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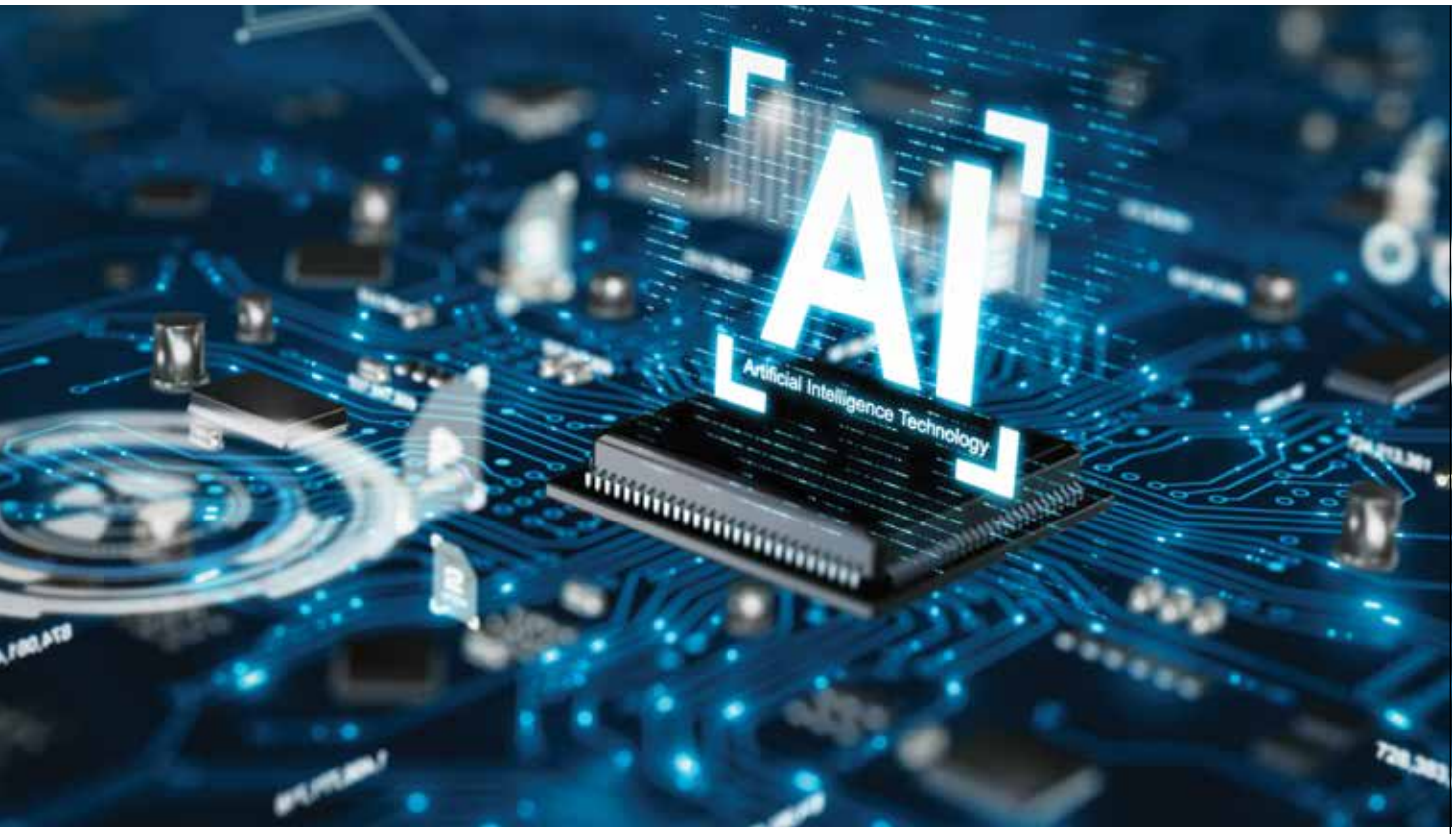

ARTIFICIAL INTELLIGENCE - MODERN WEAPON DEVELOPMENT

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Artificial intelligence (AI) is being increasingly utilised in developing modern weapon systems. The ability of AI to process large amounts of data, make decisions, and take actions autonomously is providing new capabilities and advantages in military operations. This article intends to explore several ways in which AI is being used to develop modern weapon systems.

AI Sufficiency

The application of Artificial Intelligence (AI) has played a significant role in enhancing the levels of autonomy of unmanned systems for military applications. The integration of AI algorithms has allowed unmanned systems to operate more independently, reducing the need for human intervention and increasing their efficiency, accuracy, and safety.

