

# Artificial Intelligence and the Law: Human Rights, Justice Systems, and Governance in the Age of Autonomous Decision-Making

Dr. Syed Ibad Ali,

Associate Professor, Parul Institute of Engineering & Technology, Parul University, Vadodara, India  
[Ibad85@gmail.com](mailto:Ibad85@gmail.com)

## Abstract:

This paper critically examines the intersection of artificial intelligence (AI) and legal systems, with a particular focus on human rights, justice administration, and governance in an era of autonomous decision-making. Drawing from the Council of Europe's initiatives (CAHAI, CDCJ, CEPEJ), the European Union's Artificial Intelligence Act, and comparative legal perspectives, it explores how emerging AI applications—from predictive policing and biometric surveillance to case file digitization and algorithmic adjudication—are reshaping legal processes. Key issues addressed include the right to a fair trial, the "black box" effect, AI personhood debates, liability allocation, and the integration of ethical and technical safeguards to mitigate bias, enhance transparency, and preserve judicial independence. The paper also investigates the role of AI in criminal law, prosecutorial workflows, and civil dispute resolution, assessing both the efficiency gains and the attendant risks to fundamental rights.

Keywords - **Human Rights, AI, Ethical AI, Justice system, ML**

## Introduction

This paper looks at the intersection of artificial intelligence (AI) and legal systems, focusing on what this means for human rights, the justice system, and governance in a time when more and more autonomous decision-making systems are being used. This paper builds on the work of the Council of Europe, the European Union's Artificial Intelligence Act, and other international efforts to bring together what we already know with current debates about AI ethics, regulation, and enforcement. It talks about how AI affects the right to a fair trial, debates about personhood, predictive policing, biometric surveillance, and how AI should be governed in both criminal and civil justice.

### 1.1. Context: The Growth of AI and Its Effects on the Law

Innovation has been moving forward at an unending pace in the 21st century, bringing artificial intelligence (AI) out of the realm of computer scientists and into the very heart of society's operations, governance, economy, and daily life. The growing use of AI systems, whether they are machine learning, natural language processing, robotics, or data analytics, has not only made things more efficient and capable, but it has also constantly

tested existing legal, social, and moral frameworks.

AI is not just one technology; it is a mix of different approaches, such as algorithmic methods, large-scale data processing, neural networks, and systems that can make predictions or decisions that people would consider "intelligent." The fact that AI is becoming more widely used has brought to light a major legal irony: the law's traditional focus is on setting fixed rules for how people should behave, but AI is adaptable, unpredictable, and, most importantly, able to act without direct human oversight.

Agnieszka Gryszczyńska edited the multi-author monograph *Legal Aspects of Artificial Intelligence*, which comes from this historic meeting of minds and is based on research done as part of the international Polish-Hungarian Research Platform. It gives a wide-ranging and in-depth look at the main legal problems that AI raises, from fair trial guarantees in courts that use AI to the theoretical legitimacy of AI as a legal or technological "person," to criminal responsibility, regulatory changes at the EU level, and practical issues in law enforcement.

## 1.2. Why Law and AI Meet

It's not just a technical issue when AI and law meet; it raises questions about basic principles, like what makes someone (or something) a person in the eyes of the law. How can we protect people's rights to a fair trial and a good remedy when "black box" AI systems are making more and more decisions in court? What kinds of moral, social, or criminal risks come up when AI is used for predictive policing, criminal justice, or surveillance? Can the law change its ideas about responsibility, liability, and due process to fit technologies that learn, change, and sometimes act in ways that are hard to predict?

As several contributors to the monograph point out, there is no universally accepted, working definition of artificial intelligence in the law. Instead, different working definitions, like those from the European Union, the OECD, and others, tend to focus on how a system works: a machine-based system that uses input data to make outputs (like predictions, recommendations, content, or decisions) that change real or virtual environments. This definition is very broad and flexible, which shows how uncertain regulating AI is, but also how promising it is.

The human rights point of view is also very important. As AI systems are used more and more in the legal system, from digitizing documents to assessing risk, setting bail, sentencing, and even writing draft verdicts, the risk of unfairness and illegitimacy in the legal system grows. This has direct effects on privacy, non-discrimination, and access to justice.

