Emerging Intelligence in the Context of the Fourth Industrial Revolution

Hamza BELHOCINI *
Djillali Liabes University - Sidi Bel Abbes, Algeria
hamza.belhocini@univ-sba.dz

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Abstract: Artificial intelligence (AI) is considered one of the modern scientific disciplines that has widely spread in recent years. It represents one of the most significant outcomes of the Fourth Industrial Revolution, which emerged at the beginning of the third decade of the 21st century. This revolution has pushed innovations beyond all boundaries and expectations, prompting efforts to develop a form of machine intelligence capable of emulating human intelligence in both performance and operational methods. AI encompasses various types and possesses multiple characteristics that enable it to simulate human cognitive functions and perform a wide range of tasks aimed at assisting humans in their daily lives.

Thus, AI is considered a driving force in research, having achieved and continuing to achieve numerous benefits. However, it is not without its drawbacks.

Keywords: Artificial intelligence; Fourth Industrial Revolution; autonomy; prediction; interactivity.

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*** Corresponding author: Hamza BELHOCINI.**

Introduction:

Today's world is highly complex and interconnected, with scientific and technological advancements reaching unprecedented levels. Innovations and developments have surpassed all boundaries, and one of the most significant phenomena we are witnessing today is artificial intelligence. AI is considered a modern scientific field that has rapidly expanded in recent years and represents one of the primary outcomes of the Fourth Industrial Revolution, which began in the third decade of the 21st century. This revolution has propelled innovations beyond all limits and expectations, leading to the development of machine intelligence capable of emulating human intelligence in both function and operation.

Artificial intelligence exists in various forms and exhibits multiple characteristics that allow it to simulate human cognitive performance while performing diverse tasks aimed at assisting human life.

Based on this context, this research paper seeks to answer the following question:

- **What are the defining features of the new intelligence that has emerged in the context of the Fourth Industrial Revolution?**

To address this question, the paper will first clarify the concept of artificial intelligence, examining the accuracy of the term itself. It will also highlight the different types of AI and the characteristics they possess, which will facilitate an understanding of their advantages and limitations.

Answering the above question and achieving the objectives of this research necessitates adopting multiple methodologies, including descriptive, analytical, and comparative approaches.

To comprehensively address these topics, the paper is structured into two main sections:

- **Section One: The Concept of Artificial Intelligence**
- **Section Two: Evaluation of Artificial Intelligence**

Section One: The Concept of Artificial Intelligence

The topic of artificial intelligence (AI) is a relatively recent subject that has entered the field of legal studies in recent years. Interest in AI has grown due to the increasing penetration of intelligent machines into everyday life. Self-driving cars, unmanned aerial vehicles (drones), and numerous software applications supporting professionals in the medical field, as well as in the judicial sector and other sensitive areas, have become widespread. Consequently, it has become essential to examine AI by defining its meaning, distinguishing it from human intelligence, and identifying its types and characteristics.

Subsection One: Definition of Artificial Intelligence

The definition of artificial intelligence will be examined from three perspectives: linguistic, technical, and legal. From a linguistic perspective, the term *"artificial intelligence"* is composed of two elements: *intelligence* and *artificial*. To understand its linguistic meaning, each element must be analyzed separately.

In this regard, intelligence (Arabic: الذكاء) originates from the Arabic root *"ذكا"* (*dhakā*), which conveys meanings such as sharpness, perceptiveness, and astuteness. In classical Arabic

usage, the expression *"ذكت النار"* refers to the intensification or ignition of fire. Linguistically, intelligence denotes sharpness of mind, keen perception, and quickness of understanding.[1]

According to *Al-Waseet Dictionary*, intelligence is defined as **the ability to analyze, synthesize, distinguish, make choices, and adapt to new situations**.[2]

The term *artificial*, on the other hand, linguistically refers to anything that is made, i.e., not natural. Accordingly, the word "artificial" is derived from the verb *to make* or *to fabricate*. It is used to describe all things that result from human activity or intentional creation, distinguishing them from objects that exist naturally without human intervention.[3] While the linguistic definition of artificial intelligence, or what is sometimes referred to as machine intelligence, provides a foundational understanding, it is noteworthy that the term *artificial intelligence* was first introduced in 1956 at the **Dartmouth Conference** by the American scientist **John McCarthy**, who is often called the "father of artificial intelligence."[4]

Regarding its technical and scholarly definitions, multiple perspectives have emerged, reflecting the different angles from which scholars have approached the concept. Some focused-on AI as a research field, others emphasized AI as advanced, autonomous systems, while another group defined it in comparison to human intelligence.

