



Applications of Artificial Intelligence in the Military and Its Advantages

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DOI: 10.5281/zenodo.14056728

Submission Date: 12 Oct. 2024 | Published Date: 08 Nov. 2024

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Abstract

This document presents an assisted operation system of a robotic arm for positioning near an explosive device selected by the user through the visualization of the cameras on the screen. Two non-converging cameras mounted on the robotic arm in camera-in-hand configuration provide the three-dimensional (3D) coordinates of the object being tracked, using a 3D reconstruction technique with the help of the continuously adaptive mean shift (CAMSHIFT) algorithm for object tracking and feature matching. The inverse kinematics of the robot is implemented to locate the end effector close to the explosive so that the operator can perform the operation of grabbing the grenade more easily. Inverse kinematics is implemented in its geometric form, thus reducing the computational load. Tests conducted with various explosive devices verified the effectiveness of the system in locating the robotic arm in the desired position.

Keywords: Military Drones, Military Capabilities, Modern Military Applications, Military Operations. Artificial intelligence (AI).

I. INTRODUCTION

Artificial intelligence (AI) has been gradually improving and becoming a more efficient way worldwide with the help of data, computer processing power, and machine learning developments, especially during the last two decades. As a result, AI is being used increasingly and more frequently in the daily lives of various sectors. A few of the various uses of this technology include speech recognition, biometric authentication, mobile mapping, navigational systems, transportation and traffic control, management, manufacturing, supply chain management, data collection, and control targeted online marketing. Therefore, it should come as no surprise that AI has many applications in the military sector also, in a vast range [1]. Military capability is the current measurement index when determining a country or nation's "power force." The U.S. Department of Defense defines military competence or capability as "the ability to achieve a certain combat objective (win a war or battle, destroy a target set)." It is directly or indirectly influenced by modernization, structure, preparedness, and sustainability. The equipment, arsenal, and level of technical sophistication largely determine the degree of modernization [2]. The Internet is replacing the conventional way of initiating war instigated from the start of the Second World War. Studies show that hacking attacks on for-profit companies and governmental institutions around the AI sector are more common now. According to researchers, modern autonomous systems and artificial intelligence (AI) are expected to be crucial in future military confrontations [3]. Recent scientific publications show how prevalent neural network technology is today in the cyber fight. The development of intelligent transport systems (ITS) is one of the major examples, along with forecasting and assessing environmental phenomena, separating informational tweets from non-informational ones (containing information that are rumors or nondetailed irrelevant data), and forecasting dynamic FX conventional markets. This type of enhancer helps in the military sector in various ways and turns out to be the greatest weapon in developing military capability [4]. Data on a wide range of resources and capabilities (human resources combat and support vehicles, helicopters, cutting-edge intelligence and communication equipment, artillery, and missiles) that can carry out complex tasks of various types, such as intelligence gathering, movements, direct and indirect fires, infrastructure, and transports, should be considered in military decisions