## 1.3. The goal and range of this manuscript

This paper brings together and builds on the main legal ideas from the monograph, adding new information and points of view from larger international debates. The paper is divided into clear sections that cover the main research areas: personhood and liability, fair trial and explainability, criminal law, administrative and law enforcement practice, changing regulatory frameworks, and forward-looking recommendations. Its goal is to give a complete, up-to-date picture of where law and AI meet, where

there are conflicts, and how legal systems need to change.

There are three main challenges that are always brought up:

Should AI be seen as a legal or "technological" person when it comes to personhood and responsibility? If not, who is responsible when AI hurts someone?

**Fairness and Explainability:** How can we use AI in the legal system and in government without violating people's rights to a fair trial, openness, and accountability?

**Governance, Regulation, and Human Rights:** What mix of hard law, soft law (ethical guidelines), and constitutional principles can create a stable, flexible system that protects both innovation and basic rights in a world where technology is changing quickly?

The study uses real-world events (like the EU's Artificial Intelligence Act), comparative law, and the complicated situations in Poland and Hungary, but it makes its points more broadly to include all of Europe and the world.

## (II) THEORETICAL FOUNDATIONS: AI, PERSONHOOD, AND LEGAL RESPONSIBILITY

**2.1. Traditional Ideas About Personhood in Law**  
Over the years, the legal idea of "personhood" has changed to mean people (usually humans) who have rights and responsibilities under the law. In its most basic form, a person is thought to be a natural, rational, and self-aware being. However, the law also includes "legal persons"—corporations, associations, and other groups of people who don't have their own consciousness or ability to act in the usual sense.

There are two philosophical traditions that can be seen:

The Rationality/Self-Consciousness Tradition says that only beings that are rational and self-aware (for example, they can understand, choose, and be

responsible for their actions) are "persons."

**The Legal-Fiat Tradition:** Legislatures and courts can and do recognize as legal persons those entities (human or otherwise) that are seen as necessary for society, such as corporations, ships, and even rivers at times.

But, as the monograph says, the truth is more complicated. People are not always "rational agents" (children, people in comas, animals with legal rights, etc.), and in practice, the will of the legislature can create or deny legal personhood.

## **2.2. The Debate Over AI as a "Technological Person"**

The use of AI in legal discussions raises radical questions: Should intelligent, self-driving AI systems be treated as people under the law, or should they stay things? Is there a real difference between "legal person," "technological person," and the way liability is actually assigned in cases involving AI?

Main points:

The monograph, which is in line with a wide range of scientific opinion, says that legal personality should not be given to "technological persons," except maybe to AI that becomes sentient and has a real interest in itself. Most AI systems today, even highly autonomous or "learning" systems, don't have consciousness, a sense of self, or the ability to take responsibility. These are traits that make someone a person in traditional or even business settings. Seeing AI as a person could make it harder to see important problems like accountability, openness, and human control.

**The Problem of Agency and Risk:** Another problem is that being a legal person means being able to not only have rights but also obligations, do business, and take on existential risks. Even if current-generation AI is autonomous, it still needs people to create, own, or operate it. It doesn't have "skin in the game," so it can't be punished in a meaningful way through sanctions, economic penalties, or retributive punishment.

**The Liability Dilemma:** When AI hurts someone, the law wants to find out who is to blame, usually the person who programmed, operated, or made the AI. In reality, giving these people strict, vicarious, or indirect liability is both logically sound and easy to do, without having to pretend that the AI is a person.

Another problem is that making "electronic persons" could let people avoid responsibility by setting up poorly funded shell companies, which would defeat the purpose of redress and deterrence. It is very important to have a liability system that is credible and can be enforced.

## **2.3. Current and Future Regulatory Approaches**

The consensus is quickly moving away from proposals like the European Parliament's earlier "electronic person" suggestion and toward holding the people and organizations behind AI responsible and making them follow rules. Most proposals now include:

Using AI as a tool instead of a legal subject.

Putting strict or changed product liability rules on harm caused by AI.

Creating special insurance or compensation funds for AI applications that are very risky.

Only sentient, autonomous agents are being looked at as possible candidates for new legal statuses, but as the monograph points out, this is still just a theory.

In this case, Poland, Hungary, and the rest of the European legal family agree with what most other countries think: AI is an agent of humans, not a subject of rights or duties.

