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Military Applications of Artificial Intelligence: Impact on Warfare

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Abstract

Artificial Intelligence (AI) has surfaced as a potent enabler that has penetrated all areas of human life. Given its profound efficiency and inspired by the postulates of realism, this dual-use enabler is now being integrated into the military sector at a fast pace by policymakers worldwide. The increasing autonomy and speed of decision-making associated with AI is bound to impact future warfare in novel ways. This paper examines the use of AI across various military domains, including Intelligence, Surveillance Reconnaissance (ISR), Command and Control (C2), Autonomous Weapon Systems (AWS) / Lethal Autonomous Weapon Systems (LAWS), cyber defence / offence, military planning, training, and logistics. It also explores the numerous opportunities and potential risks that AI can steer vis-a-vis warfare. Noting the dynamic nature of AI, the paper also discusses Pakistan's status in this field.

Keywords: Military, AI, Algorithms, Warfare.

Introduction

New technologies are swiftly making their way into the battlefield and have the potential to impact future warfare. Artificial Intelligence (AI) is one such emerging enabler which has extended its scope in diverse areas. Defining AI is quite difficult, and experts have not reached a consensus on any particular definition. An elementary way to explain it would be to programme machines in a way that their cognitive ability simulates human intelligence, enabling them to perform a variety of tasks. AI-enabled systems are capable of learning and predicting future scenarios through processing large amounts of data. The algorithms which process the given data act as analytical models to programme the systems in the most optimal way and learn from their experiences over time. This continuous learning allows better utilisation of the available information and execution of the most rationale decision/action according to the given context.[1] Hence, it is a technology which is forward-looking and increases efficiency in terms of performance of various tasks and decision-making as well.

The research on AI commenced in 1940[2] yet a notable burgeoning effect was witnessed after 2010 given the availability of more data, better machine learning and faster computer processing power. This technology has especially attracted military policymakers around the world. Russia's President Putin declared that 'Whoever leads in AI will rule the world'[3] akin to Alfred Thayer Mahan's assertion that whoever controls the waves will rule the world.

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1 Ziyad Muhammed, "Artificial Intelligence Definition, Ethics and Standards," (paper, The British University in Egypt, Cairo, 2019).

2 Keith D. Foote, "A Brief History of Artificial Intelligence," *Dataversity*, April 5, 2016, https://www.dataversity.net/brief-history-artificial-intelligence/.

3 David Meyer, "Vladimir Putin says Whoever Leads in Artificial Intelligence Will Rule the World," *Fortune*, September 4, 2017.

AI is being termed as the third revolution in military affairs followed by nuclear weapons and gun powder, respectively.[4] The blinding efficiency of this technology has now pushed major powers to employ it in the military sector. Currently, the United States of America (USA) and China are leading this race and are engaged in serious competition in this technology. Experts such as Elon Musk have repeatedly termed AI more dangerous than nuclear weapons and argued that states should avoid applying this unpredictable technology in weapons, stressing serious concerns over its lethal nature. However, defence forces are inclined to augment their strength with the aid of this technology.

The militarisation of AI is not entirely new yet with the passage of time, the level of human involvement in the latest weaponry is decreasing rapidly with machines becoming more autonomous and less reliant on humans.[5] AI is applicable in almost every military technology and experts are bent on gaining better funding in order to chalk out avenues and potential applications where it can strengthen the military domain.

As of now, around 20 countries have developed AI policies with prospects of more joining the race. AI is becoming a central element of modern warfare with the emergence of new applications and increasing level of sophistication.

Military Applications of AI

AI has emerged as a dual-use technology - applicable both in the civil and military sector. Militarisation of AI has widely been associated with Lethal Autonomous Weapon Systems (LAWS) -

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4 Samuel Gibbs, "Elon Musk leads 116 Experts calling for Outright ban of Killer Robots," *Guardian*, August 20, 2017, https://www.theguardian.com/technology/2017/aug/20/elon-musk-killer-robots-experts-outright-ban-lethal-autonomous-weapons-war.

5 Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (New York : W.W Norton, 2018), 11.

more often referred to as 'Killer Robots.' However, AI is applicable across a wide spectrum whereas LAWS constitute only one aspect of the applications of AI in armed forces.