[3, 5]. For instance, the decisional component necessitates an integrated framework that can carry out the necessary processes, from capturing a high-level course of action (COA) to implementing a thorough analysis/plan of activities. One possibility is to build the approach on several AI methods, such as qualitative spatial interpretation of COA diagrams and interleaved adversarial scheduling, and many others likewise enhance the military world in different paths [6]. The contributions of this paper are for the advancement of AI in the military capabilities, and the significance of this narrative review is to identify several key applications of AI in the military, including target recognition, surveillance, homeland security, cybersecurity, transportation and logistics, autonomous vehicles, and combat training. We have also highlighted the potential benefits of using AI in these areas, including increased efficiency, accuracy, and decision-making capabilities. The paper also identifies several challenges and potential risks associated with using AI in the military, such as the potential for malfunction, hacking, and other forms of cyberattacks. The ethical and legal implications of using AI in the military are discussed in detail, particularly in relation to issues such as autonomous weapons and the potential for unintended harm. The contributions of this paper are for the advancement of AI in the military capabilities, and the significance of this narrative review is to identify several key applications of AI in the military, including target recognition, surveillance, homeland security, cybersecurity, transportation and logistics, autonomous vehicles, and combat training. We have also highlighted the potential benefits of using AI in these areas, including increased efficiency, accuracy, and decision-making capabilities. The paper also identifies several challenges and potential risks associated with using AI in the military, such as the potential for malfunction, hacking, and other forms of cyberattacks. The ethical and legal implications of using AI in the military are discussed in detail, particularly in relation to issues such as autonomous weapons and the potential for unintended harm. The study has the potential to inform policy and decision-making in this area, particularly in relation to issues such as military modernization and preparedness. The research findings could potentially aid in developing guidelines and regulations for the responsible use of AI in military settings [7]. The research hypothesis underscores the necessity for robust, multi-layered security systems combining physical protection, advanced technological measures, and clear operational procedures. The research methods used in the work include, among others, a comprehensive review of literature and data analysis. The study examines past incidents and current best practices. The research highlights the potential of advanced technologies such as drone surveillance, biometric access controls, and artificial intelligence to significantly enhance security. However, their successful implementation requires proper integration, continuous updates, and thorough training for personnel. The study also emphasizes the importance of balancing stringent security measures with operational efficiency, ensuring that enhanced security protocols do not impede daily operations. Internal security measures are critical, as insider threats can be as dangerous as external attacks. Stringent background checks, continuous personnel monitoring, and fostering a culture of security awareness are essential to mitigate these risks. The study calls for international cooperation to share best practices and innovations in military air base security, recognizing that these challenges are global and collaborative efforts can lead to more robust solutions. Future research should focus on developing advanced cybersecurity defenses, exploring the human factors influencing security personnel performance, and fostering international cooperation to share best practices. Integrating traditional security measures with modern technologies and international collaboration can significantly enhance the protection of military air bases, ensuring their safety and operational readiness in an increasingly volatile world. By addressing both conventional and emerging threats, this research provides actionable insights for enhancing the security of military air bases globally, ensuring their safety and operational readiness amidst evolving threats and technological landscapes [8].

This study provides an overview of the history and current state of military drones, considering a global and Ecuadorian background. Then, a classification of the UAVs developed and built in Ecuador is conducted based on their endurance, altitude, and wing span to understand the national context and progress. The research also delves into the applications of UAVs in several military operations and missions, aiming to create a framework that aligns UAV capabilities with specific operational needs; this permits the identification of the challenges and opportunities the country faces. Unmanned aerial systems have changed the battlefield, and the government needs to adapt to a national strategy that incorporates this technology. This research analyzes and provides insights to improve military capabilities, such as exploring modern UAV military applications, technical updates in communication, navigation, and data acquisition systems, and the integration of emerging technologies like smart materials, artificial intelligence, and electric propulsion systems. This study provides valuable insights into the Ecuadorian UAVs that enhance the country's military operations and offers some applications and uses of this technology for national security [9]. The role and significance of artificial intelligence technologies in the military-technical sphere are determined. The principles of using artificial intelligence technologies in the activities of the armed forces are outlined. Attention is focused on the threats and risks posed by the use of artificial intelligence in the military technical sphere. The peculiarities of the legislative provision of the military use of artificial intelligence technologies in the USA are highlighted. Detailed aspects of the technological implementation of artificial intelligence during the execution of military tasks in the context of the American experience. The conceptual foundations of the Russian use of artificial intelligence technologies of military nature are revealed. The institutional capabilities and achievements of the Russian federation in the field of technological support of the needs of the army in the field of artificial intelligence have been determined. The scope and directions of the Russian army's innovative developments using artificial intelligence technologies are outlined. It has been updated that unmanned