## **(III) A FAIR TRIAL, JUDICIAL TRANSPARENCY, AND THE "BLACK BOX" ISSUE**

### **3.1. The Right to a Fair Trial in the Age of AI**

A big question at the intersection of AI and the legal system is whether adding AI to the courts, prosecution, and police will weaken the basic rights

to a fair trial, transparency, and judicial independence.

Article 6 of the European Convention on Human Rights (ECHR) and similar constitutional provisions protect the right to a fair trial. This includes the right to a fair and impartial tribunal, public hearings, reasoned decisions, and access to effective remedies.

There are a number of risks that come with using AI for things like digitizing documents, processing natural language, or even writing draft judgments.

Opacity, or the "black box" effect, happens when AI systems, especially those that use deep learning, make outputs that are hard to understand or explain. This can lead to decisions that even experts can't figure out why they were made. This makes it harder for people to see what's going on and for parties to challenge or appeal.

**Automation Bias:** There is a chance that judges and parties will trust "objective" algorithmic recommendations, even if they are wrong or based on biased data.

**Risk of Discrimination:** AI systems that learn from biased data may repeat or even make worse existing social, racial, or gender biases, which can lead to unfair results.

**3.2. The Council of Europe and AI in the Courts**  
The Council of Europe and the European Union have both made a lot of soft law (like guidelines and ethical charters) and now hard law (like the AI Act):

The European Ethical Charter on the Use of AI in Judicial Systems lists five main principles: respect for basic rights, non-discrimination, data/model quality and security, openness, and the need for "human-in-the-loop" control.

**Regulatory Proposals:** There seems to be a growing agreement that AI should help human judges do their jobs, not take their place. Any AI-driven draft or recommendation must be able to be explained, challenged, and reviewed by a judge. More and

more people think that the "right to explanation" is important when AI has a big effect on legal decisions.

**National Implementations:** Poland and Hungary, like other EU countries, are moving forward with digitizing the justice system, but they are being careful not to rely too heavily on AI for important legal decisions.

### **3.3. Practical Examples: Digitizing Documents and Managing Data**

Switching to electronic case files, search, and data management in the justice system is a digital transformation that has big benefits for access, efficiency, and saving money.

Important points:

Poland's PROK-SYS and other similar systems are digitizing millions of pages of criminal case files. This makes it easier for everyone to get to the data and makes sure that everyone gets a fair trial.

The real breakthrough is using AI to improve search, extraction, and information retrieval, not to automate judgment.

Automation must go hand in hand with safe, easy-to-use interfaces for all parties and strict privacy and data security.

But without strong oversight and ways to challenge or audit AI functions, there is still a risk that mistakes, biases, or technical problems could violate rights. It is not possible to change the rules about constant human oversight, auditing, and openness.

## **(IV) AI IN CRIMINAL LAW: RESPONSIBILITY, PUNISHMENTS, AND REAL CHALLENGES**

### **4.1. Criminal Responsibility and AI: Old Problems and New Ones**

When AI systems are involved in actions that hurt people, criminal law has tough questions to answer: who is responsible, and what theory do they use?

The monograph looks at different ways that criminals can be held responsible for harm caused by AI:

Direct ("Individual") Liability of AI Itself: Most people don't agree with this because AI doesn't have consciousness, moral reasoning, or intention; current law only holds natural people criminally liable.

Indirect liability (also called "perpetration by another" or "vicarious liability") means that the human operator, programmer, manufacturer, or owner is responsible as if they were using a "instrument," which is the AI.

Negligence or Failure of Duty of Care: A responsible person is liable if they carelessly set up, don't supervise, or don't fix a dangerous AI system.

Command Responsibility: Similar to military or corporate law, people in charge who didn't properly direct or control AI may be held responsible.

In practice, most serious legal systems still hold people responsible for their actions or lack of action. AI is not yet, and may never be, a legal subject for criminal purposes.

## 4.2. The Issue of Action and Intention

Traditional criminal law assumes that a crime is an act that is done on purpose and willingly by a person. AI, on the other hand, works either deterministically or stochastically based on programmed algorithms and learned data. This makes it hard to tell if someone is guilty of "act" or "mens rea" (the mental state of being guilty).

Some people want to make the definition of "act" more flexible so that AI-driven decisions are included. However, this brings up uncomfortable questions of principle and how predictable things will be in practice.

Instead, future changes are more likely to focus on the actions or inactions of those in charge of using and controlling AI, along with specific liability systems.

