representation.[54] Autonomous mobility technology can thus be seen as an issue of equality and non-discrimination.

F. Ethical Decision-Making and Autonomous Systems

Autonomous vehicles might face a situation wherein accidents are inevitable and prioritization is needed for the algorithms in order to deal with the competing interests. The "trolley problem" is an example used to demonstrate such a scenario.[55] Typically, criminal laws do not require any utilitarian evaluation when it comes to dealing with human lives. However, autonomous technology might consider the inclusion of ethical decision-making in its software architecture. The question of ethics becomes a significant issue when it comes to determining who decides on what moral principles are to be programmed into an autonomous vehicle and under what regulatory regime.

G. Regulatory Vacuum in India

At present, India does not possess any statutory law that pertains specifically to AVs or AI-powered mobility.[56] Current transport laws in India tend to be focused on traditional cars driven by people. The lack of a legal framework makes issues like licensing criteria, cybersecurity, data management, responsibility of algorithms, and liability in the case of crime ambiguous. Some jurisdictions, such as Europe and Germany, have started formulating specific laws for autonomous mobility that focus on safety, explainability, and human oversight.[57] However, no such framework has been established by India.

H. Conclusion

The use of autonomous vehicles poses significant challenges with regard to evidence, constitutional law, and regulations within the Indian criminal justice system. Current legal procedures and principles are mainly formulated based on typical human behavior, making them ill-equipped to handle algorithm-based decision-making processes. The lack of specific legal rules for regulating algorithms, digital evidence, and autonomous mobility may hinder the prosecution

[53] *Maneka Gandhi v Union of India,* (1978) 1 SCC 248.
[54] Cathy O'Neil, *Weapons of Math Destruction* (Penguin Books 2016) 21.
[55] Patrick Lin, Keith Abney and Ryan Jenkins, *Robot Ethics 2.0: From Autonomous Cars to Artificial Intelligence* (Oxford University Press 2017) 71.
[56] Motor Vehicles Act 1988.
[57] European Commission, 'Proposal for Harmonised Rules on Artificial Intelligence' COM (2021) 206 final.

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process. Therefore, India needs radical changes incorporating criminal law, constitutional law, artificial intelligence management, and transportation law.

VI. CONCLUSION AND REFORMATIVE FRAMEWORK FOR INDIA

A. Introduction

The emergence of autonomous vehicles poses a disruptive challenge to existing doctrines of criminal law. In contrast to ordinary motor vehicles that are controlled by humans, autonomous vehicles employ artificial intelligence, machine learning algorithms, and automation in performing tasks without human intervention. In such a case, the application of doctrines of criminal negligence and mens rea under the laws of Indian criminal jurisprudence becomes complicated due to this transformation from human-controlled vehicles to autonomous vehicles. In previous sections, it was observed that the current criminal laws and frameworks are based on assumptions of human interventions, human culpability, and human foreseeable actions. Autonomous vehicles disrupt these assumptions. This section is a summary of key findings of the study.

B. Major Findings of the Study

The paper demonstrates that conventional doctrines regarding criminal negligence fall short of controlling autonomous vehicles' adverse effects. Criminal law in India under the Bharatiya Nyaya Sanhita, 2023 still perceives liability from the perspective of human intent, human knowledge, rashness, and negligence. However, autonomous technology makes this difficult as any negative consequences might occur due to software malfunctions, algorithm failures, bias in data, and unpredictability in machine learning. The study further reveals that technology-based distribution of responsibility exists in case of autonomous systems amongst manufacturers, programmers, software designers, maintenance staff, and regulators. Current doctrines premised on individual culpability face considerable challenges in light of such findings. Another important finding is associated with evidence-related uncertainty. Such technology-based autonomous systems often rely upon "black box" computation systems which challenge established principles of causation and foreseeability. In addition to the above, the study identifies a critical gap in autonomous vehicle regulation in India.

C. Need for Reinterpretation of Mens Rea

Another of the key arguments in this research is the necessity of the redefining mens rea in the context of autonomous technology. Traditionally, the culpability principle involves conscious human intent and blameworthiness. However, autonomous systems cannot be considered to possess independent consciousness or any legal personality. At the same time, the absence of such intention during technological activities does not mean that there should be no accountability. Consequently, the basis for mens rea should be shifted to more general principles of technological responsibility and risk management. This research suggests taking into account the following

aspects of mens rea: Duty-based responsibility in terms of technology use; Risks which could be predicted by the system; Liability of corporations; and Algorithmic transparency.

D. Legislative Reform in India

Currently, India does not have a special law regulating autonomous vehicles and AI-enabled mobility services since the current laws such as the Motor Vehicles Act, 1988 were drafted taking into account the traditional mode of transportation. There exists a dire need for autonomous mobility laws with provisions that outline statutory definitions and classification of autonomous systems depending on the level of autonomy and liability; mandatory safety standards with compulsory testing and cybersecurity audit and algorithm assessment before deployment in public domain; criminal liability framework that defines the extent of algorithmic liability and corporate liability; explainability requirement that ensures transparency of the system as well as forensic assessment and investigation; and data governance regulations relating to the preservation of electronic evidence, data privacy, and cybersecurity.

E. Judicial and Procedural Reforms

The reforms in legislation will have to be accompanied by changes in the process as well. In terms of the criminal justice system, courts and law enforcement need special technical capabilities to deal with autonomous vehicles offenses. The recommendations include: the creation of special digital forensic units for autonomous vehicle cases, judicial education about artificial intelligence algorithms, standard setting for digital evidence, and incorporation of explainability and auditability criteria into the criminal process.

F. Comparative and Global Perspectives

Some nations such as the European Union, Germany, and the United States have started to frame regulatory models for autonomous mobility and the liability aspect of artificial intelligence. The said models include risk-based regulation, human intervention, corporate liability, and the element of transparency in algorithms. While comparative models offer valuable assistance, India has to introduce its own reforms according to its socio-legal system and infrastructure needs.

G. Conclusion

Autonomous vehicles present the very basis for a paradigm shift in existing principles of criminal negligence and mens rea by replacing the control exercised by the human factor with computer algorithms. Current Indian laws are ill-prepared to provide appropriate regulation for technologically autonomous systems where randomness and opacity dominate due to machine learning. It is concluded that future development of Indian criminal law will be contingent upon its movement towards a hybrid model that combines traditional fault-based principles with technology-related accountability. Significant legislation and procedural changes are required to

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guarantee that further technological progress is in line with constitutional values of equality, justice, and legality. The future relevance of criminal law lies in regulating artificially intelligent societies while preserving democratic values and human rights.