systems are singled out as a special priority for the application of technologies in the field of artificial intelligence of the Russian Federation. The main global trends in the use of artificial intelligence technologies in the military sphere are revealed. Further directions for improving the field of military use of artificial intelligence technologies have been identified. It was concluded that the development, introduction, and approval by the world community of criteria for the responsible use of artificial intelligence for military purposes will contribute to the construction and formation of an international consensus on the responsible handling and use of artificial intelligence technologies. This article analyzes the use of artificial intelligence technologies in military systems. Various aspects of the use of artificial intelligence are discussed, including autonomous weapons systems, forecasting and analytics, cybersecurity, and strategic planning. The advantages and opportunities provided by the use of artificial intelligence in military formations are highlighted, and attention is also paid to the ethical and legal aspects of this issue. The article focuses on the importance of a balanced approach to the use of artificial intelligence technologies for military purposes, taking into account their capabilities and risks [11]. This paper highlights the remarkable advancements in the entire ecosystem of AI-associated technologies comprising machine learning, computer vision, natural language processing, robotics, brain-machine interfaces, etc., and their innovative usage in pioneering military technologies and strategies. This paper scrutinizes the unprecedented contingencies and challenges of AI application on three core facets of future defense, i.e., autonomous weaponry and warfare, intelligence, and national security. Several powers in the “geopolitical chessboard” have already begun to exploit AI for military applications like intelligence analysis, surveillance, autonomous weaponry, reconnaissance, and logistics. This will eventually propel AI to be the new dimension of military strength evaluation and a pivotal entity for national security. This paper predicts the future of military applications, their constraints and challenges, and also recommends the steps to be pursued by technologically fragile countries like Nepal to acclimatize with these AI-induced transformations. The research will follow a qualitative methodology to analyze AI development and its military incorporation, challenges, and prospects. The review of the published articles, opinions, commentaries, and findings worldwide on AI-driven innovations underscores the results. In sum, the research aims to discuss the future of military applications in light of the burgeoning ecosystem of AI [12]. The land military doctrine is changing with the new technology tools and their ability to influence operation planning and execution. In this regard, this paper aimed to illustrate the characteristics and primary technologies utilized in Logistics 4.0, focusing on using artificial intelligence (AI) as a predictive tool for military operations. The text shows the main aspects of Logistics 4.0, The Use of Artificial Intelligence in Logistics 4.0, Inventory Management with Artificial Intelligence, Machine Learning (Linear Regression and Decision Tree), The characteristics of logistics use in modern conflicts, and the application of AI in military operations logistics. In conclusion, some armed forces, like the US Army, have already used this tool in task prediction, medical support, driverless refueling operations, and data storage via cloud services. However, other prospects for optimizing logistics commanders’ planning remain unexplored. Artificial intelligence has tremendous potential in the military for optimizing the many approaches used in logistical planning, particularly concerning anticipating tasks and materials for operations [13]. The military operations planning is one of the major functions of military staffs. The increasing complexity of the contemporary operating environment requires a new approach to the understanding of the situation and realization of a viable plan. The aim of this paper is to scrutinize the potential usage of future artificial intelligence tools in the process of military operations planning. The main question is whether artificial intelligence in its current state can be applied in military operations planning. To answer this question, the paper provides a short overview of military operations planning, a summary of military-related artificial intelligence research and existing solutions, and then identifies criteria and fields of application for future artificial intelligence-driven tools. Analyzing the topic gives some insight into this possible way of increasing the effectiveness of the planning groups, thus contributing to finding more effective solutions for emerging complex and comprehensive problems [14]. This article reviews the relevant literature, reports, and representative incidents, which allows to construct a typology of the malicious use and abuse of systems with AI capabilities. The main objective is to clarify the types of activities and corresponding risks. Our starting point is to identify the vulnerabilities of AI models and outline how malicious actors can abuse them. Subsequently, we explore AI-enabled and AI-enhanced attacks. While we present a comprehensive overview, we do not aim for a conclusive and exhaustive classification. Rather, we provide an overview of the risks of enhanced AI applications that contributes to the growing body of knowledge on the issue. Specifically, we suggest four types of malicious abuse of AI (integrity attacks, unintended AI outcomes, algorithmic trading, membership inference attacks) and four types of malicious use of AI (social engineering, misinformation/fake news, hacking autonomous weapon systems). Mapping these threats enables advanced reflection of governance strategies, policies, and activities that can be developed or improved to minimize risks and avoid harmful consequences. Enhanced collaboration among governments, industries, and civil society actors is vital to increasing preparedness and resilience against malicious use and abuse of AI [15]. This paper aims to overview artificial intelligence and data applications in offensive and defensive military operations and provide various insights on them. It also provides the ways how artificial intelligence and data capabilities can be applied in the military field with various examples. The extensive research on artificial intelligence and data applications in offensive and defensive military operations was conducted across various platforms in order to get data with great integrity. There are also case studies for autonomous sentry guns and the Indian Ministry of Defense Annual Report, which give insight into the artificial intelligence and data concepts described in this research paper. The points in the