## 4.3. Criminal Punishments and Sentences

It is both legally and practically pointless to punish AI directly because AI cannot be deterred, punished, or rehabilitated. When something bad happens, punishments should be given to the people or groups who are to blame (through fines, jail time, or other punishments) and to the systems that caused the problem (through withdrawal, redesign, destruction, or regulatory penalties).

When AI is used as evidence, it is very important to have strict rules about what is allowed, what is clear, and what is checked.

## (V) AI IN LAW ENFORCEMENT AND ADMINISTRATION: ETHICAL, PRACTICAL, AND REGULATORY CHALLENGES

### 5.1. Biometric Surveillance and Predictive Policing

There are a lot of real-world pilot projects and commercial solutions that use AI in law enforcement to predict criminal risk (predictive policing), analyze patterns, recognize faces, and identify people using biometrics.

Possible benefits:

Better use of resources.

Recognizing patterns in complicated datasets faster and more accurately.

Better at finding criminal networks, spotting financial crimes, and processing forensic data.

But there are a lot of risks involved in these changes:

Predictive Policing: Putting old crime data into AI systems may make old biases stronger and deeper. This could lead to too much police presence in poor communities and put the presumption of innocence at risk.

Bulk Biometric Surveillance: The ability to identify huge numbers of people in public places from a distance and automatically, in real time, is a huge

change in surveillance technology that has clear effects on privacy, freedom, and discrimination.

**Opacity and Accountability:** A lot of AI tools are private, not very clear, and can't be easily audited or challenged.

## **5.2. Regulatory Responses: The EU AI Act and More**

Regulatory responses have been made in response to growing concern across the EU:

The proposed EU Artificial Intelligence Act divides risks into four groups: unacceptable risk (outright bans, like untargeted mass biometric surveillance), high risk (subject to registration, transparency, and auditing), limited risk, and minimal risk.

When it comes to high-risk areas like crime prediction and biometric identification, there are rules that say there must be transparency, human oversight, prior judicial approval, and protections for human rights.

There is still a lot of debate about how far these regimes can go and how they can be enforced. Detailed technical, procedural, and rights-based controls are still being worked on.

Best practices suggest that AI should be limited or banned in ways that can't be made compatible with rights to privacy, not being discriminated against, and a fair trial.

## **(VI) THE FUTURE OF AI LAW AND REGULATION: FROM SOFT LAW TO HARD BINDING RULES**

### **6.1. The New Patchwork of Legal and Moral Governance**

AI regulation is changing; there are three main ways it is changing:

**Hard Law ("Binding Rules"):** Laws at the national and EU levels, like the AI Act, changes to the Product Liability Directive, and changes to criminal law in certain sectors.

**Soft Law ("Ethical Charters, Self-Regulation"):**

These are rules from expert groups (like the EU HLEG and the Council of Europe CAI), charters on AI ethics, and codes for specific sectors (like judicial AI).

**Judicial/Constitutional Oversight:** The need for constitutional protections, especially for basic rights, a fair judicial process, and a good remedy.

Legal systems need to be harmonized and able to work together, especially in the EU, for good governance. This is because AI-driven technologies can work across borders.

## **6.2. The Case of Poland: National Implementation**

Poland, like many other EU member states, is working to make sure that its plans for law enforcement, data management, and digitization of the courts all meet EU standards. Some of the problems that keep coming up are:

Some parts of the criminal process are not very digital.

There needs to be clear, strong rules about how AI can be used for things like evaluating evidence, digitizing documents, and forensic methods.

Making sure that any use of AI is accompanied by good human review, openness, and ways to challenge automated decisions.

## **(VII) CONCLUSIONS AND SUGGESTIONS FOR POLICY**

### **7.1. Problems and chances**

Artificial intelligence promises to make things more efficient, save money, and add new features to the justice system, the government, law enforcement, and society as a whole. But it also puts privacy, non-discrimination, transparency, and the basic ideas of justice at great risk. The "black box" problem, automation bias, and the chance of making social injustices worse are all real.

## 7.2. What needs to happen for a flexible, people-centered legal system

Based on the above, here are some suggestions:

**Human Rights Are Important:** AI development, use, and regulation must always be guided by strong ideas of dignity, freedom, fairness, and justice.

**No Replacing Human Judgment in Key Legal Areas:** AI can help with technical, administrative, and analytical tasks, but decisions that affect rights, freedoms, or the outcome of legal processes must still be made by people.

