

The Responsibility Gap in Militarized Application of AI and the Construction of Global Accountability Mechanism

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Abstract: In the era of rapid technological development, the application of AI in the military domain is now reshaping the nature of warfare. The unexplainability of algorithmic decision-making and autonomous weapon systems, as well as the risks associated with secure data, have sparked profound ethical and legal debates. This paper focuses on the challenge of defining war responsibility brought about by the militarization of AI, specifically the "responsibility gap" caused by the disconnection between technological autonomy and human control. By analyzing typical incidents of AI weapon misfires in the Nagorno-Karabakh conflict from 2020 to 2023 and the Russia-Ukraine war, it reveals the predicament of "black-box decision-making - fragmented responsibility" under the current international law framework. Building on previous research, it proposes a responsibility determination approach based on technological traceability and introduces the idea of using blockchain and other technologies to construct a cross-border accountability system. This study finds that the separation of decision-making levels in military AI makes traditional responsibility provisions difficult to apply, and the timestamp accuracy of combat orders needs to reach a high standard to meet the requirements of the evidence chain. Finally, this paper suggests that within the framework of existing international conventions, relevant mechanisms should be improved to enhance governance over the militarization of AI, providing a fundamental reference for research and practice in this field.

Keywords: Militarization of AI, Lethal Autonomous Weapon Systems (LAWS), accountability gap, accountability system, global governance

1. Introduction

In the era of rapid technological development, the application of artificial intelligence (AI) technology in the military field is becoming increasingly widespread. Current research has shown that AI has a significant impact on the performance of weapon systems, the implementation of military operations, and the vulnerabilities and advantages of military forces. These developments have attracted the attention of the academic community, national leaders and the general public, carrying serious implications for the future of warfare [1]. From unmanned aerial vehicles (UAVs) conducting reconnaissance missions to intelligent weapon systems with autonomous defense capabilities, AI technology has brought about new changes to modern warfare, significantly enhancing the efficiency and accuracy of combat operations. However, this technological transformation has also raised a series of complex legal and ethical issues, among which the determination of war responsibility has become a focus of international concern.

In the traditional warfare mode, the determination of responsibility is relatively clear, with commanders bearing the main responsibility for combat decisions and action consequences. However, with the deep application of AI in the military field, the decision-making process of lethal autonomous weapon systems (LAWs) has become complex and partially autonomous, making the traditional way of determining war responsibility difficult to adapt to the new war forms. This has led to the problem of "black box decision-making-fragmentation of responsibility", posing a challenge to the existing international law framework [2].

This research aims to deeply analyze the difficulties in defining war responsibility in AI militarization applications, explore the establishment of an effective cross-border tracing mechanism, and promote the transformation of the global governance paradigm. Through this research, it can not only fill the theoretical gap in the determination of AI military application responsibilities but also provide theoretical support for the international community to formulate relevant policies and regulations. This will promote the safe, reliable and responsible use of AI technology in the military field and help maintain the international security order. Such efforts hold great practical significance for safeguarding human peace and development, as well as for fostering international cooperation and regulation in the emerging field of military technology.

2. Formation Mechanism of the Responsibility Gap

The formation of the responsibility gap can be analyzed from two dimensions: the technical dimension and the legal dimension.

2.1. Analysis from the Technical Dimension

From the technical dimension, the compression of the "decision-execution" time gap of autonomous weapon systems and the attenuation of the traceability of machine learning models are the two core issues currently existing.

Firstly, in modern warfare, lethal autonomous weapon systems (LAWs) have demonstrated extremely fast response speeds. According to the United Nations Panel of Experts on Libya, Turkey's Kargu-2 drone swarms deployed in Libya have demonstrated the capability to engage targets without requiring data linkage between operators and munitions, effectively achieving a "fire, forget, and find" operational capacity. The rapid engagement capability of these autonomous weapon systems significantly limits human commanders' ability to effectively intervene in or review the decision-making processes of such systems within critical timeframes [3]. In case of accidental injuries and other unexpected situations, it is difficult to accurately determine the attribution of responsibility. This rapid decision-execution process breaks the traditional mode where humans can control combat actions in real time, bringing huge difficulties to responsibility determination.

Secondly, machine learning models are the core part of lethal autonomous weapon systems (LAWs). However, as the models are continuously trained and iterated, the traceability of their decision-making basis gradually decreases. Taking the common ResNet-152 model as an example, in the continuous iterative process, the feature attribution loss rate keeps rising. This means that in the process of learning and evolving, the roots of the models' decisions become increasingly difficult to trace and explain. When lethal autonomous weapon systems (LAWs) make decisions based on these traceability-decayed models, it becomes extremely difficult to determine the responsible party for the decisions.

2.2. Legal Dimension Dilemma

The legal dimension dilemma mainly encompasses two major problems: the potential failure of the commander's responsibility principle and the ambiguity of the legal status of new entities.