AI is rapidly bringing changes to the battlefield at both the micro and macro levels. Not only can it aid soldiers in the battlefield, but it can also streamline war planning and logistics. It is important to understand that AI is not a technology in itself rather it is an enabler which will add to the capabilities of existing technologies to make them more efficient. Hence, its application can be three-fold: It can bring autonomy to various systems, generate new and advanced techniques involved in warfare, and interpret/ process available information for further action. [6] Some of the areas where AI can be employed in the armed forces are discussed in the following sections.

Intelligence, Surveillance and Reconnaissance (ISR)

ISR is one of the most important areas where AI can effectively and efficiently help the armed forces. The ability to collect data through drones and sensors can provide large amounts of important information to support a wide range of military activities. Moreover, militaries have to process large volumes of data for surveillance which requires considerable time and effort. Between 2001 and 2011, data gathered by drones increased by 1600 percent.[7] Machine processing algorithms integrated with computer vision can process large volumes of data in unexpectedly small time thereby discerning important threats and targets making surveillance tasks easier for defence forces. Due to bandwidth limitations, some of the data can be analysed on ISR platforms

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[6] Michael C. Horowitz, "Artificial Intelligence, International Competition and Balance of Power," *The Scholar* 1, no. 3 (2018): 41, https://repositories.lib.utexas.edu/bitstream/handle/2152/65638/TNSR-Vol-1-Iss-3_Horowitz.pdf?sequence=2&isAllowed=y.

[7] Thom Shanker, "In New Military, Data Overload Can Be Deadly", *New York Times*, January 16, 2011, https://www.nytimes.com/2011/01/17/technology/17brain.html.

deployed in the battlefield, while more sensitive data can be analysed at intelligence processing centres.

The data, which is now available in the form of information, is then used to derive the picture of what is happening on the battleground. It is then further used for decision-making at the military commander's end. Once the potential response is ready to be executed, the role of ISR once again comes into play. The AI-enabled sensors provide the commander with the location and other necessary details of their targets. In addition, the data regarding the presence of any threat is also relayed back to the commander to ensure operational success.[8] This way AI tremendously aids ISR in outmanoeuvring an adversary.

At present, differing data processing mechanisms and data synchronisation obstructs ideal communication between air and ground forces. Alternatively, AI-enabled software can process large amounts of data and categorise it according to the requirement of the recipient which would enable different units of military to receive the information without any delays.[9]

Machine learning systems can create normalcy patterns based on data which is trained overtime. These normalcy patterns take into consideration various factors, such as speed, direction, and movement of different weaponry stationed in sea, land, and air. Whenever a deviation is observed from the standard pattern, the behaviour can be detected and relayed for further action. Automatic Identification System (AIS), Fuzzy Adaptive Resonance Theory

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[8] Nishawn S. Smagh, *Intelligence Surveillance and Reconnaissance Design for Great Power Competition*, report (Washington, D.C.: Congressional Research Service, 2020), 15.

[9] Eaton Joshua, "An Emerging Capability: Military Applications of Artificial Intelligence and Machine Learning," *Small Wars Journal* (2019): 12, https://smallwarsjournal.com/jrnl/art/emerging-capability-military-applications-artificial-intelligence-and-machine-learning.

(ARTMAP) neural network, Gaussian Mixture Model (GMM), Kernel Density[10] are some of the systems which are autonomous and being used for surveillance in order to detect any suspicious activity. Hence, AI will expedite the process of sifting available data which allows it to get hold of information which is critical.[11]

Command and Control (C2)

Militaries around the world rely on C2 structures to operate smoothly. These refer to the exercise of authority and direction for the accomplishment of a given operation. By taking help of AI-enabled systems, these structures can meet their intermediate, mid-term and far-term needs.[12] Intermediate needs refer to data which is provided for a respective operation. Mid-term needs refer to the dynamic planning and coordination which is done by the AI systems. AI could also help C2 in meeting its far-term needs, i.e., centralised control with a decentralised execution.

Armed forces can employ AI in C2 to have better defence organisation. A Multi-Domain Command and Control (MDC2) is already being planned by the US forces.[13] Such systems aim to chalk out an integrated network where sea, land, air and space-

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[10] Peter Svenmarck, "Possibilities and Challenges for Artificial Intelligence in Military Applications," *Swedish Defence Research Agency* (2018): 3.

[11] Jack Corrigan, "Three-Star General Wants AI in Every New Weapon System," *Defence One*, November 3, 2017, https://www.defenseone.com/technology/2017/11/three-star-general-wants-artificial-intelligence-every-new-weapon-system/142239/.