**All AI systems used in state and judicial functions must be clear, easy to understand, and open to real challenges.**

**Strict Regulation of High-Risk Applications:** Predictive policing, bulk biometric surveillance, and other high-risk uses should not be allowed unless there are clear protections for people's rights.

**Ongoing Training and Institutional Capacity:** Public officials, judges, and prosecutors need to have the digital skills and analytical skills to understand, question, and challenge AI-supported processes.

## 7.3. The Next Step

As AI gets better, from data mining to advanced language generation to the edge of general intelligence, the law needs to change both its tools and its spirit. For AI to move forward safely and for the public to trust it, we need a new, flexible legal system that is based on rights but also aware of how technology works.

The work of the EU, the Council of Europe, and national bodies shows that we are moving away from blindly accepting technology or being overly optimistic about it and toward a more balanced, human-centered, rights-protective approach. Law and AI don't have to be at odds with each other, but only if the law doesn't give up its main job to machines.

## References

- [1] M. S. Shaikh, P. S. Chouhan, I. Baig, and S. I. Ali, "Quantum computing for optimization problems: A review and future directions," *COMPUSOFT, An International Journal of Advanced Computer Technology*, vol. 11, p. 3995, 2022.
- [2] M. S. Shaikh, P. S. Chauhan, I. Baig, and S. I. Ali, "Decentralized autonomous networks for secure data sharing: A theoretical framework and conceptual analysis," *COMPUSOFT, An International Journal of Advanced Computer Technology*, vol. 12, p. 4007, 2023.
- [3] S. I. Ali, "VHDL-AMS modelling of transmission lines and matching networks for RF stage connections," *International Journal of Advanced Electronics & Communication System*, vol. 1, no. 1, pp. 28–32, 2012.
- [4] S. I. Ali, "FPGA design of offline signature verification utilizing Koblitz curves," in *Proceedings of the National Conference on Recent Development in Science & Technology*, RGpv Bhopal (TEQIP-III), 2019, pp. xx–xx.
- [5] S. I. Ali, "Offline signature verification using fuzzy similarity and interval-valued symbolic data," *INFOKARA*, vol. 8, no. 10, p. 188, 2019.
- [6] S. I. Ali, "Comparative study of different tools used for offline signature verification system," *International Journal of Computer Science and Engineering Information Technology Research*, vol. 10, no. 2, pp. 79–88, 2020.
- [7] S. I. Ali, "5G technology and sustainable development concerns: A systematic analysis," *International Journal of Scientific Research and Engineering Development*, vol. 4, no. 3, pp. 786–790, 2021.
- [8] V. Dakshinamurthi, S. I. Ali, T. Karthikeyan, and N. S. Kulkarni, "Causal convolution employing Almeida–Pineda recurrent backpropagation for mobile network design," *ICTACT Journal on Communication Technology*, vol. 14, no. 4, p. 3091, 2023, doi: 10.21917/ijct.2023.0460.
- [9] S. I. Ali, P. K. Nandi, M. Sayed, S. Shahane, and A. Iqbal, "Utilizing digital twin technologies to integrate AI's unrealized potential with digital public health initiatives," in *Harnessing AI and Digital Twin Technologies in Businesses*, S. Ponnusamy, M. Assaf, J. Antari, S. Singh, and S.

Kalyanaraman, Eds. Hershey, PA, USA: IGI Global, 2024, pp. 432–440, doi: 10.4018/979-8-3693-3234-4.ch031.

[10] B. S. Suthar, S. I. Ali, and K. Patel, “Hand gesture sign language recognition embedded with Arduino Uno,” in *IET Conference Proceedings*, vol. 2025, no. 7, Parul University International Conference on Engineering and Technology (PiCET 2025), 2025, doi: 10.1049/icp.2025.1565.

[11] M. S. Shaikh, N. K. Jain, A. Biswal, P. K. Patidar, I. Panwar, and S. I. Ali, “Sensors to insights revolution: Leveraging IoT, AI, and big data for next-gen patient monitoring,” in *Proceedings of the IEEE International Conference on Emerging Technologies in Engineering, Technology, and Scientific Innovation (ICETETSIP)*, 2025, doi: 10.1109/ICETETSIP64213.2025.