Within the first approach, artificial intelligence (AI) is defined as *"a science concerned with the creation of machines whose actions are considered intelligent by humans*[5]*."*

Other scholars describe AI as *"the science and engineering of making intelligent machines, particularly intelligent computer systems."*

Another definition states that AI is *"the science that enables machines to perform tasks that require intelligence when performed by humans."*

Based on these definitions, it is evident that artificial intelligence is a science in its own right, aiming to endow computers and other machines with intelligence. It enables machines to perform activities that were once considered uniquely human, such as thinking, creativity, learning, and communication.

It can thus be observed that artificial intelligence is the science of creating devices and computer programs capable of thinking in a manner similar to the human brain: learning as humans learn, making decisions as humans decide, and acting as humans act.[6]

In this context, another definition describes AI as "a branch of computer science through which computer programs can be developed and designed to mimic human intelligence, enabling computers to perform tasks that require thinking, understanding, hearing, speaking, and movement in place of humans"[7]

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[1] **Al-Wali Abdullah Saeed Abdullah,** *Civil Liability for Damages Arising from Artificial Intelligence Applications in Emirati Law: An Analytical and Comparative Study*, 1st ed, Dar Al-Nahda Al-Arabiya & Dar Al-Nahda Al-Ilmiya, Egypt and the United Arab Emirates, 2021, p. 26.

[2] **Dwidar Abdel Fattah Muhammad, Al-Zayat, Salmi Muhammad, & Al-Sheikh, Nada bint Ahmad,** *Artificial Intelligence: Its Challenges and Aspirations*, Dar Al-Matbouat Al-Jame'iyya, Alexandria, Egypt, 2023, p. 2.

[3] **Dwidar Abdel Fattah Muhammad,** *previously cited work***, p2.**

[4] **Mayad Issa Mohammed Al-Farsi,** *Provisions of Civil Liability Arising from Artificial Intelligence under Omani Legislation*, **Journal of University Studies for Comprehensive Research**, Vol. 7, No. 18, 2002, p.3529.

[5] **Khaled Mamdouh Ibrahim**, *The Legal Regulation of Artificial Intelligence*, 1st ed., Dar Al-Fikr Al-Jami'i, Alexandria, Egypt, 2022, p. 19.

[6] **Dwidar, Abdel Fattah Muhammad,** *previously cited work*, p7.

[7] Mohammed Ali Al-Sharqawi, *Artificial Intelligence and Neural Networks*, **Future Computer Science and Technology Series**, Artificial Intelligence Center for Computers, Modern Egyptian Office Press, Cairo, 1996, p.23.

According to this definition, artificial intelligence is an intelligent entity created by humans, capable of performing tasks autonomously without explicit instructions. It possesses the ability to think and act rationally, humanely, and professionally.[8]

From this perspective, AI works to enable technical systems to perceive their environment, interact with what they perceive, and solve problems. Some scholars define AI by distinguishing it from human intelligence, describing it as "a field that seeks to understand the nature of human intelligence by creating computer programs that imitate intelligent actions and behaviors."[9]

It is also worth noting that the simplest definition of AI considers it as "the ability of a machine to emulate human intelligence through computer programs."

Based on the aforementioned perspectives, and by integrating the three approaches used to define AI, it can be concluded that artificial intelligence is "the method through which human cognitive abilities are simulated. It is a branch of computer science that deals with the design of intelligent systems, which exhibit a range of properties associated with intelligence, particularly those reflecting human behaviors."[10]

Furthermore, these definitions highlight an important point: AI fundamentally simulates human intelligence. Consequently, the definition of artificial intelligence is closely linked to human intelligence, and the two cannot be entirely separated. The objectives of AI include learning, reasoning, and perception, enabling it to think, act, and make decisions in ways that mirror human capabilities.

Subsection Two: Types of Artificial Intelligence

Scholars differ in classifying the types of artificial intelligence, depending on the perspective they adopt. Some classify AI according to the functions it is designed to perform, while others categorize it based on the underlying technology.