below paper act as the understanding through research of real-life applications of artificial intelligence and data in defense operations and act as the material to understand those specific points [16].

II. MILITARY APPLICATIONS OF AI AND THE BENEFITS OF ARTIFICIAL INTELLIGENCE IN THE MILITARY

1. Warfare Systems

Warfare systems such as weapons, sensors, navigation, aviation support, and surveillance can employ AI in order to make operations more efficient and less reliant on human input. This additional efficiency means that these systems may require less maintenance. Taking away the need for full human control of warfare systems reduces the impact of human error and frees up humans' bandwidth for other essential tasks. Specifically, regarding weapons, the Pentagon recently updated its autonomous weapons policy to take into account recent advances in AI. Since the policy's original creation in 2012, a number of technological leaps forward have been made that necessitated this update. The update provides guidance for the safe and ethical development and use of autonomous weapons, one of the most useful military applications of AI. In addition to reviewing and testing requirements, the policy creates a working group focused on autonomous weapons systems to advise the DoD.

2. Drone Swarms

One of the most exciting developments in developing military applications of AI involves leveraging swarm intelligence for drone operations. These swarms of drones are inherently much more effective than a singular drone for several reasons. When a drone receives vital information, it can act upon it or communicate it to other drones in the swarm. These swarms can be used in simulations as well as actual training operations and have the ability to make decisions in a variety of situations, with the swarm having an overarching objective but the individual drones having the ability to act independently and creatively towards it. AI-controlled swarms of drones are actually programmed to act in the same manner that swarms of insect's act in nature. For example, when a bee finds something that could benefit the rest of the hive, it will report that information in detail to other bees. The drones can do the same. They are able to communicate the distance, direction, and elevation of a target, as well as any potential dangers, just as a bee does. The ability to use AI-powered drone swarms to put this powerful collective intelligence to work towards military objectives represents a critical frontier in the military applications of AI.

3. Strategic Decision Making

One of the best benefits of artificial intelligence in the military is in an area where military commanders might feel hesitant to let AI contribute. That is helping with strategic decision-making. AI's algorithms are able to collect and process data from numerous different sources to aid in decision-making, especially in high-stress situations. In many circumstances, AI systems can quickly and efficiently analyze a situation and make the best decision in a critical situation. It is also able to neutralize prejudices that may come with human input, with the caveat that AI may not yet have a fully developed understanding of human ethical concerns, and there is a danger of AI learning from the biases that may exist in materials in its database. However, decision-making under pressure is a critical part of being a service member, and AI and humans can work together to make this process easier. The combination of humans' ethical understanding and AI's quick analytical abilities can speed up the decision-making process. Generative AI can contribute to the decision-making process in military settings. Rapidly sorting through large amounts of data, generative models can show connections, patterns, and potential implications that humans alone would take a longer time to find. This information can be presented to human decision makers not only as reports but also in a conversational format, facilitating human-AI collaboration. AI can also create simulations to test out possible scenarios, allowing for more informed decision-making. Upon receiving this information from AI, humans must fill in the gaps, using their understanding of ethical principles, national security interests, and situational nuances to create optimal outcomes. With close human supervision, generative AI has a lot of potential to enhance military leaders' strategic thinking. Among the considerations in implementing AI to assist decision-making include counteracting harmful biases, accounting for real-world conditions that may be beyond models' understanding, safeguarding classified data, not using AI as a replacement for human judgment, and ensuring alignment with regulations, ethics, and more. The key takeaway here is that the capabilities of AI for decision-making are those of assisting humans, rather than taking this function out of their hands.