[12] M. S. Shaikh, P. K. Patidar, B. A. Vaghela, A. N. Pandwal, and S. I. Ali, “Advanced heart disease risk assessment using random forest algorithm: A comprehensive predictive model,” *AIP Conference Proceedings*, 2025, doi: 10.1063/5.0292473.

[13] S. I. Ali, “Algorithmic justice: Navigating AI’s role in cybersecurity and legal transformation,” in *Moral and Legal Aspects of Artificial Intelligence: Machine Bias and Rule of Law*, J. Luftman and A. Tomer, Eds. Hershey, PA, USA: IGI Global, 2026, pp. 229–264, doi: 10.4018/979-8-3373-3114-0.ch007.

[14] A. Biswal, K. Bhushanwar, P. G. Paija, K. Zalawadia, P. P. Pradhan, and S. I. Ali, “Procedural generation and adaptive gameplay: The role of AI and generative AI in contemporary game development,” in *Reshaping the Video Game Landscape With AI and GenAI*, J. Sousa and R. Tavares, Eds. IGI Global, 2026, pp. 233–258, doi: 10.4018/979-8-3373-4637-3.ch008.

[15] S. I. Ali, K. Macwan, G. Sharma, N. Pal, and P. K. Nandi, “Applied AI and blockchain in global real estate: Intelligent infrastructures for transparent, efficient, and secure property ecosystems,” in *Applied AI and Blockchain in Global Real Estate*, E. Babulak, Ed. IGI Global, 2026, pp. 97–124, doi: 10.4018/979-8-3373-7001-9.ch004.

[16] S. I. Ali, B. A. Salunke, S. Salunke, P. S. Chouhan, and S. Shahane, “Decentralized smart grids with AI and blockchain: Enabling peer-to-peer energy trading and energy equity,” in *Advancing Energy Production and Distribution With Blockchain and AI*, E. Babulak, Ed. IGI Global, 2026, pp. 163–200, doi: 10.4018/979-8-3373-6996-9.ch006.

[17] S. I. Ali, A. Dubey, S. Salunke, B. A. Salunke, and P. N. Chopkar, “Advancing energy production and distribution with blockchain and AI,” in *Advancing Energy Production and Distribution With Blockchain and AI*, E. Babulak, Ed. IGI Global, 2026, pp. 83–112, doi: 10.4018/979-8-3373-6996-9.ch004.

[18] M. S. Shaikh, P. K. Patidar, B. A. Vaghela, A. N. Pandwal, and S. I. Ali, “Advanced heart disease risk assessment using random forest algorithm,” in *Proceedings of the 2025 International Conference on Computational, Communication and Information Technology (ICCCIT)*, Indore, India, IEEE, 2025, doi: 10.1109/ICCCIT62592.2025.10927994.

[19] S. I. Ali, J. Jadhav, R. Arunkumar, and N. Kanagavalli, “A smart resource utilization algorithm for high-speed 5G communication networks based on cloud servers,” *ICTACT Journal on Communication Technology*, vol. 13, p. 2800, 2022, doi: 10.21917/ijct.2022.0414.

[20] C. S. T. Sharmiladevi, D. Sugumar, S. I. Ali, T. A. Jones Mary, and S. Kumar, “Using smart wearable devices to monitor social distancing in smart cities,” in *Proceedings of the 2023 International Conference on Research Methodologies in Knowledge Management, Artificial Intelligence and Telecommunication Engineering (RMKMATE)*, Chennai, India, IEEE, 2023, pp. 1–5, doi: 10.1109/RMKMATE59243.2023.10369118.

[21] S. I. Ali, P. T. Kalaivaani, S. Ambigaipriya, and M. D. Rafeeq, “Evaluation of AI model performance,” in *Toward Artificial General Intelligence: Deep Learning, Neural Networks, Generative AI*. Berlin, Germany: Walter de Gruyter GmbH & Co. KG, 2023, p. 125.

[22] S. I. Ali, “Reinforcement learning for autonomous optimization in intelligent engineering,” in *AI-Driven Approaches for Fully Automated Smart Engineering*, E. Babulak, Ed. IGI Global, 2026, pp. 313–344, doi: 10.4018/979-8-3373-4839-1.ch011.

[23] B. Pattanaik, S. S. Kumari, K. C. Kumar, M. Pattnaik, S. I. Ali, and M. Kumarasamy, "An innovation of algebraic mathematical-based statistical analysis model for complex number theory," in *Proceedings of the 2023 International Conference on Disruptive Technologies (ICDT)*, IEEE, 2023, pp. 94–99, doi: 10.1109/ICDT57929.2023.10151169.

