

SYSTEMS WITH ARTIFICIAL INTELLIGENCE FOR DEFENSE AND SECURITY

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***Abstract:** To date, artificial intelligence systems are predicted to rapidly enter the defense and security sector. The importance of such automation systems is still under research, in order the qualitative and quantitative indicators for decision making to be improved. In such researches, real-time data analysis tools have to be used and their data exchanged. Common examples are surveillance drones, large amount of sensors and the connection to cloud computing. In the field of cybersecurity AI algorithms undergo continuous revolution. By the use of Artificial intelligence algorithms predictions are the key results for adequate and correct decisions. Huge amounts of data processing define the possibility to make right decisions in non-deterministic environments. In this review report an overview of the already used systems is made and benefits and risks of using artificial intelligence systems in defense and security is examined.*

***Keywords:** Artificial intelligence, defense and security, military weapons*

1. INTRODUCTION

AI technology in military science is applied in four primary domains, namely logistics, reconnaissance, the cyber domain, and electronic warfare. Advanced AI applications have already been implemented or are currently undergoing testing in the logistics, reconnaissance, and cyber domains [1]. In wartime, through the implementation of computational agents and artificial intelligence, the aim is to reduce the costs of servicing the army. Artificial Intelligence (AI) systems can be used in a variety of ways in the military and can provide significant advantages. Here are some of the examples of AI systems in the armed forces:

1) Threat detection: AI algorithms can be used to analyze large amounts of data in real-time, such as satellite imagery, radiolocation ISAR images [16] and social media data, to provide early warning of potential threats and identify patterns that may not be easily recognizable to humans.

2) Logistics and supply chain management: AI systems can be used to optimize logistical operations by predicting the best routes and supply schedules, and by automating tasks like inventory management and maintenance.

3) Remote operations: AI systems can be used to control unmanned vehicles, such as drones and ground robots, to perform a wide range of functions such as reconnaissance, surveillance, targeted strikes and logistics.

4) Cybersecurity: AI-powered cybersecurity systems can detect and respond to threats in real-time, protecting sensitive military data and networks from cyberattacks.

5) Training and simulations: AI can be used to create realistic virtual simulations that help soldiers train for different battle scenarios in a safe and controlled environment.

- 6) Smart weapons that use AI to increase accuracy and targeting capabilities.
- 7) Autonomous ground vehicles (AGVs), like unmanned vehicles, can perform a variety of tasks, some of which are: logistics and transportation, search and rescue.
- 8) Predictive analytics programs that use AI to analyze large amounts of data to identify patterns and make predictions about future events.

Artificial intelligence machines and agents in particular are programmed to assist soldiers both in an attack and in the event of insecurity (Fig.1) [2]. AI agents are influenced by paralinguistic, demographic, visual and physiological factors. Through acoustic (paralinguistic) improvements to the robots, it is aimed to accurately and clearly convey the information that is necessary for the successful completion of military operations. The interaction between agents and people is determined by demographic factors. Through physical characteristics such as gender and age, the smart agents assess the soldier's reaction and make a decision how they can cooperate with it. By using computer vision, agents recognize patterns, but the information provided is not the most accurate and correct due to various circumstances on the battlefield, such as noise disturbances caused by explosions and gunfire (visual factors). Training the machine with AI allows monitoring the emotional state of the soldier and, if necessary, taking the actions needed, while physiological factors play an important role.



Fig. 1 A theoretical agent reacting to uncertainty in a soldier-agent mission [2]

2. WEAPON SYSTEMS WITH AI IN THE ARMY

Regarding autonomous, weapon systems can be broadly categorized into three tiers:

- 1) Partially automated weapon systems (human in the loop).

A weapon system, once activated, is designed with the sole purpose of engaging individual targets or specific target groups that have been deliberately selected by a human operator [7]. Some of them are: Black Hornet, Samsung SGR-1, LRASM.

- 2) Human-monitored intelligent weapon systems (human on the loop).

The term “autonomous” is commonly utilized by engineers to denote systems that operate independently without direct human intervention. In the military, some of the systems are highly automated, but are not yet classified as fully autonomous as they operate under the supervision and direct control of humans. Additionally, even though equipped with weaponry that possesses certain automated functionalities, such as laser-guided missiles and GPS-guided bombs, these systems still depend on human operators to directly control and make all decisions regarding targeting and firing [8].

Examples of weapon systems that fall into the “human in the loop” category include Israel's Carmel tanks and Aegis combat system, as well as missile defense systems such as the Patriot and Iron Dome systems.

3) Weapon systems that operate fully autonomously, without the need for human intervention or oversight (removing humans from the decision-making process).

As of now, no military utilizes fully autonomous weapons systems. The concept of a fully autonomous war is currently only a dystopian vision within the realm of AI-assisted warfare. [1].

There are a number of AI systems successfully integrated into the military. Some of them are:

Black Hornet Nano – it is a small unmanned aerial vehicle created by Prox Dynamics AS in Norway. It is utilized by the armed forces of multiple countries including Norway, the United States, France, the United Kingdom, Germany, Ireland, Australia, the Netherlands, Poland, New Zealand, India, Turkey, South Africa, and Algeria. The drones have dimensions of approximately 16×2.5 cm and offer ground troops with immediate situational awareness in their immediate surroundings. They are compact enough to be held in one hand and weigh 18 g with batteries. The UAV is outfitted with a camera that provides the operator with both video footage and still images [3]. Drones have proven to be highly valuable assets in Ukraine, particularly in reconnaissance missions and the gathering of data for artillery purposes [4].