[12] Matthew Walsh, Lance Menthe, Edward Geist, Eric Hastings, Joshua Kerrigan, Jasmin Leveille, Joshua Margolis, Nicholas Martin, and Brian P. Donnelly, *Exploring the Feasibility and Utility of Machine Learning-Assisted Command and Control: Volume 1, Findings and Recommendations*, report (Santa Monica: RAND Corporation, 2021), https://www.rand.org/pubs/research_reports/RRA263-1.

[13] Kelly M. Saylor, *Artificial Intelligence and National Security*, report (Washington, D.C.: Congressional Research Service, 2021).

based operations are centrally planned and well-integrated together. Currently, there are diverse platforms which provide the military leadership with the information which is critically assessed by the decision-makers for possible action.[14] For the future battlefield, a 'Common Operating Picture' is being envisioned which will act as single source of information providing a comprehensive picture of the events of the battlefield based on the information collected through different sensors, thereby enabling seamless integration. Although MDC2 is still in infancy yet the US Air Force is collaborating with a number of companies, including Lockheed Martin, in order to have this capacity for the purpose of which a series of war games were held in 2018 to further plan requirements in this regard.[15]

In the future, communication patterns will also benefit from AI-enabled programmes. AI can introduce alternate modes of sending information in scenarios where communication networks have been disrupted by the adversaries. Apart from sifting incoming information, AI algorithms are also capable of providing military commanders on the battlefield, several possible options for execution, taking into account real-time analysis of any given scenario. All these measures will streamline C2 for military commanders.

[14] Theresa Hitchens, "Air Force Expands 5G as it Transforms to Multi-Domain Ops: Donovan," *Breaking Defence*, September 4, 2019, https://breakingdefense.com/2019/09/air-force-expands-5g-as-it-transforms-to-multi-domain-opsdonovan/.

[15] Mark Pomerlau, "How Industry's Helping the US Air Force with Multi-Domain Command and Control," *Defence News,* September 25, 2017, https://www.defensenews.com/c2-comms/2017/09/25/industry-pitches-in-to-help-air-forcewith-multi-domain-command-and-control.

Autonomous Weapon Systems (AWS) / Lethal Autonomous Weapon Systems (LAWS)

Armed forces can incorporate AI in a wide range of their existing weapons such as aircraft, naval vessels, air-defence systems, tanks, and other military equipment. It can also be integrated into systems and software, such as radars in order to make them more efficient. Likewise, AI can also be employed in weaponry which can be used for supporting missions such as the 'Loyal Wingman' which is used for aircraft combat support missions.

On the other hand, AI is also a critical element in the development of LAWS, which are systems equipped with the capability to independently discern and engage their targets without any command from human beings.[16] There is a clear shift in warfare which is marked by its transition from automated weapons to autonomous weapons.[17]

It is important to differentiate between the concept of 'automation' and 'autonomy' to understand the applications and implication of AI. When military leaders assign a specific command to a machine, they delegate a certain amount of authority to that machine. If the level of authority is high, the system is autonomous.[18] AWS execute their decision based on reasoning, perception, and rationale, thereby, chalking out an optimal output. On the other hand, decision-making abilities of automated systems depend on pre-defined sets of inputs which do not have any cognitive capability, they execute what they are programmed to do which suggests that they have less authority in each mission/programme. The

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16 Ronald Arkin, "Lethal Autonomous Systems and the Plight of the Non-combatant," *AISB Quarterly* (2013): 1.

17 Ibid.

18 Forrest E. Morgan, Benjamin Boudreaux, Andrew J. Lohn, Mark Ashby, et al., *Military Applications of Artificial Intelligence: Ethical Concerns in an Uncertain World*, report (Santa Monica: RAND Corporation, 2020), https://www.rand.org/pubs/research_reports/RR3139-1.html.

development of LAWS will gradually replace 'automation' with 'autonomy'.

Militaries aim to enhance their precision strikes through LAWS which can be deployed in various land, air , sea, and space-based platforms.The decision-making aspect of a LAW is highly debated. Technology experts have repeatedly emphasised that these 'killer robots' should not be given the autonomy of initiating an attack as they can precipitate undesirable results. However, major powers particularly, the US and China are all set to bring such systems into the battlefield.