[24] S. S. Srivastava, S. I. Ali, A. K. Srivastava, and C. Goswami, "Improving 5G network performance with MIMO technology using beamforming algorithm," *ICTACT Journal on Communication Technology*, vol. 15, no. 2, pp. 3173–3180, 2024, doi: 10.21917/ijct.2024.0472.

[25] S. I. Ali, M. S. Shaikh, P. Kelkar, and S. Chowdhury, "Analyzing and visualizing learning data: A system designer's perspective," in *Revolutionizing Education With Remote Experimentation and Learning Analytics*, IGI Global, 2025, pp. 57–68, doi: 10.4018/979-8-3693-8593-7.ch004.

[26] M. S. Shaikh and S. I. Ali, "An integrated analysis of the effects of learning analytics dashboards on learner perspective, inspiration, engagement, and accomplishment," in *Revolutionizing Education With Remote Experimentation and Learning Analytics*, IGI Global, 2025, pp. 19–36, doi: 10.4018/979-8-3693-8593-7.ch002.

[27] S. I. Ali, M. S. Shaikh, P. K. Nandi, and S. Chowdhury, "Learning analytics: Drivers, developments, and challenges," in *Revolutionizing Education With Remote Experimentation and Learning Analytics*, IGI Global, 2025, pp. 277–286, doi: 10.4018/979-8-3693-8593-7.ch016.

[28] S. I. Ali, H. K. Ravuri, V. T. Lakshmi, A. Ramya, K. Lavanya, and S. Bahade, "The role of nanomaterials in the development of high-performance batteries," *Nanotechnology Perceptions*, vol. 20, suppl. S11, pp. 1125–1140, 2024.

[29] S. I. Ali, M. S. Shaikh, K. Bhushanwar, and S. Shahane, "Blockchain for smart mobility," in *Leveraging VANETs and Blockchain Technology for Urban Mobility*, IGI Global, 2025, pp. 59–74, doi: 10.4018/979-8-3373-0265-2.ch004.

[30] M. S. Shaikh and S. I. Ali, "The joint creation of an instructor dashboard for online learning environments in college and university," in *Revolutionizing Education With Remote Experimentation and Learning Analytics*, IGI Global, 2025, pp. 545–558, doi: 10.4018/979-8-3693-8593-7.ch032.

[31] M. S. Shaikh, S. I. Ali, and U. F. Siddiqui, "Li-Fi: An emerging wireless communication technology," *International Journal of Advanced Electronics & Communication Systems*, vol. 5, no. 1, Art. no. 10758, 2016.

[32] M. S. Shaikh and S. I. Ali, "Smart waste management by integrating data analytics, IoT, and AI for sustainable urban solutions," in *Leveraging VANETs and Blockchain Technology for Urban Mobility*, IGI Global, 2025, pp. 383–404, doi: 10.4018/979-8-3373-0265-2.ch018.

[33] M. S. Shaikh and S. I. Ali, "A review on exploring blockchain-enabled VANET solutions for sustainable solid waste management," in *Leveraging VANETs and Blockchain Technology for Urban Mobility*, IGI Global, 2025, pp. 359–382, doi: 10.4018/979-8-3373-0265-2.ch017.

[34] M. S. Shaikh, P. K. Patidar, H. Patel, M. Kumar, and S. I. Ali, "Exploring the role of artificial intelligence in image forgery detection and prevention," in *Proceedings of the International Conference on Recent Advancements and Modernisations in Sustainable Intelligent Technologies and Applications (RAMSITA 2025)*, Atlantis Press, 2025, doi: 10.2991/978-94-6463-716-8\_19.

[35] M. S. Shaikh and S. I. Ali, "Revolutionizing the impact of education using advanced online tools," in *Revolutionizing Education With Remote Experimentation and Learning Analytics*, IGI Global, 2025, pp. 471–488, doi: 10.4018/979-8-3693-8593-7.ch028.

[36] K. Karunambiga, S. I. Ali, A. P. Esteban, and M. Pascual, "Marketing policy in service enterprises using deep learning model," *International Journal of Intelligent Systems and Applications in Engineering*, vol. 12, no. 7s, pp. 239–243, 2023.