1. Classification Based on Function

When considering AI types according to the functions they aim to achieve, they include reactive **machines, limited memory machines, theory of mind AI, and self-aware AI**. These types are often arranged hierarchically according to their level of sophistication. The simplest level allows machines to perform only basic functions, whereas more advanced levels involve high-end technology capable of executing complex tasks.

1.1 Reactive Machines

Reactive machines, also known as **response machines**, represent the foundational form of artificial intelligence and are among the oldest AI systems with relatively limited technical capabilities. These machines lack memory and do not use past experiences to inform future actions. Instead, they rely solely on the current data available to them. They perform predefined tasks and cannot operate beyond the scope of their programming. Consequently, reactive machines are restricted to simple, programmed operations.

1.2 Limited Memory AI

Unlike the first type, limited memory AI is characterized by its ability to interact with its environment and learn from past experiences. This learning capability enhances its technical proficiency, enabling it to make intelligent decisions in the future.

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[8] **Khaled Mamdouh Ibrahim**, *previously cited work*, p. 22.

[9] **Abdel Fattah Mohammed Dweidar,** *previously cited work*, p. 09.

[10] ***Ibid***., p. 08.

What distinguishes this type of AI is its extensive training data, which allows it to process and analyze information at high speed. Its memory stores previously learned information, including datasets, events, and experiences, enabling the system to build empirical knowledge from prior observations.

A notable example of limited memory AI includes **partially autonomous vehicles**, which rely on onboard sensors to detect rough terrain, steep inclines, and pre-stored traffic signals. This information allows the vehicle to make real-time decisions to avoid accidents and optimize driving performance.

1.3 Theory of Mind AI [11]

This type represents one of the most advanced forms of artificial intelligence. Theory of mind AI can understand human emotions, beliefs, thoughts, and expectations. It is capable of social interaction, accurately perceiving rapid changes in human emotional and behavioral patterns. Real-world examples of this type of artificial intelligence include **Sophia the Robot**[12] and **Kismet**.[13]

1.4 Self-Aware Artificial Intelligence

Self-aware AI, also referred to as consciousness-based or self-conscious artificial intelligence, is currently hypothetical. At present, it exists mainly as a theoretical concept in science fiction films and graphic novels. Researchers in AI systems are still working on developing this type, which represents the most advanced form of AI. It is an extension of theory of mind AI, but more advanced: it not only understands human emotions and beliefs and replicates human behaviors, but also aims to create machines with their own consciousness. Such AI would possess extraordinary intelligence closer to the human brain, including emotional awareness, enabling it to recognize its own existence and the existence of others.

2. Classification Based on Technological Capabilities

Some scholars classify artificial intelligence according to technological capabilities into three levels: narrow AI, general AI, and super intelligent AI.

2.1 Narrow AI

Also known as weak AI, narrow AI represents the simplest form of artificial intelligence. It is programmed to perform specific tasks within a defined environment and reacts to particular situations[14]. It cannot operate beyond its programmed scope.[15] Narrow AI is limited to performing one or two narrowly defined tasks. This category includes developments ranging from basic systems to complex decision-making algorithms used by machines. Common

[11] The theory of mind in psychology refers to the ability to attribute mental states (beliefs, intentions, desires, emotions, etc.) to oneself.

[12]The robot Sophia was created in 2016 by Hanson Robotics. The cameras in Sophia's eyes, together with computer algorithms, allow her to see, maintain eye contact, recognize individuals, and track faces. A clear example of this is her interviews in Egypt as well as with the American artist.

[13] This robot was developed in the late 1990s by a researcher at the Massachusetts Institute of Technology. It was equipped with visual, auditory, and cognitive sensory inputs, as well as motor outputs including sounds, facial expressions, and motor abilities to control the direction of its gaze and head. It can imitate and recognize human emotions, but it cannot follow eye movements or shift attention to humans.

[14] Basem Mohammed Fadel Madbouly, *Alternative Means of Compensation for Damages Caused by Artificial Intelligence*, Dar Al-Fikr Al-Jami'i, Alexandria, Egypt, 2023, p. 30.

[15] Khaled Mamdouh, *previously cited work,* p. 67.

examples include **Google Translate**, **image recognition programs**,**Amazon product** and [16] **recommendation systems**.…[17] ..