Samsung SGR-1 – It is a semi-autonomous weapon system that patrols the border between North and South Korea. SGR-1 detect and target but requires a human operator to approve the kill shot [9]. The Samsung SGR-1 incorporates advanced heat and motion detection technology, enabling it to identify potential targets at distances exceeding 2 miles. Equipped with a 5.5 mm machine gun and a 40 mm grenade launcher, the SGR-1 is capable of engaging and neutralizing these identified targets effectively [10].

LRASM – A mobile missile launcher whose targets are selected, modeled and programmed before launch by human operators. LRASM (Long Range Anti-Ship Missile) is specifically engineered to detect and eliminate high-priority targets present within groups of ships, even in challenging electronic warfare jamming conditions. It possesses the capability to engage and neutralize these targets from extended distances. The LRASM is directed at enemy ships up to 200 nautical miles from its launch aircraft. This missile system receives new information through a data link and on-board sensors.

Israel's Carmel tanks are equipped with smartphone-sized AI. The Carmel is a manned vehicle that incorporates a significant level of automation, utilizing Artificial Intelligence to oversee numerous functions of the tank. Weighing thirty-five tons and equipped with tracks, the Carmel requires a crew of two to operate effectively [6]. Carmel collects data from infrared and radar sensors and uses them to determine the location of enemy fighters located in trenches hidden underground on the battlefield. The data obtained is transmitted to the commanding officer and under his control, it is processed in order to prepare a battle plan using the best methods of attacking each of the targets.

Aegis Combat System (ACS) – AEGIS is an advanced system that detects, tracks and destroys enemy targets through advanced radars, automatic detection and tracking, a versatile multifunctional radar system with a phased array antenna and powerful computers. Through specialized radars, the system tracks more than 100 concurrent objectives. The central component of the Aegis combat system is the automated directive and choice module. This interface empowers the Aegis combat system to execute concurrent operations against various threats involving multiple missions, encompassing air defense, surface attack, and submarine defense [12].

Patriot is a surface-to-air missile (SAM) system that include a command center, a phased array radar station, power generation equipment, computers and up to eight launchers, each containing four ready-to-fire missiles [14]. The Patriot system covers an area of around 68 kilometers. Its radar can track up to 50 targets and engage five of them at once. Depending on the version in use, the interceptor missiles can reach an altitude of more than 24 kilometers and hit targets up to 160 kilometers away. Each unit requires about 90 troops to operate [13], with only three soldiers sufficient during combat.

Iron Dome weapon systems detect, evaluate and intercept a variety of short-range targets such as: missiles, artillery and mortars. These systems are designed for utilization round the clock and irrespective of atmospheric conditions. The Iron Dome features a multi-purpose launcher designed to fire a variety of interceptor missiles. Iron Dome's Tamir missile takes down incoming threats fired from ranges of 4-70 km. Tamir missiles have electro-optical sensors and guidance vanes with high-explosive warheads [15].

3. BENEFITS AND RISKS OF USING ARTIFICIAL INTELLIGENCE IN DEFENSE AND SECURITY

There are several benefits of using artificial intelligence in defense and security, including:

1)Enhanced surveillance: AI can help in monitoring and analyzing vast amounts of data coming from various sources such as satellites, drones, and surveillance cameras. This can help identify potential security threats and predict criminal activities.

2)Improved threat detection: AI algorithms can be trained to detect an array of threats such as unauthorized access, malware, and other cyberattacks, which can be tough for traditional security systems to detect.

3)Real-time decision-making: With AI, commanders can get real-time insights and situational awareness that enables them to make informed decisions faster.

4)Cost savings: By automating certain tasks and reducing manual labor, AI can help reduce the operating costs of a security system.

5)Enhanced defense capabilities: AI can help in the development of advanced weapons systems and technologies such as autonomous vehicles and drones, making defense and response more efficient and effective.

As with any technology, there are also potential risks of using artificial intelligence in defense and security. These risks include:

1)Dependence on technology: There is a risk of over-reliance on AI, resulting in potentially catastrophic consequences if the technology fails, or produces incorrect results.

2)Bias and discrimination: AI systems are trained based on data, and if that data contains bias, the system may produce biased results. This could contribute to, for example, discrimination in the selection of potential security threats.

3)Increased vulnerability: AI systems can become targets for attacks from hackers and cybercriminals, who may exploit flaws in the system's design or programming to conduct their activities.

4)Lack of transparency: Numerous AI systems exhibit intricacy and opaqueness, making it challenging to comprehend their result-generation mechanisms. This absence of clarity can have detrimental consequences as it creates a breeding ground for errors and malicious activities to go unnoticed.

5) Ethical considerations: The use of AI in defense and security raises ethical considerations, such as the potential for autonomous weapons, which raises concerns about accountability and the need for human control.

CONCLUSIONS

AI is a powerful tool in defense and security, providing improved situational awareness and threat detection capabilities with the ultimate goal of improving the country's national security. Although AI has enormous potential in defense and security, it is necessary to consider both the benefits and risks when developing and deploying these systems. Adequate oversight and transparency are needed to minimize AI risks in defense and security. AI has significant potential benefits in military applications, as well as several considerations for ethical and legal use of AI in the military, including accountability and oversight for autonomous systems, potential for bias, and ensuring compliance with international laws of warfare, and lastly – own security risk precised. The battlefield is an extremely dangerous place, and AI can mitigate some of the threats that the military personnel faces. A prime example of how AI keeps soldiers safer during combat is identifying hazards more quickly, and providing soldiers' guidance on how to deal with potential hazards. Today's ground vehicles and military aircrafts have intelligent sensors, radars and advanced computing, which is of great benefit to the military as it reduces the risk to human life, but future algorithms development is inevitable for evolution proceeding.

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