Cyber Defence and Offence

The threat from cyber warfare is a persistent one and is likely to grow in the future. Protecting data from the malicious activities is crucial to protect the integrity and confidentiality of important information from potential attacks. Due to this, the vulnerability of computers and software is increasing since traditional methods of detecting cyber-attacks is not adequate to detect their evolving forms.

Militaries around the world are prone and subjected to attacks from their adversaries. Apart from the systems/data damage done through such attacks, the armed forces are also encountered with major attribution challenges. In order to deal with this issue, military policymakers are looking towards AI as it can be a major tool to avert such attacks noting that data, software and programmes protected with AI are relatively less prone to cyber-attacks. AI can record the pattern of cyber-attacks and through machine learning, it can find ways in order to develop measures to execute counter-strikes against those attacks in order to avert the exposure of important data. An Intrusion-Detection System (IDS) can effectively distinguish between normal data and intrusive data to avert the disruption of crucial data.

The most popular technique to detect intrusive data is the signature-based technique. This method employs AI to recognise

malware and cyber-attacks. Systems are fed with malware signatures (byte sequence of a code) of different known malwares.[19] This database uses the available signatures to identify a potential malware and prevent it from penetrating further into the system. While it is true that such methods are less effective against malwares which are new, there is considerable effort being done in this regard to train the systems in a manner that enables them to record patterns and use machine learning to identify new forms of malwares on their own.

Likewise, for some states, this might function as a robust tool to carry out offensive attacks in the cyber domain against their adversary noting that cyber is one of the avenues which is quite vulnerable. The success of the attack will depend on the defensive systems. It is likely that this might lead to a contest between AI-enabled offensive cyber-attacks versus AI-enabled defensive cyber-attacks. The side which will employ the 'enable' more smartly will prevail in such scenarios. Hence, both offensive and defensive capabilities of AI, in the cyber domain, are likely to be used by states.

Planning and Training

AI will be instrumental in providing military leadership, from an infantry soldier to the top general, the required planning and training. It can provide a better overview of how to plan missions effectively that improve accuracy, reduce manpower, expenditure, and most importantly, save the time that is invested when everything relies on human beings. Machine learning can play a paramount role in offering armed forces with more secure networks, making them less vulnerable. Likewise, militaries can also benefit from AI by forecasting component failure at an early stage. Cross-referencing and automatic co-relational analysis can

[19] Kirti Raj Bhatele, Harsh Shrivastava and Neha Kumari, "The Role of Artificial Intelligence in Cyber Security," in *Countering Cyber Attacks and Preserving the Integrity and Availability of Critical Systems* (Pennsylvania: IGI Global, 2019), 181.

assist in the detection of any faults and anomalies. Furthermore, threats can be detected via sensor data. Analysing all this data, decision-makers can come up with more pragmatic conclusions. Even though absolute delegation of planning will not be regulated by AI-enabled systems, they will provide soldiers the larger picture of the battlefield.

AI systems can also be utilised in the training of armed forces. Individual capabilities and learning styles can be considered, making the learning more personalised. They will also enable commanders to choose the best people for a given operation in a potential conflict. Machine learning systems can take into account various factors fed into the data sets and provide analytical models to military commanders to make decisions that will be beneficial for combat. Factors such as soldier's performance over time, his/her skills, personality traits, ability to work under pressure, strength and weaknesses can be drawn up against specific requirements of a mission.[20] Simultaneous analysis of all these factors could enable selection of the best officers for a given operation.

Moreover, AI, based on its cognitive capability, could also decide postings and promotions of officers using programmes which analyse an officer's capabilities, learning experiences and performance in order to come up with the most suitable posting. In this way, the capabilities of the armed forces will be best utilised with optimal stationing of the combatants.[21] In addition, it will also prevent the practice of bias in any of the above stated activities.

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[20] Matthijs Maas and Tim Swejs, "Artificial Intelligence and Future of Defense: Strategic Implications for Small and Medium-Sized Force Providers," (paper, The Hague Centre for Strategic Studies, Hague, 2017).

[21] Fabien Merz, "AI in Military Enabling Applications," *CSS Analysis* (2019): 2.