[37] K. Sharma, B. Bajpai, H. Vaghela, P. K. Patidar, S. I. Ali, and M. S. Shaikh, "Blockchain for intelligent transportation systems: Purposes, obstacles, and possibilities," in *Leveraging VANETs and Blockchain Technology for Urban Mobility*, IGI

Global, 2025, pp. 45–58, doi: 10.4018/979-8-3373-0265-2.ch003.

[38] S. I. Ali, M. S. Shaikh, P. K. Patidar, and S. Pagare, “Reimagining urban mobility: A blockchain perspective,” in *Leveraging VANETs and Blockchain Technology for Urban Mobility*, IGI Global, 2025, pp. 29–44, doi: 10.4018/979-8-3373-0265-2.ch002.

[39] S. I. Ali and M. S. Shaikh, “The ethical dilemma of using (generative) AI in science and research,” in *Responsible Implementations of Generative AI for Multidisciplinary Use*, IGI Global, 2025, pp. 249–264, doi: 10.4018/979-8-3693-9173-0.ch009.

[40] S. I. Ali, M. S. Shaikh, S. Shahane, K. Sharma, and K. Macwan, “The era of metaverse and generative artificial intelligence,” in *Responsible Implementations of Generative AI for Multidisciplinary Use*, IGI Global, 2025, pp. 29–44, doi: 10.4018/979-8-3693-9173-0.ch002.

[41] M. S. Shaikh, U. B. Chandrawat, S. M. Choudhary, S. I. Ali, S. Ponnusamy, R. A. Khan, and A. G. Sheikh, “Harnessing logistic industries and warehouses with autonomous carebot for security and protection,” in *Harnessing AI and Digital Twin Technologies in Businesses*, IGI Global, 2024, pp. 239–257, doi: 10.4018/979-8-3693-3234-4.ch017.

[42] M. S. Shaikh, K. Bhushanwar, N. Khodifad, and S. I. Ali, “Dual purpose IoT enabled smart cleaner hexabot with edge detection mechanism,” in *Proceedings of the 2024 International Conference on Advances in Computing Research on Science Engineering and Technology (ACROSET)*, IEEE, 2024, pp. 1–6, doi: 10.1109/ACROSET62108.2024.10743997.

[43] S. I. Ali, M. S. Shaikh, S. Ponnusamy, and P. S. Chouhan, “Technological collaboration, challenges, and unrestricted research in the digital twin,” in *Harnessing AI and Digital Twin Technologies in Businesses*, IGI Global, 2024, pp. 380–399, doi: 10.4018/979-8-3693-3234-4.ch028.

[44] M. S. Shaikh, S. Ponnusamy, S. I. Ali, M. Wanjari, S. G. Mungale, A. Ali, and I. Baig, “AI-based advanced surveillance approach for women’s safety,” in *Wearable Devices, Surveillance Systems, and AI for Women’s Wellbeing*, IGI Global, 2024, pp. 13–25, doi: 10.4018/979-8-3693-3406-5.ch002.

[45] S. I. Ali, G. P. Kale, M. S. Shaikh, S. Ponnusamy, and P. S. Chouhan, “AI applications and digital twin technology have the ability to completely transform the future,” in *Harnessing AI and Digital Twin Technologies in Businesses*, IGI Global, 2024, pp. 26–39, doi: 10.4018/979-8-3693-3234-4.ch003.

[46] M. S. Shaikh, S. I. Ali, A. R. Deshmukh, P. H. Chandankhede, A. S. Titarmare, and N. K. Nagrale, “AI business boost approach for small business and shopkeepers,” in *Digital Twin Technology and AI Implementations in Future-Focused Businesses*, IGI Global, 2024, pp. 27–48, doi: 10.4018/979-8-3693-1818-8.ch003.

[47] Y. Farooqui, S. I. Ali, K. Shekokar, P. K. Patidar, K. Bhushanwar, and P. K. Nandi, “A secure framework for decentralized digital lockers using blockchain technology,” *Journal of Computer Science*, vol. 21, no. 9, pp. 2105–2112, 2025, doi: 10.3844/jcssp.2025.2105.2112.

[48] S. I. Ali, “Cognitively tuned AI bots for linguistic equity: A neuro-symbolic framework for policy-aligned language learning systems,” *International Journal of Scientific Research and Engineering Development*, vol. 9, no. 1, pp. 17–34, Jan. 2026.