2.2 General or Strong AI

General or strong AI is characterized by its ability to gather information, analyze it, and accumulate experiences from various situations, enabling it to make independent, autonomous decisions[18]. It can learn and perform any intellectual task that a human can execute. [19] Examples include **self-driving cars** and **chatbot robots**. [20]

Unlike narrow AI, strong AI is not restricted by a fixed set of limitations; it can learn and improve across multiple tasks, effectively creating computer systems capable of multifunctional intelligence similar to human abilities.[21]

2.3 Super intelligent AI

Super intelligent AI represents the most advanced form of artificial intelligence and is closely associated with self-aware AI. It remains largely under development and experimentation. This type of AI not only imitates human intelligence but is designed to surpass human cognitive abilities.[22]

Super intelligent systems are capable of performing tasks more efficiently than humans by leveraging vast memory capacities and high-speed processing capabilities. Such advanced memory and rapid decision-making abilities enable machines to execute complex tasks with high efficiency and within a short period of time.

Subsection Three: Characteristics of Artificial Intelligence

Artificial intelligence exhibits numerous characteristics, the most important of which include prediction and adaptation, autonomy, learning and response, mobility, and perception.

Regarding **prediction and adaptation**, this is considered one of the most crucial properties of AI. It relies on algorithms and pre-programmed data, which enable it to learn problem-solving techniques and make decisions. A common example in this domain is utility software systems, such as spell-checkers in word processing programs, which can predict what a user intends to write, as seen in Go**o**gle's search engine. Applications that exemplify this property include self-driving vehicles and drones, where advanced systems control the machine and make all operational decisions autonomously.

Concerning **decision-making**, AI's ability to predict and adapt allows it to infer, analyze data, and gain new experiences, enabling it to make decisions more comprehensively and quickly than humans.

Learning capability is another essential characteristic of artificial intelligence. AI systems can learn from patterns, methods, and diverse situations. A prominent example in the field of machine learning is deep learning, which constitutes a subset of AI. A well-known application of this approach is Amazon's recommendation system.

Regarding **interactivity,** most existing AI systems are currently reactive machines and have not yet reached the level of super intelligent AI or self-aware AI. Consequently, they

[16] https://www.annajah.net, accessed September 4, 2023, at 18:00.
[17] Khaled Mamdouh, *previously cited work*, p. 67.
[18]Abdel Fattah Mohammed Dweidar, *previously cited work*, p. 20.
[19] https://www.annajah.net, accessed September 4, 2023, at 18:10.
[20] Basem Mohammed Fadel Madbouly, *previously cited work*, p. 32.
[21] Khaled Mamdouh, *previously cited work* p. 67.
[22] https://www.annajah.net, accessed September 4, 2023, at 18:15.

cannot form memories or make ethical choices. Interactivity allows AI to understand a given problem and respond based on its existing knowledge. A practical example of this is **Deep Blue,** the chess-playing computer, which, despite its ability to recognize each chess piece and determine all possible moves, cannot remember previous moves.[23]

In addition to the above properties, AI also exhibits **autonomy**. Due to its ability to perceive events, understand, interpret, and interact with its environment, AI can perform tasks and make decisions independently, without requiring human intervention.[24]

Subsection Four: Distinguishing Artificial Intelligence from Human Intelligence

Based on the characteristics of artificial intelligence, it is evident that there are several differences distinguishing AI from human intelligence. These differences manifest in multiple aspects, the most important of which include:

Superiority of Human Intelligence in Performing Tasks: Due to the complex structure of humans, they are capable of performing multiple functions, both physical (such as walking and manual work) and mental (such as thinking, planning, learning, and analyzing). Humans can accomplish diverse tasks and produce impressive results even with limited information or prior experience. In contrast, AI algorithms can only perform specific tasks assigned to them. To execute multiple tasks, several AI programs must often be combined.

Differences in Decision-Making: Human decisions are rational but influenced by subjective factors related to their environment. AI systems, being purely algorithmic and devoid of emotions, make objective decisions based solely on data analysis. They lack the capacity to comprehend cause-and-effect relationships or the broader context surrounding their decisions.