Inventory, such as simulators, is also being used to train military personnel during peace time. War-gaming techniques can be refined using AI as they can provide a wide range of options in a potential encounter with the adversary.[22] This will increase the effectiveness of such technology by providing soldiers with a better field experience in order to comprehend the best ways to utilise latest technologies in a potential conflict with an adversary. Virtual Reality (VR), coupled with AI and sophisticated algorithm, is envisioned to enhance the training of armed forces by a great magnitude.[23]

Logistics

Logistics is another area where AI has the potential to strengthen the capacities of the armed forces, e.g., air forces can benefit from AI-enabled systems by employing predictive aircraft maintenance tasks. This technology would enable regular maintenance of aircraft though predetermined schedules which would save waiting for making repairs after the aircraft has been impaired. The US has already established a 'predictive logistics' cell which has been assigned the task of coming up with intelligent calculations for maintenance of aircraft. AI will help to predict when a certain component may break.[24] This method is currently being employed by F-35's Autonomic Logistics Information System which takes real-time data from different components and directs it to a predictive algorithm and analyses when the operator needs to visit and replace any components of the aircraft.

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22 Elsa Kania, "Learning Without Fighting: New Developments in PLA Artificial Intelligence War-Gaming", *The Jamestown Foundation* 19, no. 9 (2019), https://jamestown.org/program/learning-without-fighting-new-developments-in-pla-artificial-intelligence-war-gaming/.

23 Ibid.

24 Marcus Weisgerber, "Defence Firms to Air Force: Want Your Planes' Data? Pay Up," *Defence One*, September 19, 2017, http://www.defenseone.com/technology/2017/09/military-planes-predictive-maintenance-technology/141133/.

In addition, AI-enabled systems can assist the armed forces to tackle big data. Big data comprises of information which is either too large to be stored on one computer's memory, is generated too quickly to be processed by one computer or is present in different formats making it difficult for human beings to process. Conversely, AI-enabled systems can store big data more efficiently.

Machine learning algorithms can also make use of available data to formulate smart budgeting solutions for the optimal allocation of resources and cost for nearly all military activities. Likewise, it can also help in military transportation making it easier to transport troops, armaments, and ammunition in military operations. Not only can it reduce the cost required in transportation but also lower the human operational efforts.[25]

Implications for the Battlefield

Despite the fact that militarisation of AI is still in its initial stages; its increasing efficiency and fast-evolving nature, which is subject to surprise and uncertainty, can have a number of implications for future warfare. The following section of the paper will focus on the potential benefits and risks which AI will steer along on the battlefield.

Benefits

Given the unprecedented efficiency of this technology, AI will offer a number of benefits in the military domain.

Time is a major one. Autonomous systems perform tasks much more quickly than human beings, and hence, enable operating systems to increase their pace manifold, thereby accelerating the speed of combat. They particularly assist the military in tasks that

[25] Kristofer J. Carlson, "The Military Application of Artificial Intelligence," *ResearchGate* (2019), https://www.researchgate.net/publication/335310524_THE_MILITARY_APPLICATION_OF_ARTIFICIAL_INTELLIGENCE.

require long duration and are beyond human endurance.[26] Also, their autonomous capability of identifying flaws in military equipment can save militaries from unexpected breakdown delays that might pose hurdles in a potential mission.

Military analysts have to spend considerable amount of time sifting huge amounts of data. AI can play a critical part in analysing this data with speed and relaying the most important elements back to military commanders for further evaluation. Data processed by AI can give a more detailed and accurate overview to commanders who are analysing complex environments. The Central Intelligence Agency (CIA) has more than 140 projects in which AI systems will be used to collect data for analysis and decision-making. Resultantly, AI's ability to attain, process and analyse data from different sources has the potential to have a notable impact on the quantity, quality and accuracy of the data which is available to military decision-makers.

The significant improvement in deep neural networks have led to notable efficiency in image recognition. Resultantly, AI can increase the accuracy of target recognition in combat as machine learning is able to learn, detect and identify targets based on the given information and battlefield situation. Improved image analysis can save valuable time and prioritise potential threats. This data can be relayed back to response teams for further action.

Despite the fact that the legal aspect of LAWS is widely debated on many forums, yet they have the potential to replace soldiers in dangerous combat and mitigate the loss of human lives. Moreover, with MDC2, commanders can execute decisions effectively while being considerably away from the battlefield. There is also the possibility of utilising AI for providing robotic assistance on the battlefield which will strengthen war-fighting capabilities of the armed forces without increasing manpower.