Firstly, in traditional war laws, such as the "Statute of the International Criminal Tribunal for the Former Yugoslavia" and the "Statute of the International Criminal Tribunal for Rwanda," the commander's responsibility principle, stipulates that military commanders and other superiors bear corresponding criminal responsibility for specific international crimes committed by their subordinates. This principle serves as an important basis for determining war responsibility [4]. However, in the context of AI militarization applications, this principle is at risk of failure. With the continuous improvement of the decision-making autonomy of lethal autonomous weapon systems (LAWS) and the increase in decision-making levels, the actual control ability of commanders over combat decisions will gradually decline [5].

Secondly, under the existing international law system, the determination of war responsibility entities mainly focuses on state actors and military personnel. However, in AI militarization applications, new responsibility entities have emerged, such as AI developers and technology suppliers, as well as even the AI weapon entities themselves. Accountability for AI weapon entities is clearly meaningless, and the uncertainty of the deviation degree of the original technical instructions of AI weapons on the battlefield also makes the legal status and liability determination of researchers providing key algorithms and technical support for lethal autonomous weapon systems (LAWS) in AI militarized warfare unclear. This ambiguity in legal status makes it difficult to accurately identify the relevant responsible entities and hold them accountable in war events triggered by AI weapons [6].

In response to the above issues, it is necessary to re-examine the existing international legal framework to adapt to the changes brought about by emerging technologies. Through a comprehensive understanding of the responsibility gap, this paper lays the foundation for subsequent research to establish an effective responsibility determination and tracing system, emphasizing the importance of seeking cooperation and norms in global governance, thereby promoting the development of AI militarization applications towards a direction of safety and responsible use.

3. Technical Traceability Thought and System Architecture Design

3.1. Core Thought of Technical Traceability

This paper proposes a responsibility determination thought centered on technical traceability. This approach is based on the analysis of the difficulty in defining responsibilities in AI militarization applications, as well as the fact that digital supply chain traceability can already help enterprises in the civilian sector in achieving full life cycle management of goods and enhancing safety levels and product quality [7]. Specifically, by embedding specific technical means in lethal autonomous weapon systems (LAWS), key data during the combat process can be recorded and stored to achieve full traceability of the weapon's decision-making process. To this end, timestamp technology can be utilized to accurately record the time of combat instructions, ensuring the accuracy of the time sequence. At the same time, data encryption and distributed storage technologies can be adopted to ensure the security and integrity of the data, preventing data from being tampered with or lost.

3.2. Conceptualization of a Cross-border Accountability System Based on Blockchain

In order to achieve cross-border accountability tracing, this paper envisages the construction of an accountability system based on blockchain technology [8]. Blockchain has the characteristics of decentralization, immutability, loss prevention, and traceability [9]. Decentralization of blockchain refers to the fact that there is no single central authority or control node in the blockchain network to manage and verify transactions. Instead, all nodes in the network have the same power and responsibility and jointly participate in transaction verification and ledger maintenance.

At present, typical representative studies have selected Hyperledger Fabric as the blockchain network platform, successfully demonstrating that by combining the Vue front-end framework with other technical means, such as distributed ledgers, smart contracts, and the immutability feature, blockchain can solve core issues like traceability, security, and interoperability in information sharing for inspection, testing and data management [10]. In the future, on the basis of continuously overcoming existing challenges, blockchain traceability technology is expected to be able to provide a reliable storage and verification platform for the combat data of AI weapons. In this system, the combat data and decision-making instructions of AI weapons and other information will be stored in the blockchain in encrypted form, and each participant can access and verify the relevant data through specific keys. When war liability disputes occur, the data records on the blockchain can be used to quickly and accurately trace the liability subject, further promoting the formation of the accountability system. Based on this, when large-scale lethal autonomous weapons are used in major wars, the emergence of this accountability system will greatly improve the traceability efficiency of the liability subject.

3.3. Discussion on Key Technology Implementation

Currently, blockchain technology demonstrates extensive application prospects in the military domain, particularly in unmanned warfare systems [11]. Research indicates that blockchain technology holds significant potential in supporting military communication capability development, including operational command intelligence sharing, intelligent unmanned equipment requirements, and data control communication anti-jamming capabilities [12]. In military supply chain management, leading military powers such as the United States have already leveraged blockchain technology to enhance procurement and inventory management capabilities, implement comprehensive research and production management, improve logistics transportation efficiency, and ensure supply chain communication security [13]. Furthermore, in operational command transmission, blockchain-based anti-tampering solutions for scheduling operation commands have proven both feasible and effective, providing robust protection against command information tampering [14]. In conclusion, the technology traceability and transnational accountability system based on blockchain technology can establish a more transparent and equitable environment for future operations.