Dependence on Experience and Knowledge: Humans rely on past experiences and actions, which allow them to modify their environment, provide diverse information, and share insights on competence and knowledge. This is fundamentally linked to human cognition, which enables reflective thinking. AI, on the other hand, depends primarily on the data provided by humans, which define the tasks it must perform. AI lacks emotions and empathy, and therefore does not consider the social importance, responsibility, or potential consequences of the actions it executes.

Data Storage and Processing Capabilities: AI excels at storing and processing large volumes of data, as well as solving multiple problems within a short timeframe. Humans, by contrast, require repeated exposure to information to retain it in memory. Similarly, while humans forget gradually over time, AI can erase stored data instantly upon command.

Source of Intelligence: Human intelligence is considered a divine endowment, originating from God, whereas artificial intelligence is human-made, with its ability to emulate human cognition relying entirely on the information provided to it.

Basis of Thinking: Human thinking is rooted in the mind, a unique gift that distinguishes humans from other creatures. AI, however, relies on the data fed into it. Some AI systems, such as **intelligent agent systems**, do not solely depend on their own data but interact with other intelligent systems in a **multi-agent framework**, utilizing available information in their environment to make informed decisions.

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[23] **Khaled Mamdouh**, *previously cited work*, p. 39.

[24] **Fathima Zahra Jendouli**, *First Axis: Digitalization in the Field of Commercial Contracts and International Trade*, in Hamza Al-Shawwa, *Business Law and the Challenges of Digital Transformation*, 1st ed., Maghreb – Near East Center for Strategic Studies, United Kingdom, 2023, p. 8; Ihab Samer Ahmed Al-Amro, *Contractual Liability of the Electronic Agent under Jordanian Law: A Comparative Study*, Master's Thesis submitted to fulfill the requirements for a Master's degree in Private Law, Faculty of Law, Al-Isra University, 2021, p. 28.

Scope and Adaptability of Intelligence: Humans possess boundless learning abilities and can recognize and interact with their environment, exhibiting broad and adaptive intelligence. AI, by contrast, has a limited scope, initially constrained to the data it receives-especially in reactive machines. However, with the emergence of advanced AI systems featuring learning and autonomy, certain AI systems can now learn from environmental data and gather new inputs independently, as exemplified by multi-agent systems, which collect and integrate information from previous interactions to make autonomous decisions..[25]

Chapter Two: Evaluating Artificial Intelligence

Artificial intelligence (AI) is characterized by a multitude of advantages that manifest across various domains. However, despite its many benefits, it is not without drawbacks. The following discussion aims to identify both the positive and negative aspects of AI.

Section One: Advantages of Artificial Intelligence

AI possesses numerous advantages, including the following:

1. Rarity of Errors

Artificial intelligence demonstrates exceptional capability in executing assigned tasks. It also contributes to faster and more efficient decision-making compared to humans. Despite these advantages, the likelihood of computational errors is extremely low when compared to human mistakes during task performance. Most AI errors are attributable to programming flaws. This rarity of error stems from the absence of emotional factors in AI systems and their reliance on data-driven patterns and algorithms as the foundation for decision-making.

2. Reduction in Labor Intensity

The intelligent automation of organizations has significantly reduced the need for extensive human labor. AI systems operate continuously, 24 hours a day, seven days a week, without any decline in efficiency or productivity. This contrasts sharply with human labor, which requires large workforces and substantial financial costs to accomplish similar volumes of work.

Due to the effectiveness of AI systems in reducing labor intensity, their adoption has increased markedly across industries. According to the Oxford Economics Report (2019), approximately two million robots were deployed globally, primarily for lifting, carrying, and transportation tasks. This shift has allowed human workers to redirect their efforts toward production-oriented activities. Notably, **Amazon** employs over 100,000 robots in its facilities and warehouses to move inventory between locations.

3. Enhanced Quality of Decision-Making

The ability of AI systems to organize, process, and analyze vast amounts of data at high speed has empowered decision-makers to act swiftly and more efficiently. This has become especially evident in production and business environments, where AI-driven institutions can identify significant data trends and respond to the needs of large market segments with greater precision.

4. Predictive and Rapid Crisis Response

AI is distinguished by its predictive and rapid response capabilities in the face of crises and disasters. This is evident in fields such as natural disaster management-floods, earthquakes,

[25] **Ihab Samer Ahmed Al-Amro**, *previously cited work*, p. 29; Firas Al-Kasasbeh and Nabila Kurdi, *The Smart Agent from a Legal Perspective: Technical Development or a Disruption of Legal Rules?*, **Sharia and Law Journal**, United Arab Emirates University, Issue 55, July 2013, p. 139.

and volcanic eruptions-where algorithms assist in forecasting the location and timing of such events. Beyond preemptive applications, AI also serves protective post-crisis functions by aiding in disaster mitigation and relief operations.