[26] Saylor, *Artificial Intelligence and National Security.*

Not only can AI enhance situational awareness, it also provides the best possible options regarding a given context to the military commander taking into consideration various factors such as environmental conditions, weather, probability-based assessment of enemy behaviour and existing capabilities. As an ICT, AI can communicate the intentions and motivations of adversaries making it effective as a peacekeeping tool between hostile adversaries. Moreover, AI can aid critical processes such as self-regulation, self-control and self-actuation of combat systems due to its unprecedented competency in autonomous decision-making and processing capabilities.[27] Consequently, its predictive and analysis capability can help military leaders make much more informed decisions. Likewise, it will have a notable impact on the dynamics of combat preparedness. In short, it will bring in more solutions with new approaches for militaries to cater diverse challenges.

Risks

As discussed in the previous sections, the promises of AI are convincing. It presents several opportunities for militaries to improve their defence and security functions. On the other hand, armed forces must also face the dilemma of integration of AI during various phases of development, deployment, and usage. In all the stages, potential challenges with regards to safety and escalation (contesting with the potential benefits) may be overlooked. The incentives of more efficiency, rapid processing rate and lesser human involvement might overwhelm the risks posed as security forces would want to avert lagging behind in this race and prevent their militaries from becoming more vulnerable to others. This pursuit for AI could trigger an arms race and disruptive proliferation

[27] Amit Gulhane, "Military Applications of Artificial Intelligence in 2018," *Market Research Blog,* October 3, 2018, https://blog.marketresearch.com/8-key-military-applications-for-artificial-intelligence-in-2018.

of this technology.[28] Future warfare will also be rendered more uncertain and ambiguous with LAWS making their way into battlefields.

Since the level of autonomy in warfare is increasing, it is likely that in the future, a major portion of decision-making may be done by machines themselves. In such scenarios, there are ethical concerns. For example, in a potential conflict scenario, systems may start exercising absolute control in choosing their targets, deciding the mode of action and the lethality of force. Stronger AI, with no human oversight, may lead to significant collateral damage. What happens if a system or a machine fails to interpret data correctly?[29] This is major moral dilemma for military as well as political leaders as it can inflict considerable harm.

There can also be circumstances that force human beings to make all-out efforts in order to opt for de-escalation in conflict. However, machines do not adhere to safety norms. Once a machine has made itself familiar with a particular goal, it will do everything deemed necessary to achieve it. This may lead to a situation where the goals of AI may not remain compatible with those of human beings resulting in unwanted escalation. Such escalation can precipitate a major conflict which is likely to have irreversible repercussions considering the disastrous nature of LAWS, thereby, making human efforts towards de-escalation and peace, futile.

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[28] Michael C. Horowitz, "The Promise and Peril of Military Applications of Artificial Intelligence," *Bulletin of the Atomic Scientists*, April 23, 2018, https://thebulletin.org/2018/04/the-promise-and-peril-of-military-applications-of-artificial-intelligence/#.

[29] Ross W. Bellaby, "Can AI Make Ethical Decisions?" *Criminal Justice Ethics* 40, no.2 (2021), https://www.tandfonline.com/doi/full/10.1080/0731129X.2021.1951459?scroll=top&needAccess=true.

Though experts have not been able to reach consensus on a definition of AI, yet they have been able to agree that it can be (and in most cases, is), lethal.

Nick Bostrom, a well-known technology expert has expressed grave concerns about the militarisation of AI by stating that integrating technologies such as AI into weapons is similar to children playing with bombs.[30] In 2018, Apple CEO Tim Cook and SpaceX CEO Elon Musk hosted a conference in which they asserted that there is a certain limit in which human beings can control AI. Once this threshold is crossed, humans will involuntarily lose power over it, followed by a situation in which they would not be controlling AI, rather it would be the other way around with AI making decisions on its own.[31] Hence, human beings would be unable to interpret the decision-making and executing process which would enhance the spectrum of uncertainty.

For countries like China and Russia, AI has surfaced as an opportunity where they can challenge the US' hegemony and military might which has remained uncontested for a very long period. Such inclination can force states to let go of moral and ethical considerations and grant more autonomy to AI-equipped weapons.[32] Grave concerns about integrating this technology in the armed forces can be well understood by evaluating the Cuban Missile Crisis (CMC), where one false alarm could have led to a nuclear catastrophe. Likewise, similar scenarios can spiral out into situation that can bring states to a potential war-time scenario. Similarly, a setting which involves multiple AI systems would further complicate an already tense situation as different AI systems

[30] Tim Adams, "Artificial Intelligence: 'We're Like Children Playing with a Bomb'", *Guardian*, June 12, 2016, https://www.theguardian.com/technology/2016/jun/12/nick-bostrom-artificial-intelligence-machine.