Levels of autonomy in unmanned systems refer to the extent to

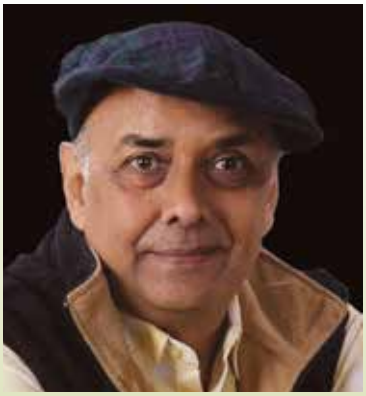
which an unmanned system can operate and perform tasks independently, without human intervention. It describes the degree of independence that an unmanned system has in making decisions and carrying out operations. The levels of autonomy in unmanned systems range from completely manual systems that require human control to fully autonomous systems that can operate independently without any human input. In between these two extremes, there are various levels of autonomy, such as semi-autonomous systems that require some human input, and supervisory control systems that allow for human oversight.

The 'level of autonomy' debate has received a fair amount of attention, Bruce T. Clough, of the US Air Force Research Laboratory had defined 11 Automatic Control Levels. A NATO working group had defined four levels for UAVs in their report, "Pre-feasibility Study on UAV Autonomous Operations", in 2004. Interestingly, however, in 2012, the US Defense Science Board (DSB) Task Force on the 'Role of Autonomy in Department of Defense (DoD) Systems', opined that unmanned systems were controlled by humans at some level; further, the design of the software was also done in a manner that limited the actions and decisions of the unmanned systems. In fact, the DSB recommended that "The DoD should abandon the debate over definitions of levels of autonomy and embrace a three-facet (cognitive echelon, mission timelines, human-machine system trade spaces) autonomous systems framework."

AI-controlled weapon systems operate for **prolonged durations,** providing a significant advantage in **coverage and persistence**

US Naval Research Lab.

AI-controlled drones can be programmed to fly to specific locations, take pictures or videos, and even drop bombs or launch missiles. This allows for the deployment of weapon systems



REAR ADMIRAL (RETD.) DR S KULSHRESTHA

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Patriot air defence system.

These weapons have raised significant **ethical and moral concerns**, as they **blur the lines** between **human and machine** decision-making

without the need for human pilots, which is useful in situations where human decision-making may be slow or prone to errors, such as in fast-moving battlefield environments. AI-controlled weapon systems operate for prolonged durations, providing a significant advantage in coverage and persistence.

Weapon systems are now being designed with intelligent targeting systems. These systems use AI algorithms to analyse data from various sensors and cameras, such as infrared and radar, to identify and track targets. This allows for more accurate and efficient targeting, which can help to reduce the risk of civilian casualties and collateral damage. For example, AI-controlled weapon systems can be programmed to distinguish between military and civilian targets, which can help to minimise the risk of harming non-combatants.

Advanced control systems are being developed using AI for use in weapon systems, such as those found in tanks, ships, and aircraft. These control systems use AI algorithms to process sensor data and decide how to move and manoeuvre the vehicle. This can help improve the weapon system's speed and agility, which can be critical in fast-paced and dynamic battlefield environments. For example, an AI-controlled tank can be programmed to avoid obstacles, which can help to increase its mobility and reduce the risk of damage.

Another application of AI is in advanced decision-making and command and control systems, which can manage many weapon systems in real-time. These systems use AI algorithms to analyse data from multiple sources, such as satellite imagery, weather forecasts, and battlefield reports, to decide how to coordinate best and deploy weapon systems. This can help improve the efficiency and effectiveness of military operations and reduce the risk of friendly fire and other accidents.

In addition, AI is now being used to develop new materials and manufacturing processes for weapon systems. As an illustration, AI algorithms can be used to analyse data from

Defence Minister Rajnath Singh released a book and an e-book on 75 AI products launched during the 'Artificial Intelligence in Defence' exhibition and symposium in New Delhi on 11 July 2022.

simulations and testing to optimise the design of new materials and manufacturing processes. This can help improve weapon systems' performance, reliability, and cost-effectiveness.

Strides By India

The first AiDef symposium and exhibition, organised by the Ministry of Defence's Department of Defence Production, took place in New Delhi on 11 July 2022. The event featured an exhibition of innovative AI solutions developed by the military, research organisations, industry, start-ups, and innovators, as well as the launch of AI products for market use. These products covered automation, unmanned systems, robotics, cyber security, human behaviour analysis, intelligent monitoring, logistics and supply chain management, speech / voice analysis, C4ISR systems and operational data analytics. Some of the featured products include the following *(Source: Document AiDef - Artificial Intelligence in Defence, released by MOD Government of India, July 2022)*:

- Deep Edge AI Vision Platform has applications in Drone Detection and Intrusion Detection.
- iSentinel- Intelligent Automated Threat Tracking and Identification System: It provides a solution for the safety and security of high-value assets.
- System of Disseminated Parallel Control Computing in Real Time (DPCC): It is being utilised in defence products like See Thru Armour (STA), loitering munitions, heavy lift UAVs, UGVs, and Vision-based Anti-Drone systems.
- The Sapper Scout is a mine-detection UGV capable of detecting and marking mines.
- AI Capability in Swarm Drones: The algorithms in the system can communicate to work together as a swarm and achieve a common objective. These algorithms are capable of finding the shortest path, forming patterns, and conducting collective searches over a large area. Each drone is equipped with distributed collision avoidance algorithms that dynamically adjust its path to avoid future collisions with other drones. The system's target detection and identification algorithms can accurately identify small targets, vehicles, and structures from high altitudes and long distances, distinguishing between equipment, humans, animals,

Soldiers push a Bayraktar TB2 UCAV at the Kulbakyne aerodrome during the Exercise Sea Breeze 2021 in Mykolaiv, Ukraine.