4. Data Processing and Research

In many cases, processing large volumes of data can be extremely time-consuming, but AI's capabilities can really add value in this area. AI can be helpful for quickly filtering through data and selecting the most valuable information. It can also aid in grouping information from various datasets. This can allow military personnel to identify patterns more efficiently, draw more accurate conclusions, and create plans of action based on a more complete picture of the situation. Generative AI's analysis capabilities mean that it can find connections in large volumes of information that might escape humans' notice or can find them faster than a human would. Thanks to their NLP abilities, generative AI models can also communicate this information to humans in a conversational manner and engage in a dialogue to explain it. AI can also be used in order to filter through large amounts of content from news and social media outlets in order to aid in identifying new information. This allows analysts to save time when tasked with large quantities of content. AI systems can also eliminate repetitive information as well as

inaccurate information. This can optimize the research process, helping analysts finish a job faster and more accurately, as well as, again, reducing human error. Generative AI can speed up the analysis process when it's critical to understand information as quickly as possible. Models can bring order to chaos when handling massive datasets, uncovering connections between seemingly unrelated data points. This allows military leaders to formulate strategy based on a deeper understanding of conditions. AI can also rapidly generate and compare thousands of scenarios by making small changes to variables; by understanding a wide range of permutations of a problem or situation, military commanders can prepare for many contingencies. Furthermore, generative models can quickly compare intelligence with existing knowledge and research and make useful suggestions, enabling better predictions. Humans, rather than AI, will still need to make final strategic decisions due to their ability to take into account context that may elude AI. However, by collaborating with AI, military leaders can have a more detailed understanding of what is happening around them and what may happen in the future.

5. Combat Simulation and Training

Military training simulation software has been used in the U.S. Army for quite some time. It combines systems engineering, software engineering, and computer science in order to build digitized models that prepare soldiers with combat systems deployed during operations. In simpler terms, military training simulation software is essentially a virtual "wargame" that is used in order to train soldiers. This software can be used for just about anything from mathematical models to simulating strategies used in non-combatative environments. In turn, this will better prepare soldiers for real-life situations. These simulations are able to provide realistic missions and tasks to soldiers to ensure they gain the most experience possible before applying their skills to real-life situations. Generative AI can improve military training and educational programs. AI-powered language models can read training manuals and other sources and use them to create new training materials, including notes, quizzes, and study guides. AI can also help evaluate students' current abilities and tailor training to their specific needs. With NLP, generative AI can answer students' questions and explain concepts similar to the way that a human instructor would. By analyzing large amounts of intelligence data, records of previous combat experiences, and more, AI can craft more comprehensive training, including detailed military simulations. Conversational AI can also provide customized feedback to help students build their skills and help commanding officers know where a particular student may be struggling. While AI holds a lot of potential for military training applications, it should never entirely replace human instructors. To avoid issues like bias or misinformation, leadership should always review AI-generated materials and be in charge of the ultimate analysis of students' skills. Human instructors should determine the overall syllabus, while AI can craft individualized lessons that human instructors can then review for accuracy and other issues. However, with AI assistance, instructors can create and administer more effective training programs because of individualized attention to students that humans may not be able to always provide, and do so more quickly due to AI's processing speed [17].

III. CONCLUSION

Numerous developments in the application of artificial intelligence (AI) in the military sectors have been observed in this research. We've also talked about their most current technological developments in the military.

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CITATION

Abdulrahman Y. A., Umar F. M., Firuze AK, & Muhammad A. B. (2024). Applications of Artificial Intelligence in the Military and Its Advantages. In Global Journal of Research in Engineering & Computer Sciences (Vol. 4, Number 6, pp. 44–49). <https://doi.org/10.5281/zenodo.14056728>