However, in the process of establishing a comprehensive system for technological traceability and transnational accountability in AI militarized warfare, several critical technical challenges remain to be addressed. For instance, enhancing the precision of timestamp authentication is essential to meet the requirements of evidence chain closure. Furthermore, it is imperative to develop encryption algorithms and distributed storage solutions tailored for military applications, ensuring data security and reliability in complex battlefield environments.

4. Progress and Preliminary Recommendations in Global Governance

While the establishment of a global accountability mechanism is technically feasible, it still faces numerous practical challenges in the realm of global governance.

Currently, there is no consensus among nations regarding the definition of lethal autonomous weapons, and strategies for AI development vary widely. At the recent Paris AI Summit, divergent views emerged on global AI regulation and governance. Sixty-one signatories, including China, France, Germany, and India, issued the "Declaration on Developing Inclusive and Sustainable Artificial Intelligence for the Benefit of Humanity and the Planet." This declaration asserts that rapidly advancing AI technologies must be "open, inclusive, ethical, and safe" and should promote the common interest of beneficial AI development. However, the United Kingdom and the United States declined to sign the declaration. Journalists have noted that while countries continue to adhere

to existing security claims, such as the Bletchley Declaration, there is a palpable sense of anxiety regarding AI development, particularly in Europe due to the technological leadership of China and the United States in the AI field. Numerous uncertainties, including differing national stances, technological iterations, and shifting global dynamics, make it difficult to reach definitive conclusions in these discussions [15].

Preliminary recommendations for advancing the development and refinement of global governance include promoting international cooperation and information sharing, enhancing international conventions and regulations, and establishing a global AI weapon registration mechanism.

Firstly, given the transnational nature of AI militarization, international cooperation and information sharing are paramount. Nations should strengthen exchanges and collaboration in the field of AI military applications, establish information-sharing platforms, and jointly develop standards and norms for accountability and traceability. Through international cooperation, there should be active calls to integrate resources from all parties to collectively address the challenges posed by AI militarization, thereby avoiding gaps and conflicts in accountability.

Secondly, international conventions and regulations should be enhanced. Under the existing framework of international conventions, such as the Convention on Certain Conventional Weapons, relevant provisions should be further refined to clarify the rules for the use of AI weapons and the delineation of responsibilities. For instance, China submitted the "Position Paper of China on Regulating Military Applications of Artificial Intelligence" to the Sixth Review Conference of the United Nations Convention on Certain Conventional Weapons in December 2021, and in November 2022, it submitted the "Position Paper of China on Strengthening Ethical Governance of Artificial Intelligence" to the Meeting of the High Contracting Parties to the Convention on Certain Conventional Weapons. Additionally, corresponding legal responsibilities and obligations should be explicitly established for new entities such as AI developers and technology suppliers.

Furthermore, it is advisable to establish a dedicated international institution tasked with overseeing and regulating the militarization of artificial intelligence, ensuring that all nations adhere to relevant laws and guidelines.

Lastly, it is recommended to implement a global AI weapons registration mechanism, which would comprehensively document and manage the development and deployment of AI weaponry by various countries. The registration should encompass technical specifications, operational capabilities, and deployment scopes of these weapons. This mechanism would facilitate real-time monitoring and tracking of AI weapons, providing foundational data for the attribution of war responsibilities. Additionally, the registration system would enhance transparency in the development and utilization of AI weapons, thereby mitigating potential security risks.

5. Conclusion

With the continuous innovation of AI technology and the emergence of AI weapons in the battlefield, the management of AI militarization has become a critical issue in contemporary discourse. This study conducts an in-depth analysis of the challenges in defining war responsibility within AI militarization. It elucidates the mechanisms underlying the responsibility gap, and proposes a responsibility attribution framework centered on technical traceability, along with a conceptual transnational accountability system based on blockchain technology. Preliminary recommendations for global governance are also presented. The research reveals that the separation of decision-making hierarchies in military AI and the attenuation of traceability in machine learning models render traditional responsibility attribution methods ineffective. Establishing robust technical traceability mechanisms and enhancing the international governance framework are identified as pivotal to addressing this issue.

Due to constraints in research conditions and individual capabilities, this study exhibits certain limitations. Specifically, the detailed implementation mechanisms of the technological traceability system and its practical application effects have not been subjected to in-depth experimental validation. Furthermore, the international governance recommendations lack comprehensive consideration of specific national policies and interest demands. Future research should focus on exploring the feasibility of technological implementation in greater depth, enhancing the study of international cooperation cases, and providing more robust theoretical and practical frameworks for accountability tracing and global governance in AI militarization. Additionally, with the continuous advancement of AI technologies, it is imperative to remain vigilant regarding emerging technological applications and legal-ethical issues, ensuring timely adjustments and improvements to relevant governance measures.

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