Section Two: Disadvantages of Artificial Intelligence

While AI systems offer substantial advantages, they likewise present several notable drawbacks, including:

1. High Implementation Costs

There is no doubt that deploying AI systems for various tasks entails substantial financial costs. These expenses are primarily related to programming, maintenance, and the need to address technical malfunctions or system breakdowns.

2. Increased Dependence on Machines

The rapid advancement of technology worldwide has led to a growing dependence on AI-powered devices across diverse and sensitive sectors-including manufacturing, automotive industries, electrical equipment, and customer service. This dependency has even extended into highly sensitive areas such as education and healthcare.

Such reliance may hinder human cognitive development, as individuals can now obtain information effortlessly through these systems without engaging in critical thinking or analytical reasoning.

3. Decline in Creativity and Critical Thinking

As previously mentioned, AI systems have not yet reached the level of **artificial super intelligence** characterized by cognitive consciousness. Despite their remarkable progress, they remain limited to performing predefined tasks and executing programmed commands. They lack the capacity for innovative, **"out-of-the-box**" thinking.

Currently available AI generations have yet to reach the creative and imaginative capabilities inherent in human intelligence.

4. Absence of Emotions

Building upon the previous point, current AI systems lack the emotions and empathy that define human beings. Consequently, they cannot establish emotional connections with humans. Moreover, improper or negligent use of such systems can potentially lead to harm or adverse consequences for users.

5. Privacy Violations

While AI systems have contributed significantly to technological advancement, they have also been exploited for privacy infringement. This is evident in applications that generate synthetic images, voices, and videos. Empirical evidence shows that some AI tools can create realistic human images without using existing facial composites, relying instead on algorithms trained on real human photos.

Similarly, certain applications can manipulate or fabricate voiceprints, while others-such as **Deepfake** technologies-can generate videos depicting individuals performing or saying actions never actually undertaken. These technologies analyze and replicate visual and auditory data to produce convincing yet entirely artificial representations.

6. Rising Unemployment

The increased reliance on AI across industries will inevitably lead to higher unemployment rates, as machines replace human workers. This dynamic is expected to

exacerbate poverty levels and deepen socioeconomic disparities-creating a divide between a wealthy technological elite and a struggling working class. The resulting imbalance may destabilize economic systems.

Beyond the economic sphere, this phenomenon will likely extend into the social domain. Greater dependence on machines can isolate individuals from their social environments, eroding interpersonal relationships. Human communication may become more complex and emotionally detached, leading to the erosion of empathy and genuine social interaction.[26]

Conclusion

The subject of artificial intelligence, as one of the key outcomes of the Fourth Industrial Revolution, represents a remarkable leap in contemporary technological development. It is a relatively new phenomenon that requires extensive study and examination by legal scholars. Through this research paper, we sought to shed light on the various conceptual and terminological dimensions of this phenomenon, which now simulates human intelligence through a set of unique features and characteristics that render it an invaluable tool serving humanity across multiple aspects of life.

In addition, the paper explored both the advantages and disadvantages of artificial intelligence systems. Based on the findings of this study, the following recommendations are proposed:

First, it is essential to adopt the term "**artificial intelligence systems**" rather than "**artificial intelligence**" alone, particularly because the latter lacks a clear and precise definition.

Second, legal professionals should collaborate with technical experts in computer science-and ideally organize specialized training workshops-in order to establish a more accurate and comprehensive definition of artificial intelligence systems. Such cooperation would help formulate appropriate legal frameworks that align with the technical realities of this field.

Third, there is a pressing need to enact legal provisions capable of addressing the various challenges raised by the use of artificial intelligence systems within the legal domain. This is especially important given the advanced characteristics these systems have acquired through rapid evolution, which raise complex issues regarding the possible recognition of AI as a legal person, as well as its potential civil liability for damages caused by its use and the criminal liability associated with its unlawful applications.

[26] **Khaled Ibrahim**, *previously cited work*, p. 50.