[31] Nick Bostrom, *Superintelligence: Paths, Dangers, Strategies* (London: University of Oxford, 2017).

[32] Ibid.

would be trained differently, and therefore, may arrive at different, conflicting conclusions and result in uncertain decision-making.

Furthermore, AI depends upon gathering data from different sensors which then interprets it. In the event that one or multiple sensors fail, the future trajectory of AI would remain highly ambiguous. The system could either crash completely, thereby tarnishing the credibility of AI or lead to fatal crisis which would roll out in a manner not taken account into by policymakers. Likewise, data can be deliberately tempered in order to force an adversary to take actions which can derail conflict management process.

The assertion that in the future, civilian casualties will be less as compared to now is not very convincing as there are chances that autonomous machines may do great damage. In a scenario where such systems are used in a conflict-stricken area or an area where the threshold of conflict is very low, damage can be significant.

Credence is a requirement of strategic stability whereas AI can also bring uncertainty and unpredictability to the battlefield. Resultantly, the sense of heightened efficiency can make the latter more prone to escalation. While it is true that high accuracy coupled with astounding precision is apt for the military purposes, yet AI-enabled systems may not be able to take into consideration contextual variation. Hence, increase in reliance on their directions means that more (rather than less) unpredictability would prevail.

Pakistan and Artificial Intelligence

Given the importance of AI, it is pertinent to discuss it in Pakistan's security context. It is evident that AI will become an integral part of future warfare. Already, numerous states are on their way to employing it in their militaries at a fast pace. The US, Russia and China have already made visible progress in this domain.

In South Asia, the Hindutva-inspired regime in India has always been keen to find opportunities to target Pakistan. This regime is also looking towards AI as a tool to revamp its aggressive designs.

In its Land Warfare Doctrine (2018), the importance of integrating AI in the armed forces was particularly emphasised. Developed by the Defence Research and Development Organisation (DRDO), the Centre for Artificial Intelligence and Computing (CAIR) is working on developing AWS for the Indian Armed Forces. Autonomous drones, autonomous tanks, and a Multi-Agent Robotic Framework (MARF)[33] are some of the initiatives which have already been completed or are near completion in India. Hence, these developments should be considered by Pakistan as well. The efficiency that is provided by AI can significantly improve the potential and capabilities of Pakistan's tri-services. But, to do so, the government needs to significantly invest in this technology. In this regard, both international cooperation and indigenous Research and Development (R&D) should be promoted in the country.

There are several universities which are offering degrees / courses related to AI in Pakistan. Air University, National University of Science and Technology (NUST) and National University of Computer and Emerging Sciences are some of the notable examples in this regard. Similarly, the Centre of Artificial Intelligence and Computing (CENTAIC) was inaugurated in August 2020 to promote R&D in both civil and military spheres. However, Pakistan still has a long way to go, and more attention is needed.

The government needs to work with friendly countries, particularly China, to make advancements in AI. Secondly, the curriculum taught in the institutions mentioned earlier needs to be compatible with international standards. Furthermore, universities should pay considerable attention to the practical applications of this technology.

[33] Shaza Arif "Militarization of Artificial Intelligence: Progress and Implications," in *Towards an International Political Economy of Artificial Intelligence* (London: Palgrave Macmillan, 2021), 230.

Conclusion

Artificial Intelligence (AI) is an enabler which has succeeded in making its way into the military domain. Over time, more states will resort to employing it for defence purposes. While its impacts on future battlefields are likely to be significant, states need to be wary of its potential risks as well, including rapid and catastrophic conflict escalation instead of de-escalation. Ultimately, the future of AI in the battlefield will primarily depend on how much autonomy, decision-makers are willing to grant such technologies.

Shaza Arif has studied Defence and Diplomatic Studies from the Fatima Jinnah Women University, Pakistan. Her areas of interest are Space, Artificial Intelligence, Military Modernisation and Strategy. She has been extensively published in international and national newspapers on issues related to politics and modern warfare.