The **Drone Feed Analysis** system is a real-time / **post-flight** military object identification system using **AI deep learning**

and other objects. Based on the target classification, the algorithms may also recommend action to neutralise potential threats to the operator.

The Drone Feed Analysis system is a real-time / post-flight military object identification system using AI deep learning. It identifies military objects from feeds from remotely piloted aircraft such as Searcher and Heron. The system creates a database and performs AI-based analysis to provide a military analysis of enemy operations and event prediction.

- The Autonomous Fast Intercept Boat AFIB: The AFIB is an indigenous platform developed in collaboration with BEL, equipped with advanced software and algorithms to perform autonomous operations at speeds up to 25NM. It is India's first AI-based flagship product in the marine segment and is capable of operating autonomously even in dense maritime traffic and shallow waters. The AFIB is equipped with navigation sensors like a high-resolution HR/IR camera, high-end X-band radar, Lidar, 200 KHz Chirp-based eco-sounder, maritime communication set with a range of 30 km, and an onboard PC with software for AFIB navigation.

The ECARS UGV is a versatile, multi-terrain modular platform. Its perception and navigation modules are AI-powered, allowing the vehicle to traverse multiple terrains. The modular design enables customisation for unmanned control and safe operation, enabling forces to undertake critical missions with reduced risk of casualties.

Russia-Ukraine War

The use of unmanned vehicles and loitering munitions in the Ukraine-Russia War has been widespread. Although, the vast majority of these systems are operated remotely by humans. Despite the advertised capabilities of Switchblades, Sahed-136s, Turkish- Bayraktar TB2 (The Russian Warship Moskva was sunk in the Black Sea using a Bayraktar drone), and the Orlan 10, the level of autonomy of these systems does not match the concept of autonomous "killer robots". Most of these systems are equipped with basic autonomous functions such as take-off, landing, and navigation, However, they cannot autonomously select, or engage a target.

One of the most prominent examples of using AI for battlefield information processing is by the American company, Primer. It is understood from media reports that the company has collaborated with Ukrainian forces in gathering, processing, analysing, transcribing, and translating unencrypted Russian military communications.

The next category of AI applications reported pertains to facial recognition. There are several examples of its use with some reports from Ukrainian government agencies claiming the implementation or experimentation of the technology for identifying individuals who are not authorised to be in the country. This combines border control and counter-intelligence operations. However, the extent of its utilisation is uncertain and

The Ukrainian military is expending far more ammunition than can be replaced as it duels with Russia in a large artillery battle along the front.

the feasibility of such capabilities, particularly in a country experiencing conflict and high levels of displacement, remains questionable.

A company named Clearview AI has reportedly supplied the Ukrainian forces with the capability to recognise deceased Russian troops captured by Ukraine. The Ukrainian forces then matched the captured troops to their social media accounts and used this information to reach out to the families and relatives of the Russian soldiers. The use of this technology and its potential consequences are uncertain.

The Ukrainian forces have been using an AI-enabled program which is able to identify Russian military equipment even though it may be covered with mud or snow. Ukrainian forces are also using big data algorithms for decision-making, data processing, analyses and selecting targets. It is said that US firm Palantir has supplied the said software. Some other AI-enabled US programs reported to be in use in the Russian-Ukraine War include Maven and Space Know. Project Maven is a US Department of Defense initiative that utilises machine learning and engineering expertise to identify individuals and objects in drone footage. This enables the government to have real-time command and control on the battlefield, and monitor, label, and carryout surveillance on targets without human intervention. Space Know specialises in providing actionable intelligence utilising machine language, advanced statistics and satellite imagery.

Slaughterbots

Lethal Autonomous Weapon Systems (LAWS) are weapons that use AI for identifying, selecting and engaging targets without human intervention after their launch. It is said that LAWS have been used in Libya in 2021 and in Gaza in 2022. These weapons have raised significant ethical and moral concerns, as they blur the lines between human and machine decision-making and could result in unintended harm or suffering.

There is an ongoing debate among international organisations, governments, and the general public about the use of LAWS, with some calling for a ban on their development and deployment. It is important for responsible and transparent regulation to be established to ensure the safe and ethical use of these technologies.

Conclusion

From the foregoing, it is apparent that AI is getting entrenched in modern weapon systems in more ways than it can be imagined today, probably a new era of 'lethal cyber weapons' is yet to dawn. However, it is important to note that using AI in weapon systems raises several ethical and legal concerns. For example, there are concerns about the accountability of autonomous weapon systems in the event of an accident or malfunction. Additionally, there are concerns about using AI-controlled weapon systems in situations where human decision-making may be more appropriate, such as in cases where there is a high risk of civilian casualties. DSA